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SATELLITE IMAGE RESOLUTION ENHANCEMENT USING DUAL-TREE DISCRETE WAVELET TRANSFORM AND MEDIAN FILTERING TECHNIQUE

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ABSTRACT

Satellite images are widely used in many applications such as geosciences studies, astrology, and geographical information systems. In this paper, the image gets enhanced and the resolution of the image is increased. Interpolation is a technique used to improve the resolution of the image. The proposed technique uses DT-DWT to decompose the image into sub bands. Here the bicubic interpolator is used to interpolate the image. The high frequency sub bands and the low resolution input image are filtered using median filter, and are combined together further reconstructed to obtain a resolution enhanced new image by inverse DT-DWT. In this technique, the PSNR ratio is increased to 22%.

KEYWORDS: (DT-DWT) Dual tree discrete wavelet transform, median filter, bicubic interpolator

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INTRODUCTION

Satellite images forms the drawbacks of losing their resolution due to climatic conditions, weather forecast, clouds. To overcome this drawback, the resolution of an image is to be increased.

Resolution is an important factor in many image and video processing applications. During enhancement the resolutions of image get reduced. Interpolation is commonly used technique in image processing to improve the resolution of an image. There are various commonly used interpolation techniques namely lancozs, bicubic, linear, bilinear, nearest neighbour and spline.

In DWT the image get decomposed into sub bands as LL (low low), LH (low high), HL (high low), HH (high high) with detailed representation as approximation, vertical, horizontal, diagonal. Here DT-DWT technique is used to decompose the image into high and low frequency sub bands.

EXISTING WORKS

Many researchers have attempted to improve the features of image by decomposing the wavelet co-efficient.

Existing techniques uses DT-CWT technique which decomposes the input image into sub band which generate sharper and detailed image [1]. The high frequency sub bands images are get interpolated to improve the resolution of an image [3]. High frequency sub bands of the DWT is being estimated by SWT where the interpolated sub bands get corrected and SWT enhances the edges of an image [2]. Sub bands get correlated with different sampling phase in DWT [6]. Lancozs interpolation technique has increased ability to detect the edges of an image and its linear feature [5]. In generalizing previous algorithms, denoising method is relatively simple resolution algorithm with no explicit motion level estimation [4].Here the proposed method DT-DWT uses bicubic interpolator and median filtering technique to improve the Resolution of the satellite image.

PROPOSED METHOD

In this paper DT-DWT as shown in figure (1) here the input image based on bicubic interpolation and median filtering technique is proposed to improve the resolution of the image.

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INPUT IMAGE	DWT	BICUBIC INTERPOLATOR	MEDIAN FILTER	INVERSE DWT	OUTPUT IMAGE

Figure: 1 Diagram for Dual Tree Discrete Wavelet Transform

Bicubic interpolator

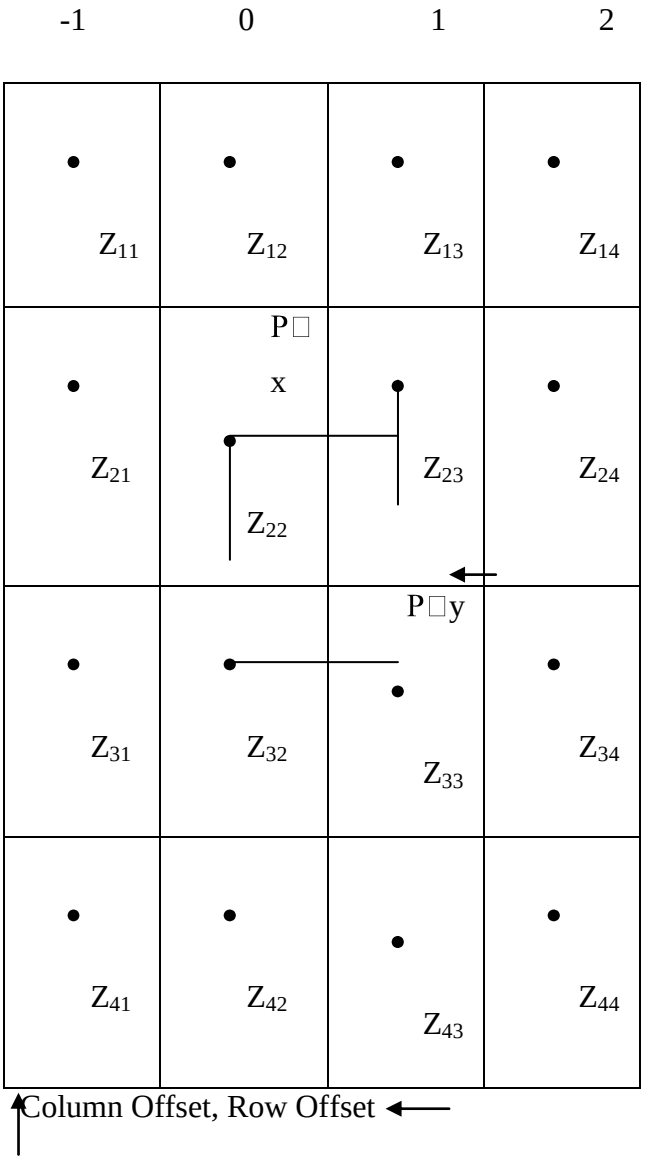
Bicubic Interpolator is an extension of cubic interpolator where the interpolated surface is smoother than in other interpolation techniques. It is used for image resampling. This interpolator will interpolate an input image of size i×j with an interpolation factor n to obtain a output image of size ni×nj is shown in below block diagram fig (2).

