IMAGE ENHANCEMENT USING DISCRETE CURVELET TRANSFORM

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ABSTRACT

Colour images are being used in many fields of research. One of the major issues of these types of colour images is their poor perception. A new method to enhance the colour image which using the concept of curvelet and multi structure decomposition. The proposed enhancement technique uses DCT (Discrete Curvelet Transform) to decomposed input image into different sub bands. Multi Structure (Morphological) decomposition is a Powerful theoretical tool, which is used in nonlinear image analysis .Detecting the positions of the edges through threshold decomposition and these edges are sharpened by using morphological filters. This method will give better qualitative and quantitative results.

1. INTRODUCTION

Enhancement of the image is necessary to improve the visibility of the image subjectively to remove unwanted flickering, to improve contrast and to find more details. In general there are two major approaches. They are spatial domain, where statistics of grey values of the image are manipulated and the second is frequency domain approach; where spatial frequency contents of the image are manipulated. In spatial domain histogram equalization, principal component analysis, rank order filtering, homomorphic filtering etc are generally used to enhance the image. Although these techniques are developed for gray valued images but few of them are also applied to color image for enhancement purpose.

2. HISTORY

Many of the techniques of digital image processing, or digital picture processing as it often was called, were developed in the 1960s at the Jet Propulsion Laboratory, Massachusetts Institute of Technology, Bell Laboratories, University of Maryland, and a few other research facilities, with application to satellite imagery, wire-photo standards conversion, medical imaging, videophone, character recognition, and photograph enhancement.[1]

3. DISCRETE COSINE TRANSFORM

Fig.1 shows the block diagram of discrete cosine transform.In the enrolment phase,the system captures the low contrast image as input and enhances the image respectively.

3.1 INPUT IMAGE

Input image is the first block of the fig.1 in this give the input as colour image and this can be seperated as planes in next step i.e. plane seperation.

3.2 PLANE SEPERATION

It divides the input image into the three planes as red, green and blue as shown in fig.1 While displaying the different bands of a multispectral data set, images obtained in different bands are displayed in image planes (other than their own) the colour composite is regarded as False Colour Composite (FCC). High spectral resolution is important when producing colour components. For a true colour composite an image data used in red, green and blue spectral region must be assigned bits of red, green and blue image processor frame buffer memory

