

Literature survey on Image Fusion Techniques

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Abstract: Image Fusion is mechanism that is used to associate admissible information from a set of images of same scene into a single image. The resultant image is known as fused image. Fused image are descriptive, complete, clear, noise free than other images. The main devotion of image fusion is to generate a solo enhanced image more appropriate for the purpose of human visual perception, object detection and target recognition. This paper further discuss the various techniques used in performing the image fusion.

Keywords: Fusion, PCA, DWT.

1. INTRODUCTION

Image fusion is booming area of image based application field on which vast research is being carried out. Input sources to this process could be multisensor, multitemporal and/or multifocus images which are converted into a composite image. It has been used in many applications such as defence system, robot vision, remote sensing, medicine image processing. The fused image will contain all relevant information as compared to other images of same scene.

Image fusion take place at three different levels

- I. Pixel Level
- II. Feature Level
- III. Decision Level

Pixel level is a beginner's level of fusion is done to analyse and merge data from different sources before original information is estimated and recognised.

Feature level is an intermediate level of fusion to draw out special features from an image like shape, length, edges, segments and direction.

Decision level is a top level of fusion which points to actual target.

Image is the two dimensional matrix of pixel values, the way these pixel values manipulate give rise to the two subgroups of image fusion techniques. These are spatial fusion domain groups and frequency fusion domain group. In Spatial fusion domain, pixels are manipulated directly on image, no pre-processing take place but in frequency domain there is no direct dealing with pixels, Fourier transform is applied on image then fusion operations are operated and last inverse of the Fourier transform gives enhanced image. Spatial Fusion techniques are Brovery method, principal component analysis, IHS, High pass filtering etc. The disadvantage of these techniques is that they produce spatial distortion in fused image. Frequency based image fusion technique is DWT.

2. IMAGE FUSION TECHNIQUES

- A. Simple Maximum Method:** In this method maximum operation is performed on corresponding pixel values of input images. The resultant fused image is defined as

$$F(i, j) = \sum_{i=0}^m \sum_{j=0}^m \max(A[i, j], B[i, j])$$

where A and B are image matrices

- B. Simple Minimum Method:** In this method minimum operation is performed on corresponding pixel values of input images. The resultant fused image is defined as

$$F(i, j) = \sum_{i=0}^m \sum_{j=0}^m \min(A[i, j], B[i, j])$$

where A and B are image matrices

- C. Simple Average Method: In this method average operation is performed on corresponding pixels of input images. The resultant fused image is defined as

$$F(i, j) = [A(i, j) + B(i, j)]/2$$

Where F is fused image and A and B are input image matrices.

- D. PCA: Principal Component Analysis is a mathematical tool, which cuts the multidimensional data sets into lower dimensions for analysis. This method regulates the weights for each source image using the eigenvector corresponding to the largest eigen value of the covariance matrix of each source image.

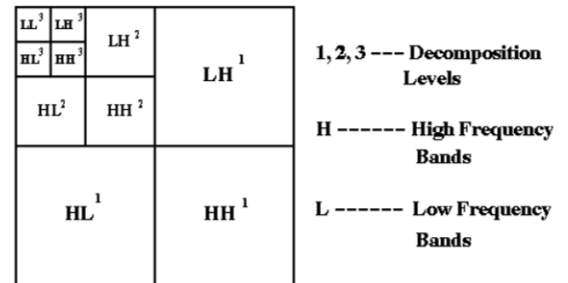
Steps for PCA algorithm are as below

- I. Produce column vectors from input images
- II. Compute the covariance matrix of the two column vectors formed in I
- III. Compute eigen vector and eigen values of the covariance.
- IV. Normalize column vector
- V. Normalized eigen vector act as the weight values which, multiply with each pixel of the input image.
- VI. Fuse the two scaled matrices will be the fused image matrix.

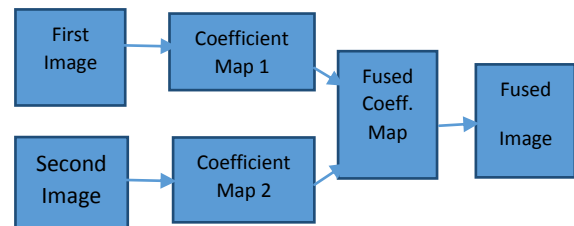
E. Discrete Wavelet Technique:

Wavelet transforms are multi-resolution image decomposition tool that offer a diversity of channels expressive the image feature by dissimilar frequency subbands at multi-scale. It is a well-known technique in analyzing signals. When putrefaction is executed, the approximation and detail component can be separated 2-D Discrete Wavelet Transformation (DWT) translates the image from the spatial domain to

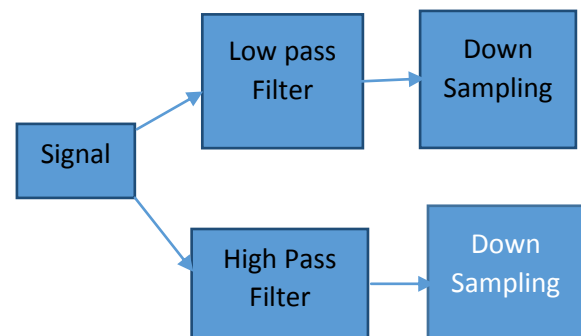
frequency domain. The image is divided by vertical and horizontal lines and represents the first-order of DWT, and the image can be separated with four parts those are LL1, LH1, HL1 and HH1.



