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An Efficient Method of Image Fusion Using SWT & DTCWT

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Abstract

Image fusion is a technique of combining more than one image to form a high configured image with good results. Image Fusion technique is used in many distinct fields such as remote sensing, robotics, medical applications and under water image processing.
The main aim of this project (An efficient method of image fusion using SWT and DTCWT) is to reduce uncertainty, decrease redundancy in the output, and maximize relevant information pertaining to an function or a task**.**

Keywords: Image Fusion, Dual tree complex wavelet transform (DT-CWT), Stationary wavelet transform (SWT), Fusion rules, Mat-lab, Verilog**.**

I. INTRODUCTION

Image fusion is the course of action of combining in order from two or more sensed or acquired images into a single fused image that is more informative and becomes more suitable for image processing or mainframe processing. Image fusion completely utilizes much complementary and disused information of the original images. The main aspire of image fusion is to combine complementary and disused information from multiple images to create a merged image that contains a better depiction of the scene than any of the individual source images. The objective is to reduce insecurity, decrease redundancy in the output, and maximize relevant information pertaining to an function or a task. Thispaper describes the efficient method of image fusion using SWT and DT-CWT. A dual-tree complex wavelet transforms and division transform is used to fragment the features of the input images, either mutually or discretely, to produce the section map. Characteristics of each section are calculated and a region-based approach is used to combine the images, section by section. The images here used are already recorded. Unrecorded image is a major source of error in image fusion.

One level advanced than pixel level image fusion is An efficient method of image fusion using SWT and DT-CWT. Domain based fusion scheme is one of the method of achieving. Primarily an image is segmented to produce a set of regions. A variety of region properties can be calculated. The properties can be used to verify which features from which images are used in the fused image**.** An efficient method of image fusion using SWT and DT-CWT has some advantages over pixel level image fusion as more intellectual semantic fusion rules and can be considered based on actual feature in the image rather than on single pixel. Feature is very important than the real pixel. Hence it is better to integrate the feature information in the process of fusion .Segmentation algorithm plays a essential role in region based image fusion method. Features should be segmented as on its own regions. Feature may divide into more than one region and each region has to be treated individually. If likely, less number of regions should be generated to reduce the computational burden.

II. DUAL TREE COMPLEX WAVELET TRANSFORMS

In the dual tree complex wavelet transform method, [1], [2], the fusion is performed using masks to extract information from decomposed structure of DT DT-CWT [3]. The DT-CWT [8,9,] structure involves both the real and complex coefficients. This complex transform uses two separate DWT decompositions. It is divided into two separate trees, tree A and tree B as shown in figure below.