Input Image i×j	Interpolator (n)	Output Image ni×nj

Figure: 2 Diagram for interpolator

This Bicubic interpolator solves for the value at a new point by analyzing the 16 data points surrounding the interpolation region, for example.

The point's z_{22}, z_{23}, z_{32} and z_{33} are the four closest points to the interpolation point and define the interpolation region.



The interpolation variables p□x and p□$_y$ are calculated by determining the normalized

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horizontal and vertical distance between the four closest points.

$$Px = \frac{px - X22}{X22 - X23}$$

And

$$Py = \frac{py - Y22}{Y22 - Y23}$$

Here p□x and p□y performs interpolation in X and Y direction.

Median filtering

In signal processing, median filtering is a technique used to remove noise in an image. It is a non-linear digital filtering technique used to preserve edges while removing noise.

It replaces the value of the centre pixel with the median of intensity values in the neighbourhood pixel. It preserves the step edges better than other filters.

PROPOSED DT-DWT BASED SATELLITE IMAGE RESOLUTION ENHANCEMENT

Resolution is an important feature in satellite images. To improve the resolution of an image the surface and edges are get smoothened. DWT separates the image into several sub-bands as HH, HL, LH, LL. Here the high frequency sub bands contain high frequency components, where the low frequency sub bands contain low frequency components.

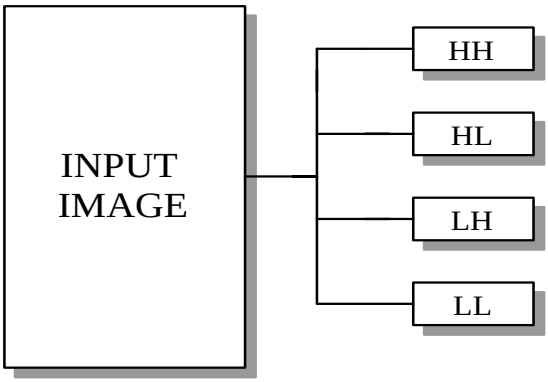

Figure: 3 Diagram for DWT

In this paper DT-DWT separates the approximated image into various sub band level which gives detailed co-efficient horizontal detail, vertical detail, diagonal detail. Here the input image gets separated into high frequency and low frequency components. The low resolution input image gets interpolated by the half of an interpolation factor β/2. Hence the low resolution input image and the interpolated approximated image with the interpolation factor 2 are combined together and get reconstructed in IDWT.

DWT is applied in order to reduce the computation time, here sub band coding is found to yield fast computation of wavelet transform.

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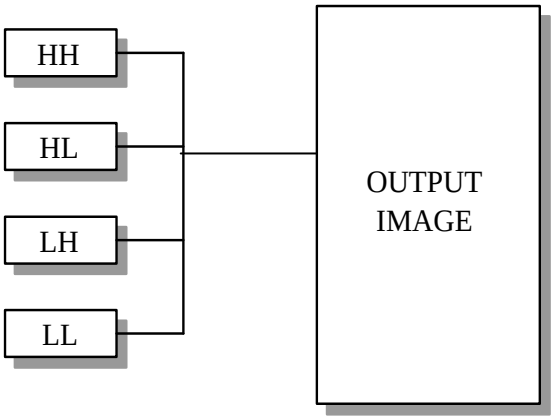

Figure: 4 Diagram for IDWT

Here the input approximation image as shown in fig (5)

