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Medical Image Fusion scheme using Wavelet Based Contourlet Transform and Directive Contrast method

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ABSTRACT

Fusion imaging is one of the the majority recent, precise and functional indicative techniques in medical imaging today. The new expertise has finished a clear difference in patient care by reducing the time in diagnosis and treatment. Even though image fusion can have diverse purposes, the main intend of fusion is enhancement in spatial resolution and image sharpening. Also in integrated imaging, it provides a combination of multimodal medical images into a solitary image with more complete and accurate portrayal of the identical thing. For illustration, PET-CT in lung cancer, MRI-PET in brain tumors, SPECT-CT in abdominal studies and MRI-CT image fusion has shown to be assisting in surgical process. In this work, the proposed Wavelet based Contourlet Transform (WBCT) based fusion technique is compared with Non Subsampled Contourlet Transform (NSCT) based image fusion. Simulation consequences proficient that the proposed WBCT method performs finer for image fusion when compared with NSCT.

KEY WORDS: Wavelet based Contourlet Transform, Medical Images, Directive Contrast, PET Image.

1. INTRODUCTION

With the advance of multiple types of biosensors, chemical sensors, and remote sensors on board satellites, more and more data have become available for scientific researches. As the degree of statistics grows, the necessitate to merge data gathered from various sources to remove the most constructive in rank. Dissimilar conditions such as data understanding, combined analysis, data integrating have been used. Since early ninetees, Data fusion has been adopt and widely used. To maintain spare specific medical information for doctors to pact with medical diagnosis, such as X-ray, computed tomography, magnetic resonance imaging and positron emission tomography (PET) images. These special medical images typically offer incompatible data. For example, the CT image can offer opaque structures like bones with a lesser amount of deformation, however it not able to perceive physiological changes. Additionally, MRI will meet the expense of normal and maximum soft tissues in sequence, though it distinguished to uphold the bones information. In this circumstance, merely one group of image cannot be adequate to offer precise clinical necessities for the doctors. As a result, the fusion of the multimodal medical images is essential and it has turn into a capable and awfully exigent research area in current existence.

In this paper, the Directive Contrast fusion rule rely on WBCT is done to obtain new precise prominent appearance. Therefore, this method is applied for fusion in this paper.

Wavelet Based Contourlet Transform: Similar to the contourlet transform, the WBCT contains two filter bank stages. The first one gives subband disintegration, in case of WBCT is a wavelet transform, in distinction to the Laplacian pyramid used in contourlets. In second, WBCT is a directional filter bank, which provides angular decomposition

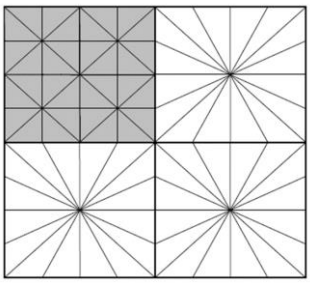

Figure.1. Two level Wavelet based Contourlet transform

2. METHODS & MATERIALS

Fusion of Image: Image fusion is union of pertinent message from two source images keen on a lone image so it contains all the data from two input images. In this paper, Image fusion is functional for combining MRI and PET images. These two images shows bones and soft tissue information and consequent fused image contains the bone and soft tissues information.

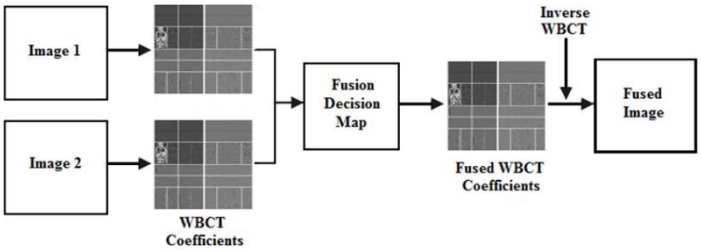

Figure.2. Block diagram of Wavelet Packet based Image fusion

Wavelet based Contourlet image fusion method block diagram is shown in Fig. 2. Image 1 is an MRI and Image 2 is a PET. Image 1 is analyzed by WBCT and Image 2 is also analyzed discretely. After decomposition several coefficients are obtained in all images. In this coefficients, single is approximation sub-band and the remaining sub-bands are detail coefficients. The proposed Fusion rule is implemented on the detail coefficients. Mean is applied to fuse approximation coefficient. Finally, fused WBCT coefficients are obtained and inverse WBCT is finished to obtain the fused image.