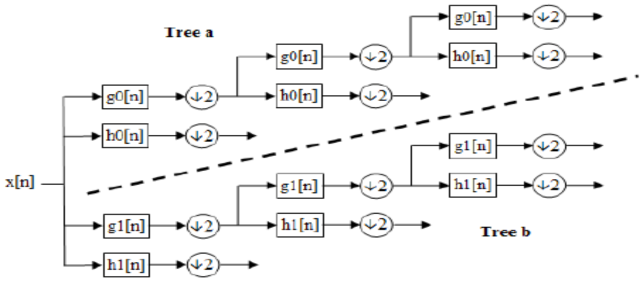

Figure 1: DT-CWT structure

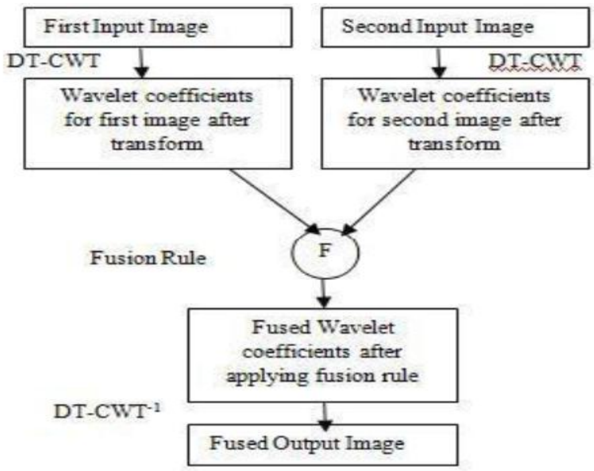

Figure2: DT-CWT based fusion

- To avoid inconsistencies this will divert human observers or other following dispensation stages.
- Sequential stability-Gray level changes in the fused image, sequence should only be caused by gray intensity change in the input sequence, not by the fusion process.

III. SCOPE OF PROJECT

The scope of an efficient method of image fusion using SWT & DT-CWT is to produce a better result than DT-CWT feature level image fusion technique and to reduce the noise in an image.

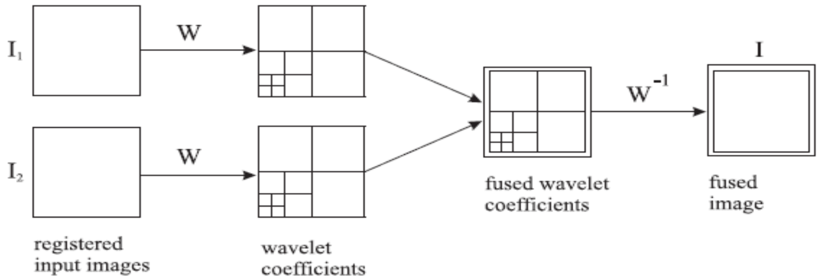

Figure 3: Fusion of the wavelet transforms of two images

IV. STATIONARY WAVELET TRANSFORM (SWT)

We know that the classical DWT suffers a drawback: the DWT is not a time-invariant transform. This means that, even with periodic signal extension, the DWT of a translated version of a signal *X* is not, in general, the translated version of the DWT of *X*.

How to restore the translation invariance, which is a desirable property lost by the classical DWT? The idea is to average some slightly different DWT, called ε-decimated DWT, to define the stationary wavelet transform (SWT). This property is useful for several applications such as breakdown point detection.