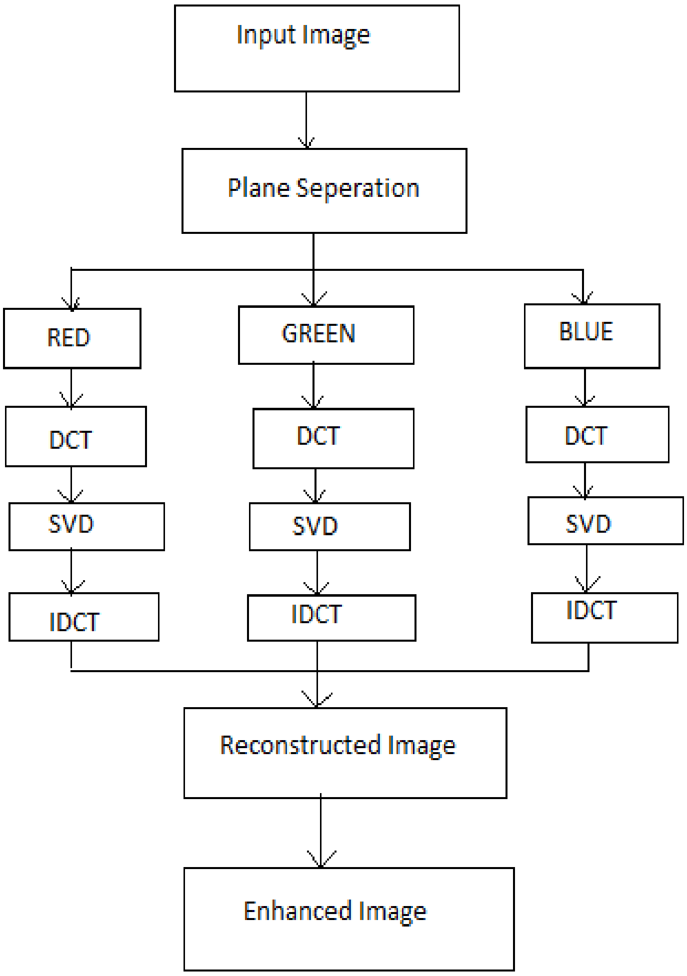

Fig.1 Block Diagram of Discrete Cosine Transform Technique

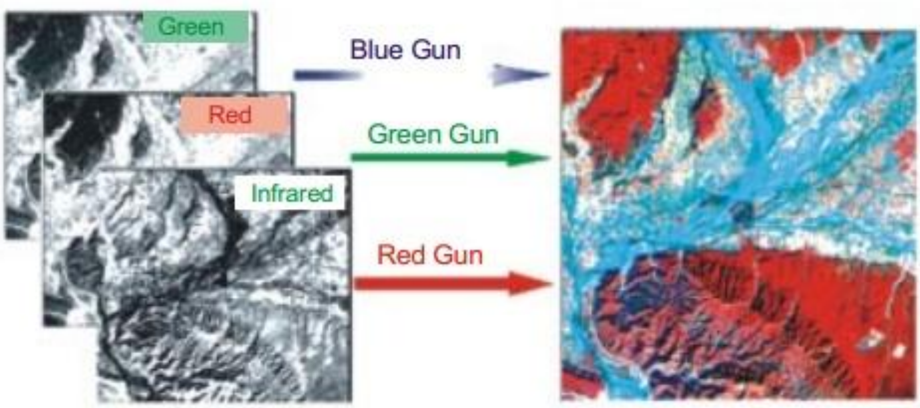

Fig.2: Plane Separation for colour image

A colour infrared composite 'standard false colour composite' is displayed by placing the infrared, red, and green in the red, green and blue frame buffer memory. In this healthy vegetation shows up in shades of red because vegetation absorbs most of green and red energy but reflects approximately half of incident Infrared energy. Urban areas reflect equal portions of NIR, R & G, and therefore they appear as steel grey.

3.3 RED PLANE

Red plane contains the only red part of the input image. Perform DCT, SVD and IDCT for red plane image as explained below.

3.4 DISCRETE COSINE TRANSFORM

In this project it divides the image into the two parts i.e. even and odd parts.

Discrete Cosine transform Technique was used to obtain the high contrast Satellite images. DCT separates an image into discrete blocks of pixels of differing importance with respect to the overall image. DCT expresses a function or signal in terms of a sum of cosine waveforms that vary in amplitude and frequency, essentially transforming the image from the spatial domain into the frequency domain. In the process, the average luminance of each block is evaluated using the DC coefficient. Transform compression is based on the premise that the low-frequency components of a signal are more important than the high-frequency components. Therefore, a substantial reduction in the number of bits used to represent a high-frequency component will degrade the quality of the image only slightly.

DCT exploits inter pixel redundancies to render excellent de-correlation for most natural images. Thus, all (uncorrelated) transform coefficients can be encoded independently without compromising coding efficiency. In addition, the DCT packs energy in the low frequency regions. Therefore, some of the high frequency content can be discarded without significant quality degradation.

Such a (course) quantization scheme causes further reduction in the entropy (or average number of bits per pixel). Lastly, it is concluded that successive frames in a video transmission exhibit high temporal correlation (mutual information). This correlation can be employed to improve coding efficiency.

3.5 SINGULAR VALUE DECOMPOSITION

Singular value decomposition is used as increase the intensity levels for even and odd parts by using the above equation of A=UDV.

In this method, a technique based on the singular value decomposition (SVD) discrete cosine transform (DCT)has been proposed for enhancement of low contrast satellite images. SVD technique is based on a theorem from linear algebra which says that a rectangular matrix A, that can be broken down into the product of three matrices, as follows: (i)an orthogonal matrix U, (ii) a diagonal matrixd and (iii)the transpose of an orthogonal matrix V [4]. The singularvalue -based image equalization (SVE) technique is based onequalizing the singular value matrix obtained by singular value decomposition (SVD) [1, 4, and 5]. SVD of an image, which can be interpreted as a matrix, is written as follows

$$A = UDV$$

Where U and V are orthogonal square matrices known ashanger and aligner, respectively, and the D matrix contains the sorted singular values on its main diagonal and basic enhancement occurs due to scaling of singular values of the DCT coefficients [4, 5].

3.6 IDCT (Inverse Discrete Cosine Transform)

By using IDCT combines the divided parts of even and odd part and reconstruct one single image as output image of red plane.

