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RESOLUTION ENHANCEMENT OF COMPRESSED SATELLITE IMAGES USING DISCRETE WAVELET TRANSFORM

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Abstract- A new method based on compressive sensing and resolution enhancement is proposed in this paper.This method initially compresses the satellite image and then increases its resolution using DWT.Initially the satellite image is compressed,so it eliminates the requirement of taking all the samples. The main purpose of this technique is that it eliminates the Nyquist criteria, that is, sampling frequency must be greater Compressive Sensing technique and it gives the best results in signal compression as it increases the PSNR and visual quality of the satellite images as compared to existing techniques,then to this image again DWT is applied, in order to obtain sub-band images after whichbicubic interpolation of the high-frequency sub-band images is done and the input image along with the interpolated compressed image is combined using IDWT. In order to achieve a sharper image.The proposed technique has been tested on various images. The quantitative PSNR (i.e peak signal-to-noise ratio) and visual results shows the superiority of the proposed technique based on DWT(discrete wavelet transform)**.** The proposed technique is better compared with the state-of-art techniques.

KEYWORDS: *Discrete Wavelet Transform (DWT),satellite-image-resolution enhance-ement***,** *Compressive sensing, run length encoding, interpolation.*

1.INTRODUCTION

Compressive sensing (CS) technique addresses the issue of compressing the signal.Lossless satellite image compression is required (or desired) in applications where the pictures are subject to further processing, intensive editing or repeated compression/decompression. Thus, medical imaging, satellite imaging, image archival systems, precious art works to be preserved, and remotely sensed satellite images, are all candidates for lossless compression. For some satellite images there are always issues of compression, and the compressive sensing is found to be a better technique that works in a manner such that it first acquires samples less than signal dimensionality and reconstructs the same signal, here wavelet transform is applied along with compressive sensing on images.

In this paper Compressive sensing is performed at the transmitter end. And then the satellite image is passed through a Gaussian channel and is received at the receiver end where resolution enhancement is performed.Resolution has been frequently referred as an important aspect of an image. Images are being processed in order to obtain more enhanced resolution. One of the commonly used techniques for image resolution enhancement is Interpolation. Image resolution enhancement in the wavelet domain is a relatively new research topic and recently many algorithms have been proposed. The proposed technique has been compared with conventional image resolution enhancement techniques and has been found to be a better technique. Resolution enhancement is performed at the receiver end. Thus my paper is based on compressing the satellite image at transmitter end so that the satellite image is easily send through gaussian channel at a faster rate and then enhancing the resolution of the image at receiver to obtain super resolution image.

2.ResolutionEnhancement OfCompressed ImagesUsing Discrete Wavelet Transform

My paper proposes a new technique which generates sharper and highly detailed super resolved satellite images from compressed images at the receiver end. The proposed technique uses discrete wavelet transform(DWT) to compress an image. This compression is performedat the transmitted end.This produces as many coeffients as there are pixels in an image.These coefficients can then be compressedmore easily because the information is statistically concentrated in just a few coefficients. This principle is called transform coding.After that the coefficients are quantized and the quantized values are entropy encoded or run length encoded.Here I have used Huffman coding for encoding purpose.Thus this produces a compressed image which is then passed through the channel,where Gaussian noise is added to the image,this completes the transmission part in the proposed method. After this the satellite image is received at the receiving end of the channel,where it is decompressed and its resolution is enhanced and after that inverse DWT is applied. The proposed technique has been compared with conventional satellite image resolution enhancementation techniques.The main loss in any satellite image occurs in its edges (i.e. high-frequency components), which is due to the smoothing caused by interpolation. Hence, in order to increase the quality of the super resolved satellite image, preserving the edges is essential. In this paper DWT has been employed in order to preserve high-frequency components of the satellite image. Compression uses the requirement of taking all the samples at acquisition. The main purpose of this technique is that it eliminates the Nyquist criteria,that means sampling frequency must be greater than two times the maximum original signal frequency.

