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Review of Different Image Fusion Techniques

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Abstract: This paper proposes study of different image fusion techniques. Image fusion is combining relevant information from two or more images into a single image. The resulting image is more informative than the original image. It is not possible to get an image with all relevant information in one try, hence we have to take no. of trials then these images can be fused to get all relevant information. This paper provides survey about several techniques which provide better approach for future research.
Keywords: Image fusion, Discrete Wavelet Transform (DWT), Principal component analysis (PCA), Discrete Cosine Transform (DCT)

I.   INTRODUCTION

Image fusion can perform on two or more images are combined into a single image retaining the important features from each original image [7]. Various types of images are available like multisource, multi view, multi temporal images taken at different time period [1], such images are changes its information due to environmental conditions. These are also multimodal images; like CT, MRI, PET images.

II.   RELATED WORK

 In this paper comparative study of several methods is introduced.

Shweta Goel et al. [1] propose a multimodal images CT and MRI are fused using dual tree Discrete Wavelet Transform. Image decomposes into wavelet co-efficient using DWT. These co-efficient are then fused using PCA for approximation coefficients and by maximum selection rule for detailed information to enhance contrast. This provides better result than other methods. Stimulation results shows that the DTDWT based multimodal medical image fusion technique using Weiner filter gives better performance and improved image quality as compared to existing technique.

Mirajkar Pradnya et al. [2] proposed an image fusion algorithm based on wavelet transform to prove the geometric resolution of two images in which two images to be processed are firstly decomposed into sub images and then the information is performed using these images under certain criteria and finally these sub images are reconstructed into result image with plentiful information. In this three method are compared and best method is found for image fusion. They got good results for stationary Wavelet based image fusion method at level 2 compared to all other method.

S. S. bedi et al. [3] provides survey about some of the various existing techniques applied for image fusion and comparative study of all the techniques conclude the better approach for future research. Combination of DWT and spatial domain fusion method like PCA improves the performance as compared to individual DWT and PCA algorithm.

Nishthula P et al. [4] proposes a simple and easy method of image fusion for bone cancer detection. This study integrated the merit both preserving spatial information of ISH Transform, reduce the spectral distortion by using retina inspired model(RIM) and minimizing redundancy by PCA transformation and obtained satisfying fused result.

In Kiran Parmar et al.[5] the fusion performance is evaluated on the basis of the root mean square error(RMSE) and peak signal noise ratio(PSNR). It gives better least MSE and highest PSNR.

In M. A. Mohamed [6] compare several techniques and conclude how did get result by using those techniques.

Anjali Malviya et al. [7] presents fusion of multifocus images based on maximum selection scheme, weighted average scheme and window based verification scheme. It gives high signal to noise ratio and less root mean square error.

Zijun wang et al. [8] proposes comparative analysis of several methods. It shows the consistency between theoretical analysis and Experimental result.

K. C. Rajini et al. [9] presents the overview of the image fusion techniques and the results from number of wavelet based image fusion schemes are compared. Wavelets provide high quality spectral content with less spectral distortion. The result show that symlet wavelet performed better in terms of performance measures.

Nivedita Jha et al. [10] perform proportional study of image fusion methods. It shows the DWT with PCA gives better result than the other techniques mentioned in the paper. And concludes that DWT with ICA (Independent Component Analysis) may be the future trend of research.

III.   IMAGE FUSION TECHNIQUES

Sr No.	Fusion Technique/ Method	Detail	Domain	Advantages	Disadvantages
1	Simple average	In this, region of image s which are in focus assume as of higher pixel intensity. It takes value of P (i, j) of each image and adds it. Average of sum can is taken by dividing it by 2 [3].	Spatial	Simplest method	It does not give a guarantee to have clear objects from the set of images.
2	Maximum selection	Algorithm chooses in-focus region of input image then select maximum intensity value for pixel by comparing it to other pixel intensities and that max value can be assigned to corresponding pixel	Spatial	It gives highly focused image	It affects on contrast of image and may cause blur the image.
3	PCA	It transforms no. of correlated variables into uncorrelated variables called principal component [1]. 1. Column vector from approximation coefficients is evaluated . 2. Using these vectors covariance matrix is calculated and diagonal values are stored. 3.From covariance matrix eigan values and eigan vectors are calculated 4. Then select column vector corresponding to max eigan value. Values of this column are then multiplied with old approximation coefficients to obtain new fused coefficients [1].	Spatial	It removes redundancy and has high directionality. It enhances features and extracts more information.	Spatial domain may produce spectral degradation.
4.	DWT	Images are decomposed into wavelet coefficients by using filters i.e. approximation and detailed coefficients.	Transform	It provides better SNR	It has less spatial resolution and has poor directional selectivity.
5	HIS transform	1. It transforms RGB channels into HIS component. 2. Match the histogram of panchromatic image with intensity component. 3. Replace intensity component with stretched panchromatic image. 4. Take inverse transform IHS to RGB channels [8].	Spatial	It offers separate channel outline for HIS.	Only three bands are involved.
6	DWT + PCA	DWT applied on source image to decompose it into different wavelet coefficient and PCA applied on low frequency coefficients [10].	Transform + spatial	It gives better result compared to PCA and DWT separately. It has high spatial resolution with high quality spectral content.	Method is complex.
7	SWT transform	Similar to DWT but process of down sampling is suppressed only. It is based on idea of no decimation. It applies DWT and suppressed down sampling in forward and up sampling in inverse transforms [2].	Transform	It is translation invariant. Edge information is enhanced It can be applied to any Arbitery image	Time for decomposition is high. Computational complexity is high and large storage space is required. Not suitable for real

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					time applications.
8	Pyramid based fusion	Pyramid levels obtained from down sampling of source images are fused at pixel levels depending on fusion rule. Fused image is obtained by reconstructing the fused image pyramid [6].	Transform	Computationally more efficient. Provide good visual quality of an image for multi focus image.	Number of decomposition levels affects image fusion result.
9	DCT	It represents fused image by dividing it into blocks then calculate the DCT representations and taking average of all DCT represent for corresponding blocks. Then finally take IDCT to reconstruct the fused image [6] [10].	Transform	It reduces the complexity and decomposes the image into series of waveform. Used for real time applications.	Fused image is of not good quality if block size is less than 8x8 or equivalent to the image size itself.
10	Brovey Transform	It normalizes the three multispectral bands used for and to multiply the result by any other desired data to add the intensity and brightness component to the image [8].	Transform	It produces RGB image with higher contrast. Simple and computationally efficient and faster.	Result in color distortion
11	Independent Component Analysis [10]	A method for finding underlying factors or components from multivariate (multi-dimensional) statistical data.	Spatial	Computational complexity is good and it shows significant enhancement.	Image should be non-Gaussian.
12	Guided Filtering [11]	1. Average filter is utilized to get the two-scale representations. 2. The base and detail layers are fused through using a guided filtering based weighted average method.	spatial	Simple method, Computationally efficient and suitable for real time applications.	It may have halos near some edges.

IV. CONCLUSION

There are Different Image Fusion techniques are available now a days. Above some of them are mentioned along with advantages and disadvantages. This study will helpful to the who are new learner of I mage fusion. This study states that DWT with PCA technique has great advantage over other method.

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