The fused coefficient map is formed from the source image. The fusion decision map is formed on the basis of fusion rules. Lastly, IDWT applied to form fused image.



DWT Decomposition: A signal is passed through number of filters for decomposition. First it is passed through low pass filter to give approximation coefficients and these signal is also decomposed by high pass filter that gives detail coefficients. After that 2nd down sampling is performed on the filters outputs.



3. LITERATURE SURVEY

Deepak Kumar Sahu et al.(2012)[1]this paper converse about numerousfusion techniques like DWT, PCA, Average method, select maximum, select minimum etc. Comparison of these techniques, helps in selecting techniques in future research work. This paper conclude that the DWT and PCA with morphological processing will improve the image quality.

S.JohnNisha et al. (2013)[2]confer about the problems like spatial distortion, color distortion arises while performing fusion with techniques like HIS, PCA,Wavelet Transform etc. The author purposed a new fusion technique called linear pixel fusion main advantage of is no need of additional transformation and fused image is similar to natural color image.

Dong-Chen He et al.(2004) [3] suggest that wavelet technique is far better than other techniques for fusion. The researcher proposed new and original method that is used to incorporate high resolution image with low resolution image with or without spectral relationship between these two images.

VadherJagruti(2014)[4] Implementation of dwt is done in this paper and author accomplish that Haar wavelet is best than other wavelet basis function. Comparison is done with the parameter Similarity Measure.

V.P.S.Naidu(2008) [5]In this paper implementation on Pixel-level image fusion using wavelet transform and principal component analysis are performed in MATLAB. Degraded performance is shown by average method.This paper conclude that DWT with higher level perform better than other techniques.

Huaxun Zhang (2013)[6]This paper introduce a method based on wavelet decomposition and different characters of wavelet theory. It usesdisassumble image to different frequency subband to save all information to have a perfect fusion. In this paper image fusion on medical images is performed and processing with DWT make calculation simple, improved fused image quality.

Mr.RajendaPanditDesale(2013) [7]This paper talk over the Formulation, Process Flow

Diagrams and algorithms of PCA (principal Component Analysis), DCT (Discrete Cosine Transform) and DWT (Discrete Wavelet Transform) based image fusion techniques. The comparative analysis of above techniques is performed and presented in the form of table. The PCA & DCT are conventional fusion techniques with many drawbacks, whereas DWT based techniques are more positive as they provides better results for image fusion.

HUANG Xisha ,CHENZhe[8] proposed in paper that pixel level fusion by DWT on scene image remove infections like images covered by clouds and their shadows, which is failed by average fusion technique.

YongYang(2010) [9] this paper proposed that fusion of medical images helps in extracting features that are not visible by naked eye. DWT is applied to perform the image fusion.

RoshnaJ.Sapkalet.al(2013) [10] proposed paper that talks about image fusion algorithm based on Fast DCT with different fusion rules. This paper discuss the limitation of DWT like it does not give better result during fusion of images containing curves. Statistical analysis of medical image is done using 7 quality metrics parameters.

Om Prakash et al.(2013) [11] propose a pixel-level image fusion scheme using multiresolutionBiorthogonal wavelet transform (BWT).Maximum fusion rule is used to fuse Wavelet coefficients at different decomposition levels. BWT are capable to preserve edge information and reducing the distortions in the fused image because of two important properties wavelet symmetry and linear phase of BWT.

SlavicaSavi(2012) [12], gives review of related image fusion methods that in fusion process use pyramidal decomposition algorithms such as DWT and EMD. Subjective analysis of those methods, that had been performed on in-house multifocus images dataset, shown superiority of fusion method based on first level of EMD.

Hyoung Lee et al (2009)[13]give review on detecting objects concealeld underneath a person's clothing using a form of electromagnetic radiation. Symlet wavelet is

used to fuse visual image and PMMW image are fused using minimum fusion rule on CA coefficients and average fusion rule on detail coefficients.

Xing-Wang Zhang et al.(2009)[14] proposed in paper,thresholding method based on wavelet fusion of color image sub band. RGB Image is decomposed into three sub bands of red,green and blue. Then Dwt is applied on each band,maximum, minimum fusion rules are applied on them. Lastly otsu'sthresholding is applied .Image produced with this proposed algorithm are rich in quality than original image.

4. CONCLUSION

Techniques like PCA,HIS ,Brovery produce spatial distortion in fused image. Over all this paper suggest that DWT is better than other techniques and provide better performance and good quality.

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