Directive Contrast Fusion Rule:

- To fuse approximation sub-sets, mean is implemented as an alternative of averaging.

$$A_i(new) = mean(A_1, A_2) \quad (1)$$

- The high frequency details are fused,

$$H_i(new) = \begin{cases} H_i^{1} & if \quad |C_i H^{1}| \geq |C_i H^{2}| \\ H_i^{2} & otherwise \end{cases} \quad (2)$$

$$V_i(new) = \begin{cases} V_i^{1} & if \quad |C_i V^{1}| \geq |C_i V^{2}| \\ V_i^{2} & otherwise \end{cases} \quad (3)$$

$$D_i(new) = \begin{cases} D_i^{1} & if \quad |C_i D^{1}| \geq |C_i D^{2}| \\ D_i^{2} & otherwise \end{cases} \quad (4)$$

3. RESULT AND DISCUSSION

The MRI image of size 256x256 is considered as Image 1, and RGB PET image of size 256x256 is taken as Image 2 as shown in Fig. 3 and in Fig. 4, respectively. Two level decomposition using WBCT for MRI and PET images are shown in Figs. 5 and 6. The fused image using proposed WBCT and NSCT are shown in Figs. 7 and 8. The values are tabulated in Table 1.

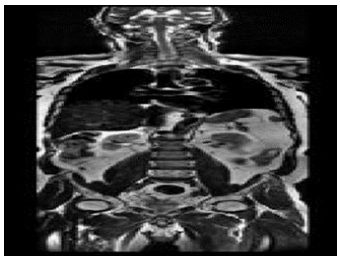

Figure.3. Image1 (MRI)

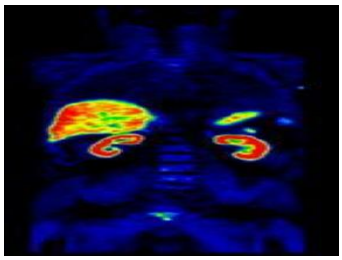

Figure.4. Image2 (PET)

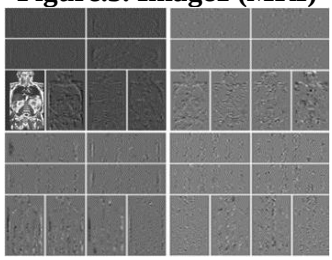

Figure.5. Two level wavelet based Contourlet transform for Image 1

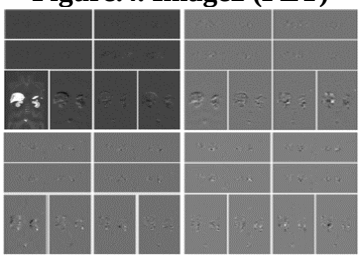

Figure.6. Two level wavelet packet decomposition for Image 2

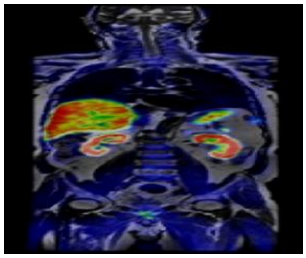

Figure.7. Fused image using NSCT

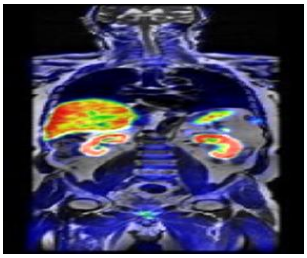

Figure.8. Fused image using proposed WBCT

Table.1. Performance comparison of proposed WPT and DWT for PSNR and Normalized Correlation

Images	MSE		PSNR(dB)		Normalized Correlation	
	NSCT based Fusion	WBCT based Fusion	NSCT based Fusion	WBCT based Fusion	NSCT based Fusion	WBCT based Fusion
MRI - CT	0.9134	0.7289	46.3925	48.9736	0.9665	0.9825
MRI – PET 1	0.9087	0.7367	47.2819	48.7301	0.9712	0.9869
MRI – PET 2	0.9117	0.7158	46.7319	49.3692	0.9709	0.9852
MRI – PET 3	0.9281	0.6524	46.2815	49.9132	0.9621	0.9891

4. CONCLUSION

In this paper, Wavelet based Contourlet Transform image fusion and Directive contrast based fusion technique is presented for MRI and PET images. Simulation results arrived using MATLAB reveals that the supremacy of the proposed Wavelet based Contourlet Transform technique to NSCT. This fusion technique found to be successful for the fusion in the survival of intrusion.

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