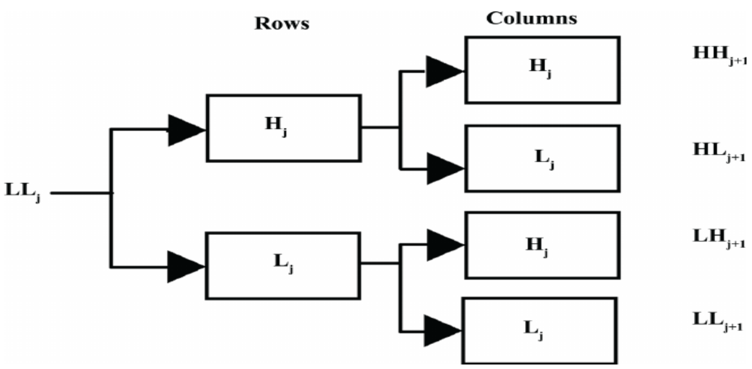

Figure 5: Block diagram segmented image

V. EFFICIENT METHOD OF IMAGE FUSION USING SWT AND DT-CWT

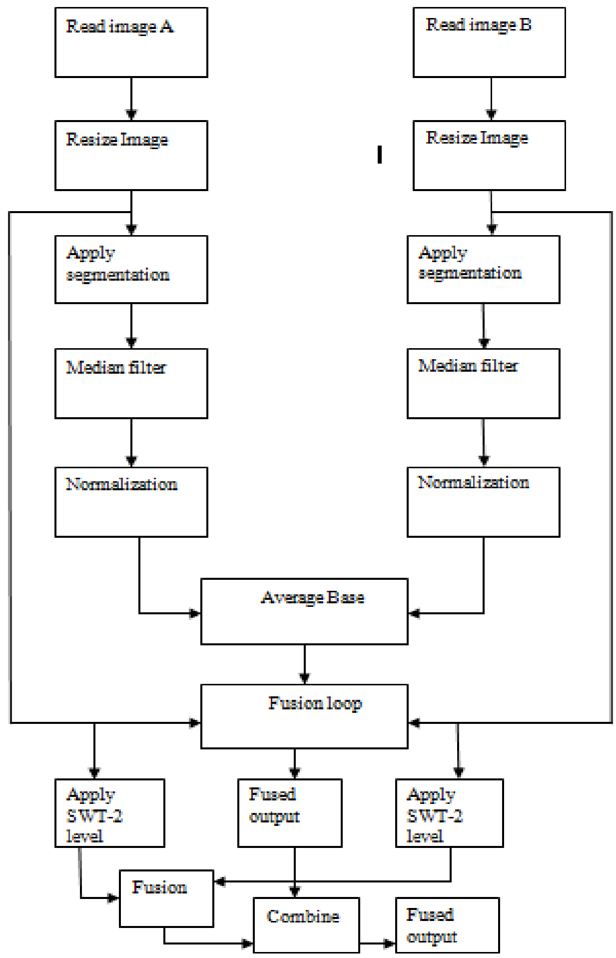

Figure 4: Block Diagram of an efficient method of image fusion using SWT and DT-CWT

The block diagram of an efficient method of image fusion using SWT and DT-CWT is as shown in Figure-4. The input images are mutual segmented by means of DTCWT. Two input images are read simultaneously and resized next the mutual segmented image is shown in Figure-5 is used as the segmentation plot. By using the segmentation plot we are calculating the salient characteristic like standard deviation, if the standard deviation of the segmented ingredient of the input image **I1** is greater than the standard deviation of the segmented part of the input image **I2** then the fused image element comes from input image **I1**, otherwise it is from input image **I2**. There after the source images are applied to median filter .The Median Filter block replaces the central value of an M-by-N neighbourhood with its median value. If the neighbourhood has a centre element.

The block places the median value there, as illustrated in the following figure after carrying out filter operation normalization is done for both the images here Normalization is Used to specify the normalization for the computed sensitivities. Averages base of both images are estimated. In the next step estimated values are generated to fusion loop which acts as a for loop, where all the multiple blocks are combined together, here the output of DT_CWT is combined along with fused output of SWT and produces a perfect fused output of **DT-CWT+SWT**.

VI. PERFORMANCE METRICS

Entropy: Entropy is used to determine the information contented of the image. Entropy is sensitive to noise and other surplus rapid fluctuations. An image with high information has good entropy level. We calculated the entropy by using the mat-lab function ‘entropy’.

Standard Deviation: Standard deviation composed of pointer and noise parts. It is more efficient in the deficiency of noise. It is used to determine the contrast in the fused image. An image with high disparity would have a high standard deviation. We are calculating, the standard deviation by using the mat-lab function ‘std2’.

Spatial Frequency: The frequency in the spatial domain indicates the overall activity level in the fused image and is given by

SF=$\sqrt{RF^2 + CF^2}$

RF - Row frequency.
CF- Column frequency

$$RF = {}^{1}\!/_{MN} \Sigma_{r=1}^{M} \Sigma_{y=2}^{N} \; [lf) - lf(x,y-l)]2$$

$$CF = {}^{1}\!/_{MN} \Sigma_{r=1}^{M} \Sigma_{y=2}^{N} \; [lf) - lf(y,x-l)]2$$

Cross entropy: Cross-entropy evaluates the similarity in information content between input images and fused images. Fused image and input image containing the same information would have low cross entropy. The overall cross entropy of source image **I1**, **I2** and the fused image **If** is