Using compressive sensing one can recover certain signals or images from far fewer samples than traditionally required. On encoding side it requires two properties of a signal: sparsity and incoherence. First, any signal is converted into dimension Nx1 vector, with the help of sensing matrix of dimension MxN. It extracts required coefficients and hence gives resultant Mx1 matrix which is also called M measurements which are non-adaptive. On decoding side we know that measurements M < N, so it requires convex optimization to solve this problem. Apart from this, greedy algorithms and basis pursuit are also helpful. Convex optimization provides solution to undetermined linear systems without knowing nature of undergoing parameters through the systems. L0, L1, L2 minimizations are used for reconstruction but L1 provides best reconstruction for more sparse signals Compressive Sensing technique gives the best results in signal acquisition as well as in signal compression. In my paper, as the number of measurements are increased, it increases the PSNR and visual quality of the images, with decrease RMSE as compared to existing techniques like JPEG and JPEG2000, as in these calculations has been applied on all the pixels of image and that is not required in our technique.

2.1 Proposed technique

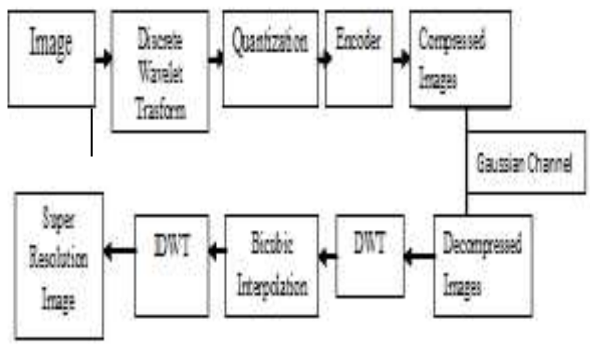

Fig1.Block diagram for Resolution Enhan-cement of Compressed Images

2.2 Block Diagram Explanation

DWT is used to compress and decompress the satellite images. Here to the satellite image initially DWT is applied and then it is quantized and passed through the encoder after which the satellite image is compressed and then passed through the channel,where Gaussian noise is added to it. Then at the receiver end when the satellite image is decompressed some of the information will be lost,so in order to improve the quality of satellite image DWT is again applied where the satellite images are divided into sfour sub-bands and this sub-bands are then bicubically interpolated. After this the input satellite image is also interpolated with half the interpolation factor α. Now, the two interpolated up-scaled images are generated. Finally by interpolating the input image by α/2 and the high-frequency sub-band images by α and then to this IDWT is applied,then the output image will contain sharper edges than the interpolated satellite image obtained by interpolation of the input satellite image directly.This is due to the fact that the interpolation of the isolated high frequency components in the high frequency sub-band images will preserve more high-frequency components after the interpolation of the respective sub-bands separately than interpolating the input satellite image directly. Thus the proposed technique interpolates not only the decompressed satellite image but also the high frequency sub-band images obtained through the DWT process. The final high-resolution output image is generated by using the IDWT of the interpolated images and the input satellite image. The visual and the peak signal-to-noise ratio (PSNR) results, show that the proposed technique outperforms the conventional method. And thus a super resoluted satellite image from a compressed image is obtainted.

3.PROJECT OUTCOME

The final result of my project is the visual analysis of an satellite image in which initially a satellite image is given as input which is 550 Kb and first it is compressed and the size is reduced to 120 kb to pass it through a Gaussian channel effectively. In the channel Gaussian noise is added and at the receiver end of the channel all the noise is removed to obtain the denoised image. And finally to this satellite image an DWT based enhancement technique is applied to obtain a high resolution satellite image. .