Figure: 5 Input Image

Here the first level of decomposition separates the approximated image (A1) into vertical (V1), horizontal (H1), diagonal (D1) which gives detailed co-efficient is shown in fig (6). In the proposed technique bicubic interpolation is applied to smoothen the image surface is shown in fig (7). Here median filtering technique is used to remove noise and preserve edges is shown in fig(8) then the second level of decomposition is obtained with low resolution input image and filtered resolution enhanced image are combined in DT-IDWT. Hence the second level of decomposition of Approximated image (A2) with detailed co-efficient such as, vertical (V2), horizontal (H2) and diagonal (D2) is shown in fig (9). Then the sub bands are get interpolated in IDWT as shown in fig (10) and it gets filtered and remove noise as shown in fig (11) to obtain a reconstructed image at the second level of reconstruction as shown fig (12) Finally First and Second level of images gets combined together to obtain a super resolved image at the third level of reconstruction as shown fig (13).

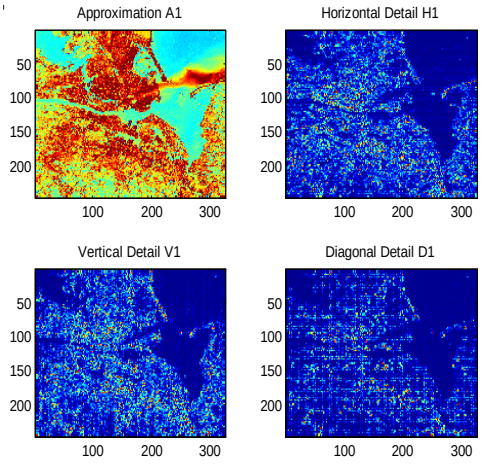

Figure: 6 first level of decomposition

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Figure: 7 DT-DWT Interpolated image

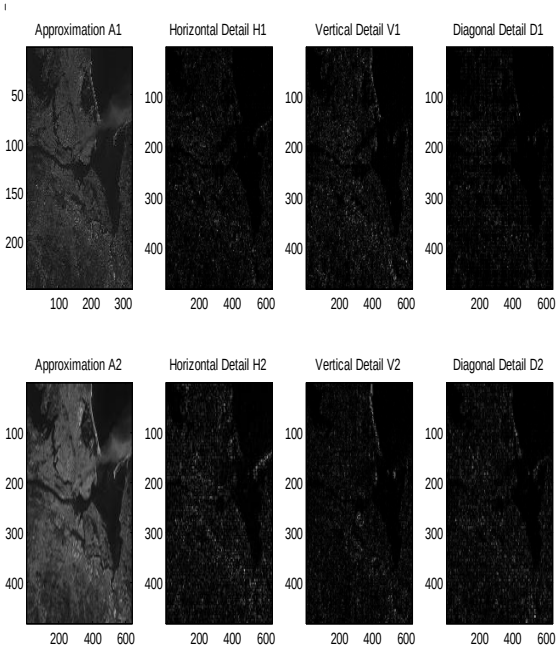

Figure: 9 second level of decomposition

Figure: 8 DT-DWT Median filtered image

Figure: 10 DT-IDWT Interpolated image

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Figure: 11 DT-IDWT Median filtered image

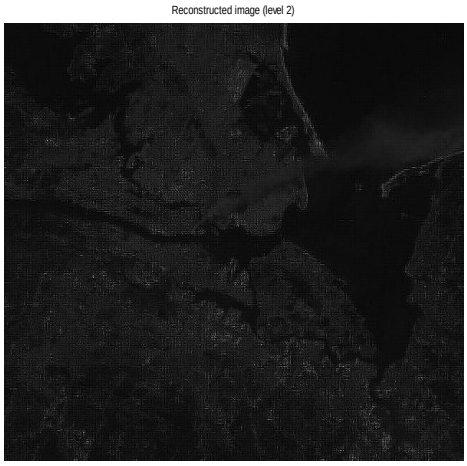

Figure: 15 Second level of Reconstruction

Figure: 13 Third level of Reconstruction

RESULTS

The proposed DT-DWT based median filtering technique provides much better resolution than other previous resolution enhancement techniques. Hence it provides improved results in terms of MSE, PSNR, Q-index are shown in the Table 1

Comparison Table for existing and proposed Techniques

TITLE	MSE	PSNR	Q-index
Existing work	0.0174	17.5895	0.9999
Proposed work	0.0128	25.0654	1.0003

CONCLUSION

Here the proposed technique uses DT-DWT to decompose the satellite image into various sub bands. The high frequency sub bands and the low resolution input image gets interpolated, filtered and are combined together and further reconstructed to obtain a new resolution enhanced image in IDT-DWT. Here the PSNR ratio is increased to 22%. Hence this technique is well suited for ordinary images also to improve the resolution of the image.

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