3.7 GREEN PLANE

Green plane contains only green colour part of the input image. Perform DCT it divides the image into two parts as even and odd part as explained by the above. And the SVD is used to increase the intensity values for image as explained by above. And by using IDCT combine the two parts of even and odd.

3.8 BLUE PLANE

Blue plane contains only blue colour part of the input image. Perform DCT it divides the image into two parts as even and odd part as explained by the above. And the SVD is used to increase the intensity values for image as explained by above. And by using IDCT combine the two parts of even and odd.

3.9 RECONSTRUCTED IMAGE

In this block combines three planes output image and get single image as enhanced image grey colour image.

3.10 ENHANCED IMAGE

In this block converts grey colour image into colour image and get final image as enhanced colour image for the input image.

4. EXPERIMENTAL RESULTS

Fig3: Input image

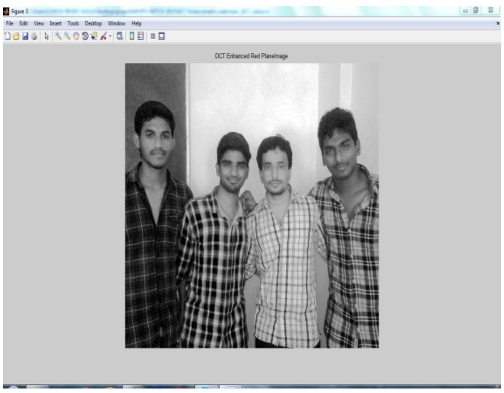

Fig.4: DCT enhanced red plane image

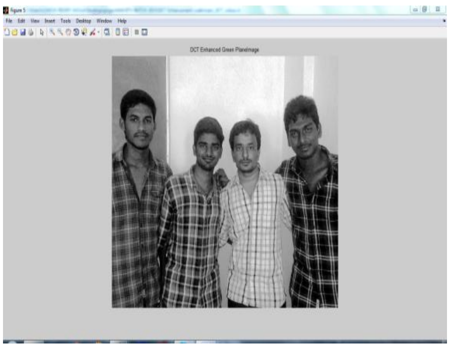

Fig.5: DCT enhanced green plane image

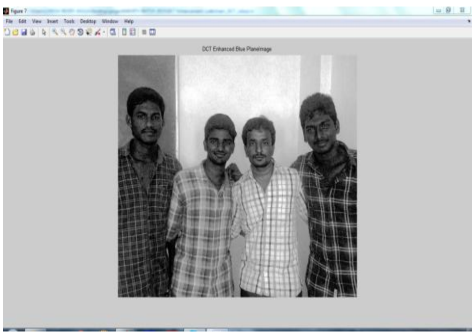

Fig.6: DCT enhanced blue plane image

Fig.7: Enhanced Image using DCT

TABLE.1: OUTPUT VALUES

PARAMETERS	VALUES
MEAN SQUARE ERROR (MSE)	4.9262e+06
PEAK SIGNAL TO NOISE RATIO (PSNR)	-43.2756

5. FAST DISCRETE CURVELET TRANSFORM

Fig.8 shows our proposed fast discrete curvelet transform method. In the enrolment phase, the system captures low contrast image as input and enhanced image as output.