Fig 2: Graphic User Interface

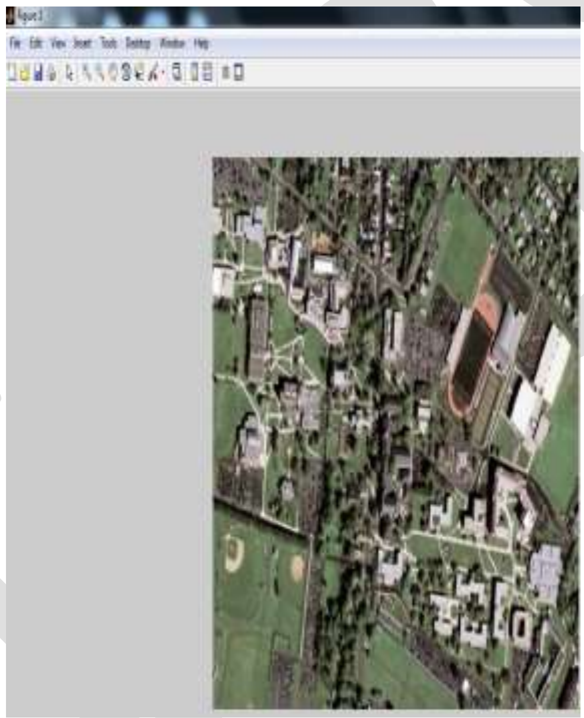

Fig 2(a)

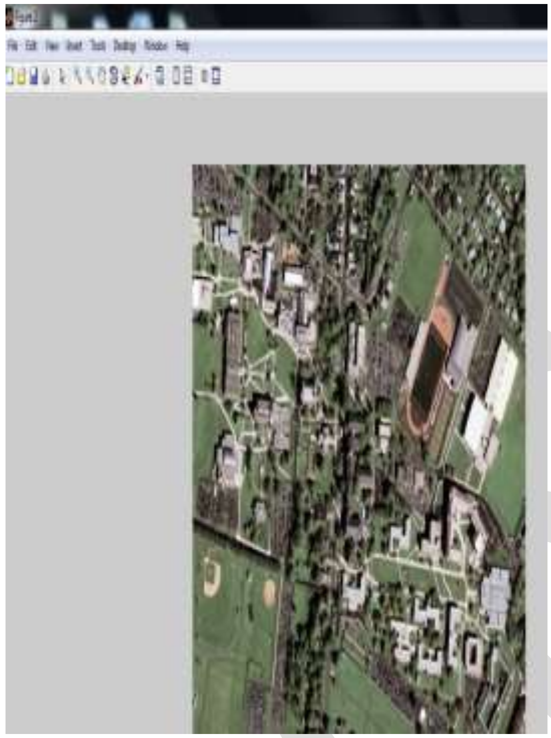

Fig.2(b)

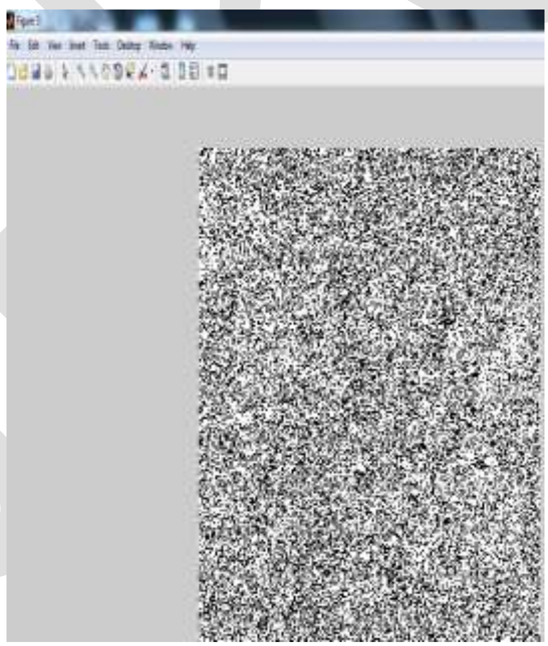

Fig.2(c)

Fig.2(d)

Fig.2(e)

Fig2:Project Outcome, (a)Input Image, (b)Compressed Iimage, (c)Transmitted Image, (d)Received Image, (e)High Resolution Image.