$$\frac{CE(I1,I2;If) = CE(I1;If) + CE(I2;If)}{2}$$

Mutual Information: It measures the degree of dependence of the two images. A larger measure implies better quality. If the joint histogram between **I**1(x,y) and **If** (x,y) is defined as **hI**1**I**f (i,j) , **I**2(x,y) and **If** (x,y) is **hI**2**If** (i,j) . Then the mutual information between source and fused image is given by

$$FMI = MI(I1If) + MI(I2If)$$

VII. RESULT&DISCUSSION

The images which underwent fusion by means of SWT and DT-CWT technique hasa improved result. The input image1 and input image2 as shown in fig are fused together by segmentation using watershed algorithm, it generates two segmented out puts The segmented image1 and segmented image 2 shown in Figure.5 , The watershed algorithm directly often consequences in over segmentation. This over segmentation can be avoided using indication controlled watershed algorithm. There should be a single segmentation plot for both the images. It could be achievable by combining the individual (uni-model) segmentation map. The segmentation map of the infrared image is shown in Fig-and the segmentation map of visible image is shown in Fig The combined segmentationmap is shown in Fig- and it is called as jointed segmented map, One can observe that there are numerous segments and hence it take more computational time. The joint segmented image shown in,Figure.6 shows the fused image by the excellence level image fusion and figure gives the wavelet based fused image. When the linear spatial filter is applied by using the mat-lab function IM filter to the fused image gives the improved result, the table 1 gives evaluation of performance metric with and without filter, for the other set of images results are shown in Figure.6

Blurred images of leg and a text

Input Image-1

Input Image-2

Segmented Image-1

Segmented Image-2

Joint Segmented Image

Segmentation Map

Figure.6: a. Input image1, b. Input image2, c. Segmented image-1, d. Segmented image-2, e. joint segmented image, f. Segmentation Mapg. Fused output.