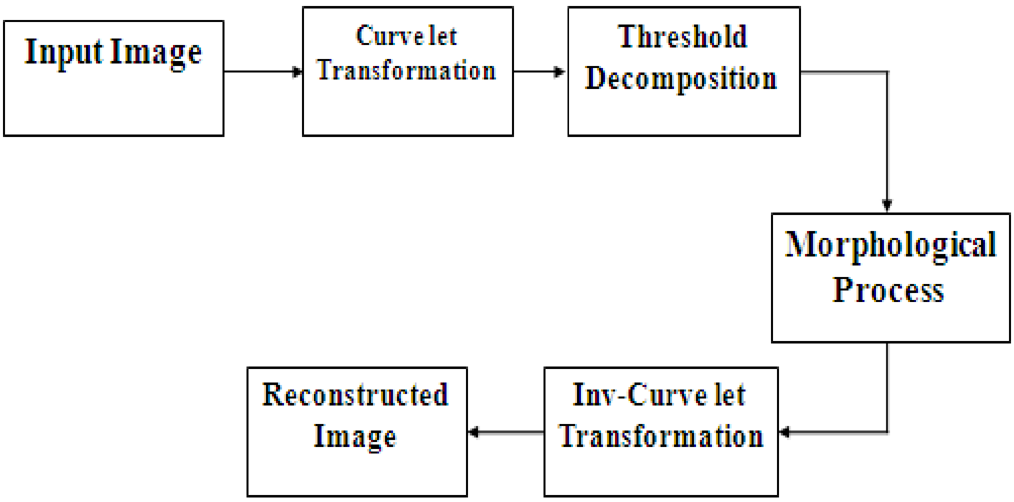

FIG.8: Block diagram of Discrete Curvelet Transform

Colour images are being used in many fields of research. One of the major issues of these types of colour images is their poor perception. In our proposed method to enhance the image using the concept of curve lets and multi structure decomposition and morphological process. The proposed enhancement technique uses FDCT (Fast Discrete Curvelet Transform) to decompose input image into different sub bands. Multi Structure (Morphological) decomposition is a Powerful theoretical tool, which is used in low contrast image analysis .Detecting the positions of the edges through threshold decomposition and these edges are sharpened by using morphological filters. This method will give better qualitative and quantitative results.