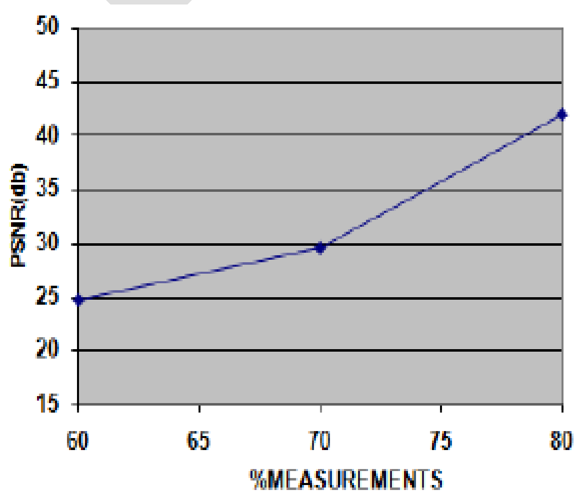

Fig 3:Graph of PSNR using conventional method for Compressive Sensing

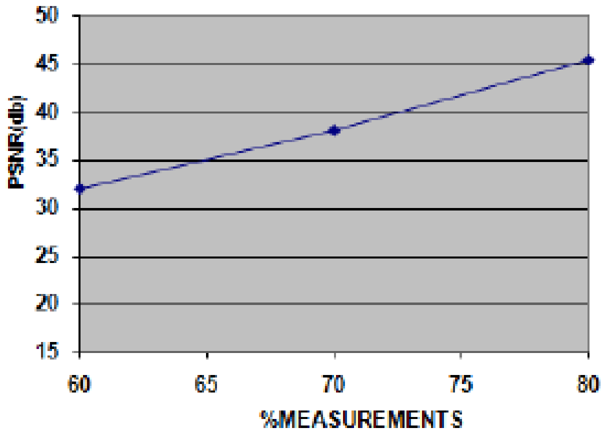

Fig 4: Graph of PSNR using proposed method for Compressive Sensing

Calculation of PSNR: PSNR is most commonly used to measure the quality of reconstruction of lossy compression (e.g., for image compression). The signal in this case is the original data, and the noise is the error introduced by compression.

$PSNR = 10 \log_{10} (255^2/MSE)$

Where, MSE is mean square error.

PSNR(db)			
Method/Image	Lena Image	Satellite Image	Other color Image
Fourier Transform	19.89	18.27	18.37
DCT	21.66	23.44	18.09
CWT	18.11	26.1	18.36
Proposed Method	22.02	28.97	18.58

Table 1: PSNR Measurements for different Images

4.APPLICATIONS

1.**Research purpose**: The proposed technique is used to analyze the whether conditions, along with the presence of fog and also one can find the presence of any type of foreign body in the space by analyzing the high resolution image obtained at the output.

2. It can be applied for both color images and black and white images. That is by programming accordingly this method can be applied for grey images and also for color images.

5.CONCLUSION

A new method based on Compressive sensing and resolution enhancement technique of satellite image is proposed. This method initially compresses the satellite image and then increases its resolution is enhanced using DWT. First the satellite image is compressed. So it eliminates the requirement of taking all the samples. The main purpose of this technique is that it eliminates the Nyquist criteria, that is, sampling frequency must be greater Compressive Sensing technique and it gives the best results in signal compression as it increases the PSNR and visual quality of the images as compared to existing techniques, this satellite image is then made to be passed through the Gaussian channel and at the receiver end this satellite image is decompressed & to this satellite image again DWT is applied, in order to obtain sub-band images after which bicubic interpolation of the high-frequency sub-band satellite images is done and the input satellite image along with the interpolated compressed satellite image is combined using IDWT. The proposed technique is better compared with the state-of-art image techniques in visual basis.

6.FUTURE SCOPE

My paper involves a method of compressing the satellite image by using compressive sensing which uses discrete wavelet transform and then it is passed to the channel. After retrieving the image from channel the resolution of image is increased by using discrete wavelet transform. As compression and resolution enhancement are the emerging fields in image processing thus in future instead of using DWT another emerging transform called SWT(stationary wavelet transform) can be used to improve the compression and resolution of the satellite image visually and also it may improve the PSNR values.

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