Blur image of leopard

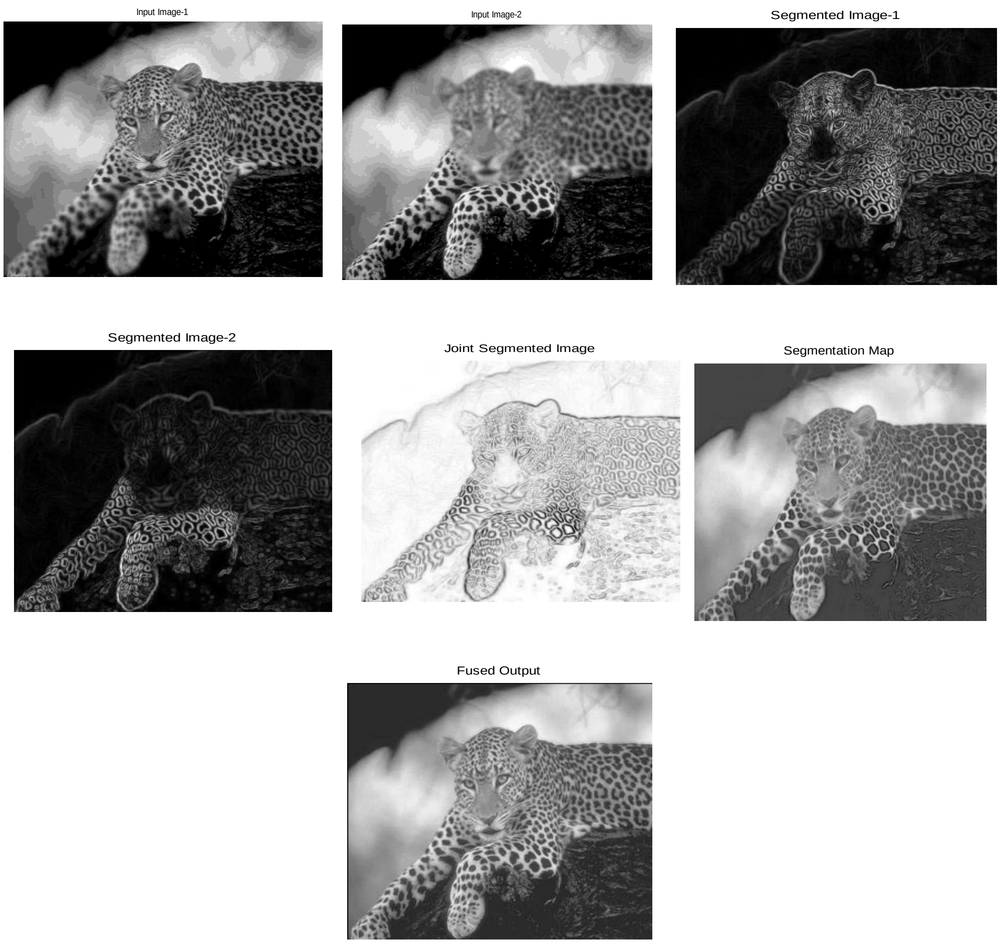

Figure 7.: a. Input image1, b. Input image2, C.segmented image-1, d. Segmented image-2,e. joint segmented image, f. Segmentation MAP, g. Fused output

Table 1: Comparison of performance parameter with and without filter

	Parameter	DT-CWT		DT-CWT+SWT	
LEG	Entropy	Without filter	With filter	Without filter	With filter
		7.5199	7.5089	7.5517	7.5628
	SD	49.3254	49.709	50.168	50.2674
	SF	3598.265	3674.34	3220.94	3256.147
	CE	3.4892	3.6402	3.5072	3.5856
	MI	2.8113	2.737	2.5664	2.5834
LEOPARD	Entropy	7.3091	7.3015	7.355	7.3665
	SD	60.7635	61.1819	62.3589	62.4869
	SF	4399.927	4514.49	4324.25	4373,06
	CE	3.2216	3.4304	3.2541	3.338
	MI	4.8059	4.0834	5.132	4.9001

CONCLUSION
Image fusion, using SWT and DT-CWT describes the conclusion and good results when compared to earlier one. And all the performance, parameters such as Entropy,. Standard deviation, spatial frequency,, Cross entropy and Mutual, information for different images gives better resultswhen compared to DT-CWT fusion.

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REFERENCES

[1] J.J. LEWIS ET AL, “Region-Based Image Fusion Using Complex Wavelets”, Proceeding of the 7th International Conferenceon Information Fusion, Pg.555-562, 2004.

[2] Robert J. O’ Callaghan and David R. Bull, “Combined Morphological-Spectral Unsupervised Image Segmentation”, IEEE Trans. On Image Proc., Vol. 14, No.1, pp. 49-62, Jan 2005.

[3] Fan Luo et al, “Wavelet-based Image Registration and segmentation Framework for the Quantitative Evaluation of Hydrocephalus”, International Journal of Biomedical Imaging, Vol. 2010.

[4] VPS Naidu, “Image Fusion using the Measure of Focus”, MSDF Report No.:1011/ATR07,06th May 2001.

[5] N.G. Kingsbury, “Image processing with complex wavelets”, philos.Trans.R.Soc.London A, Math. Phys. Sci, 357(1760):2543-2560, September 1999

[6] VPS Naidu and J.R. Raol,”Pixel-Level Image Fusion using Wavelets and Principal Component Analysis A Comparative Analysis”,Defence Science Journal,Vol 58,No.3,pp.338-352,May 2008.

[7] Rafael C.Gonzalez and Richard E.woods,DigitalImag Processing. Second Edition.

[8] VPS Naidu “Discrete Cosine Transform –Based Image Fusion” Defence Science Journal, vol. 60, No 1,January 2010.

[9] Venkateshappa & Dr. Cyril Prasanna Raj .P“Performances analysis of DWT for Image Compression, Registration and Fusion Techniques Using DWT in Micro Air Vehicle Applications”International Journal of Scientific & Engineering Research, Volume 7, Issue 1, January-2016