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Image Resolution Improvement Using DWT & SWT Transform

Thorat A.A.[1] & Katariya S.S.[2]
[1](*Electronics Dept., AVCOE Sangamner, India)*
[2](*Electronics Dept., AVCOE, Sangamner, India)*

Abstract: *In this work, the proposed method is image resolution enhancement technique that generates better high resolution image. To decompose original low resolution image into different sub bands DWT technique is used. After this interpolation of three high frequency sub band images is done using bicubic interpolation. In order to correct estimated co-efficients high frequency sub bands of input image being incremented into interpolated high frequency sub bands which are obtained by SWT. Input image is also interpolated separately at the same time. An image is decomposes into different sub bands images using Discrete wavelet transform (DWT) like LL, LH HL and HH. Stationary wavelet transform (SWT) is another type of wavelet transform which is used for image processing applications but there is no use of down-sampling in SWT, so input image and sub bands are of same size.*

Keywords: *DWT, IDWT, Interpolation, SWT*

I. Introduction

There are various ways to measure Image resolution. Resolution shows how close lines can be related to each other and visibly resolved. Resolution units can be build with physical sizes (lines per mm, lines per inch), to overall size of picture (lines per picture height, known as lines, TV lines, or TVL). Line pairs are used instead of lines; Line pair comprises dark line and adjacent light line. Line is a dark line or light line. The capability of sensor to observe or measure smallest object clearly with distinct boundaries is known as resolution. There is difference between resolution and picture element. Pixel is a unit of digital image. The size of pixel decides resolution of image. When size of pixel decreases, higher resolution results and there is more clearity in the object in image. If Image have smaller pixel size, it occupies more size on disk. Over past several years, the wavelet transform has increased gradual offer in signal processing and in research of image compression. In applications such as discrete wavelets transform based schemes and in image compression have used different coding schemes like that which are based on DCT. As there is no need to divide input image into non-overlapping 2-Dimensinal blocks and their basis functions have variable size in length, wavelet-coding schemes at ratios of higher compression, which avoids the blocking artifacts. Because of their multiresolution nature, wavelet-coding schemes are more applicable and suitable for applications which having more scalability and essential tolerable degradation. A DWT is a wavelet transform where the wavelets are discretely sampled. DWT of a signal to obtain four sub bands is calculated by using a series of high and low pass filters (HPF and LPF).[2]

2. PROPOSED SCHEME

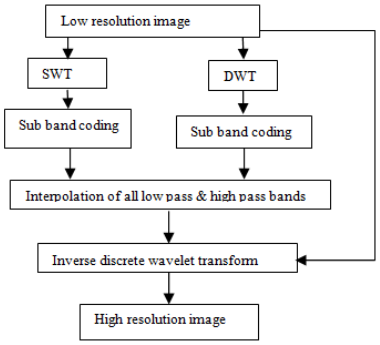

Fig.1: Block diagram of proposed system

Fig. 1 shows block diagram of the proposed system. Low resolution image obtained is passed for wavelet transform like discrete wavelet transform and stationary wavelet transform which will give sub band coding.diffrent bands like LL, LH, HL, HH all bands are interpolated with bicubic and linear interpolation technique to increase resolution with pixel based improvement then estimated bands are passed to inverse discreet

wavelet transform for reconstruction of high resolution of image. Discrete wavelet transform gives multi resolution analysis.

2.1 Low resolution image

Fig 2. Capture of low resolution image

Figure 2 shows the low resolution image whose resolution will be increased with wavelet transform. Using satellite images of low resolution image is captured and passed further for preprocessing.Diffrent cameras can be used to take input images which can be resized after processing for further operations.

2.2 DWT (Discrete Wavelet Transform)

The wavelet transform divides energy of image signals into the different number of wavelet coefficients. It has better time-frequency localization property. The main idea behind wavelets is to analyze the signals according to the scale. This was developed as an alternative to short time Fourier, which is used to overcome the problems that are related to frequency and time resolution properties. A signal decomposes into set of basic functions using wavelet transform. These basic functions are obtained from by translation and dilation using mother wavelet.

$$w\varphi(a,b) = \int_{-\infty}^{+\infty} f(x) * \varphi a,b(t)\,dx \quad (1)$$

$$\varphi a,b(t) = \frac{1}{\sqrt{a}}\varphi\left(\frac{t-b}{a}\right) \quad (2)$$

Where, the a and b are both the real numbers which quantifies the scaling and translation operations resp.

$$DWT(x,y) = \begin{cases} dj,k = \sum(x(n)\,h * j(n-2jk) \\ dj,k = \sum(x(n)\,g * j(n-2jk) \end{cases} \quad (3)$$

Where, the coefficients dj, k are detailed parameters in signal x (n) and correspond to wavelet function, and aj, k refer to the approximation components.

The functions h(n) and g(n) represents the coefficients of high-pass and low-pass filters respectively, the parameters j and k are wavelet scale and translation factors.

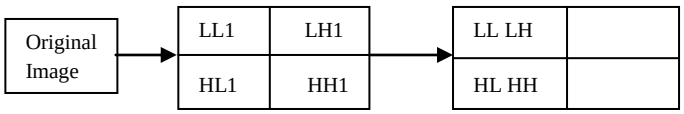

Fig.3 Process of decomposing using DWT of an image

The symbols: L and H indicate the low-pass filter and high-pass filter respectively. LL (Low-Low) refers the approximation subband. LL is low frequency sub-band that gives global description of an image, alongwith directional features. Horizontal coefficients (LH) related to the low-frequency component in horizontal direction and high-frequency component in vertical direction. DWT based wavelet transform gives good multiresolution analysis when compared to other wavelet transform.