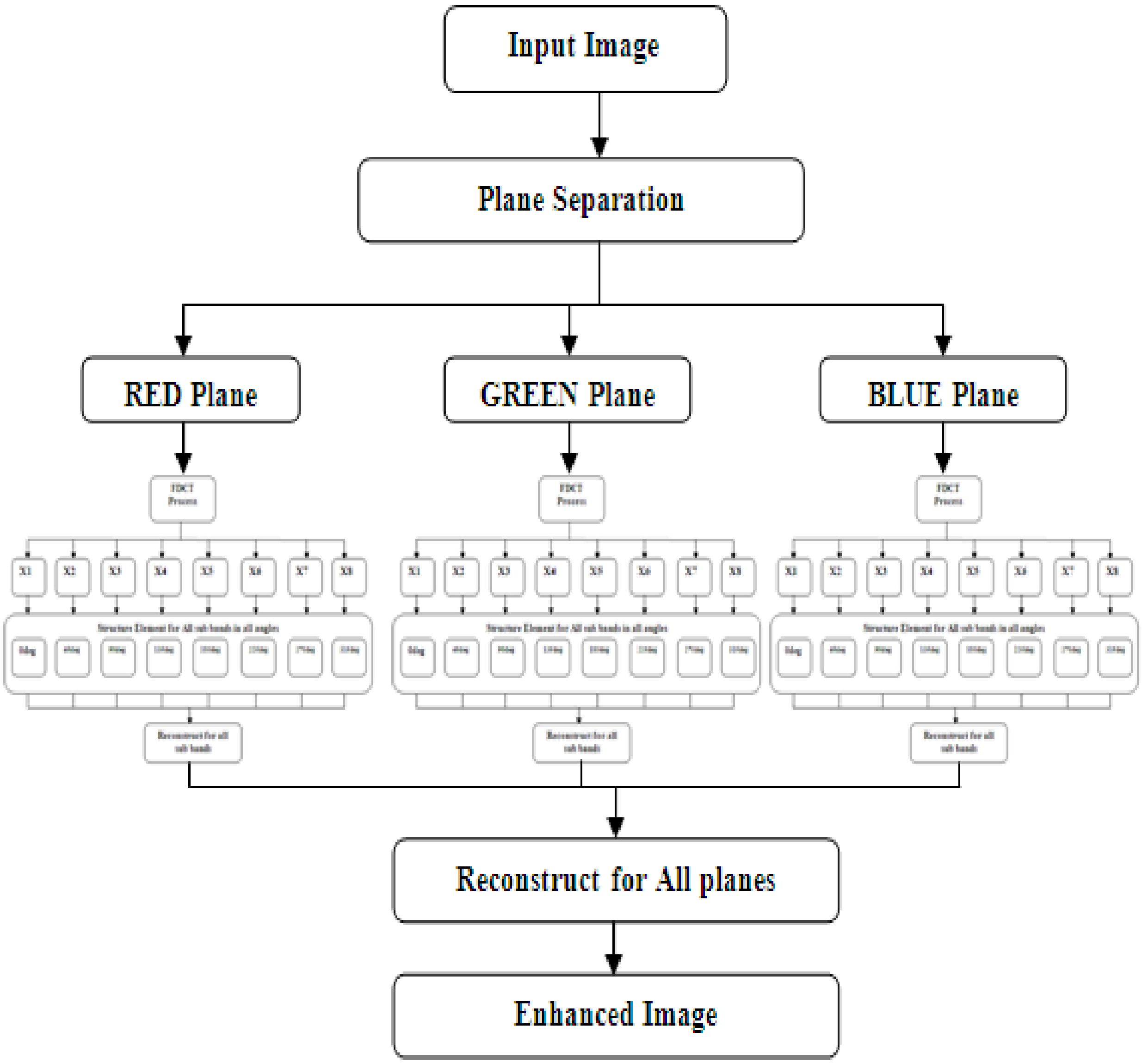

Fig.9: Detailed Block diagram of Fast Discrete Curvelet Transform

6. COMPARISION

TABLE.6.2: COMPARISION OUTPUT VALUES

PARAMETERS	EXISTING METHODVALUES	PROPOSED METHODVALUES
MEAN SQUARE ERROR (MSE)	4.9262e+06	0.1994
PEAK SIGNAL TO NOISE RATIO (PSNR)	-43.2756	55.1332
INPUT IMAGE 	OUTPUT IMAGE 	OUTPUT IMAGE 

CONCLUSION

In this paper the shape detected guided wrapping and smoothing filters succeeded in enhancing low contrast colour images. This was done by accurately detecting the positions of the edges through SVD decomposition. The detected edges were then sharpened by applying smoothing and wrapping filter. By utilizing the multi-structure element edges, the scheme was capable to effectively sharpening and detecting fine details. The visual examples shown above, have demonstrated that the DCT (Discrete Curve let Transform) method was significantly better than many other well-known sharpener-type filters in respect of edge and fine detail restoration. The MSE (Mean Square Error) and PSNR (Peak Signal to Noise Ratio) improvement compared with Discrete cosine Transform, Discrete Curvelet Transform technique is high.

REFERENCES

[1] Chao Rui; Zhang Keg Li Yan-jun. An image fusion algorithm using Wavelet Transform [J]. Chinese Journal of Electronics，2004 32(5):750 753.

[2] Li, H., Manjunath, B.S., Mitre, S.K., 1995. Multi sensor image fusion using the Wavelet Transform. Graphical Models Image, Process. 57 (5), 235–245.

[3] Li, S., Wang, Y., 2000. Multi sensor image fusion using discrete multi Wavelet Transform. In: Proc. 3rd Internat. Conf. on Visual Computing, pp. 93–103.

[4] Li, H., Manjunath, B.S., Marta, S.K., 1995. Multi sensor image fusion using the Wavelet Transform. Graphical Models Image Process. 57 (5), 235–245.

[5] PU Tina, FANG Qing Zhen, NI Gout kiang, Contrast-Based Multi-resolution Image Fusion Act Electronic Sonica, 2000 V.12, pp.116-118 (in Chinese).

[6] E. J. Candies and D. L. Donohue, "Curve lets—a surprisingly effective Non-adaptive representation for objects with edges," in Curve and Surface Fitting: Saint-Malo 1999, A. Cohen, C. Rabat, and L. L. Schumacher, Eds. Nashville, TN: Vanderbilt University Press, 1999.

[7] J. L. Stark, F. Muztagh, and A. Bijaoui, Image Processing and Data Analysis: The Multi scale Approach.Cambridge, U.K.: Cambridge Univ. Press, 1998.

[8] E. J. Candies and D. L. Donohue. Curve lets: new tools for limited-angle tomography, Manuscript, 2004.

[9] Donohue, D. L., Minimum Entropy Segmentation, in Wavelets: Theory, Algorithms and Applications, C. K. Chui, L. Montefusco and L. Pucker (eds.), Academic Press, San Diego, 1994, 233{270}.

[10] J. L. Stark, E. Candies, and D. L. Donohue, "The curve let transform for image de-noising," IEEE Trans. Image Processing, vol. 11, pp. 131–141, June 2002.

[11] A.M. Mendon and A. Campeche, "Segmentation of retinal blood vessels by combining the detection of centre lines and morphological reconstruction," IEEE Trans. Med. Image., vol. 25, no. 9, pp. 1200– 1213, Sep. 2006.

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