2.3 Advantage of DWT

DWT performs the multiresolution analysis of signal alongwith localization in both time as well as frequency. Functions with discontinuities and having sharp spikes, requires fewer wavelet basis vectors in wavelet domain than sine-cosine basis vectors used to achieve a comparable approximation. Sub band coding can be obtained using low pass and high pass filtering using DWT. DWT gives good multiresolution analysis as compared to other transform such as fourier transform (FT) which is genrally use for staionary signals.[1]

2.4 SWT

The classical DWT have a drawback: It is not a time- invariant transform, that means even with periodic signal extension, DWT of translated version of signal X is not as the translated version of DWT of X. What is the technique to restore translation invariance property which is lost by the classical DWT ?This is done using taking average of some slightly different DWT, called ε-decimated DWT, used to define the stationary wavelet transform. This property is used for some of the applications like breakdown points detection. The main important application of the SWT is de-noising the input image.

2.5 Interpolation Techniques

The process of using known data elements to calculate unknown data values is called as Interpolation. Some of the interpolation techniques are used in the atmospheric sciences: One simple method is used as linear interpolation, which requires some knowledge of two points and constant rate of change between them. With the help of this information, interpolation of values anywhere between that two points can be obtained. More advanced interpolations are also available in Data Library. They are also applied to station datasets having the not regular spacing between the stations. The methods such as Cressman and Weaver analysis are mainly used to calculate equally-spaced lattitude or longitude grid data from the station data alongwith non-constant spacing. Bicubic interpolation is the improved version of cubic interpolation method for interpolating the data points on a two dimensional (2-D) grid. In image processing, bicubic interpolation is may chosen over bilinear interpolation method or nearest neighbor method in image resampling, when speed is not of that much importance. In bilinear interpolation, that takes 4 pixels (2x2) into account, but bicubic interpolation takes 16 pixels (4x4) into account. With bicubic interpolation images resamples and are smoother and having some interpolation artifacts.[4,6]

2.6 IDWT (Inverse discrete wavelet transform)

After DWT subband coding, LL sub band concentrates illumination information. So, only the LL subband goes through process, which saves high frequency components (i.e. edges). So, after the inverse DWT (IDWT), the resultant image will be sharper with good contrast.

II. Applications

Resolution is related with the most important aspect of an image. Images are processed to obtain more effective enhanced resolution. One of the most used techniques for enhancement of image resolution is Interpolation. Interpolation is widely used in the many image processing applications like facial reconstruction, super resolution and multiple description coding.

III. Results

In this proposed technique DWT is used to decompose an image into different subbands like LL, LH, HL and HH, and then all frequency sub band images have been interpolated. In previous work only high frequency bands are used for interpolation here differently low pass band is also considered because LL low –low frequency band mainly consist directional information feature .The interpolated frequency subband coefficients are corrected by using the frequency subbands achieved by SWT of input image. Original input image is interpolated alongwith the half of the interpolation factor which is used for interpolating the high frequency subbands. Then all these images are combined using the IDWT to form super-resolved image.Uptil now DWT & SWT processing is completed further is going on.

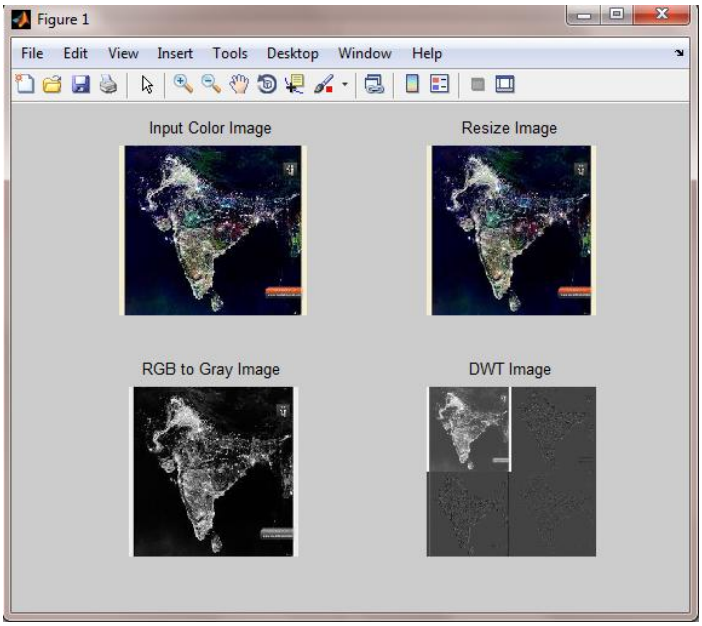

Fig 3. Results

IV. Conclusion

The interpolated frequency sub bands and the SWT frequency subbands having same size means they are added with each other. The corrected frequency sub bands can be interpolated for higher enlargement. Also it is aware that in wavelet domain, the low resolution image is formed by the LPF of high resolution image. That means, low frequency subband is nothing but the low resolution of the original input image. But still I am interpolating that image to achieve high resolution using directional information features of low low (LL) band. I am using the original input image for interpolation of the low frequency subband image. Instead of the low frequency subband with the use of input image increases the quality of super-resolved image. DWT gives better performance as compared to the discrete cosine transform.

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