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IMAGE FUSION BASED ON PRINCIPLE COMPONENT ANALYSIS AND WAVELET TRANSFORM

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Abstract
Image fusion is important method which is employed invarious fields such as biomedical, remote sensing, robotics, different medical applications. In this technique two or more images generated from same or different image sources which may carry either same or different parameters of information these images are fused into unique integrated image which will improve accuracy as well as eliminates unwanted information. This image fusion techniques minimizes uncertainty and redundancy in output which maximizes relevant information in particular application.

Introduction
Image Fusion includes mixing of two more images into one image from same or different image sources this fused image interpret data which is not obtained from single source. With the availability of multi-sensor, multi-resolution, multi-temporal, multi-view image,image fusion is best tool to integrate images generated from above sensors. Each image carry different information which are fused by using different fusion algorithms during this fusion process fusion algorithm should satisfy following two main requirements. i)They must identify important significant features in input image and should transfer them without any loss ii) Fusion process should not carry any inconsistent or artificial information which may confuse human observer. Fusion process consist of following three main steps

1. It is the process acquiring images from one or more image sensors it is called as data acquisition.
2. Point by point correspondence between multiple images from same or different scenes is called as image registration it is used to ensure relation between pixel in the input images.
3. Combination of important information from the set of source images.

Fusion algorithm
As above discussed fusion is the process of integration of two or more images into unique image which gives combined information of all images by eliminating overlapped and unwanted data. To achieve following image fusion algorithms are available.

Wavelet transform

Wavelet transform is improved version Fourier transform in Fourier transform signals are decomposed into sine and cosine forms whereas in wavelet transform signals are decomposed into set of waves, Fourier transform provides signals into frequency domain and wavelet transform decomposes signals in both time as well as frequency domain wavelet transform provides multi-resolution decomposition of an images in bio-orthogonal basis. In wavelet analysis the signal is decomposed into scaled and shifted version of original image. As name wavelet transform in this small waves grows and decays into an given time period to get these small waves wavelet should satisfy following properties:

i) Time integral of waves must be zero

$$\int_{-\infty}^{+\infty} \varphi(t)dt = 0 \quad (1)$$

ii)Time integral square of wave must be unity

$$\int_{-\infty}^{+\infty} \varphi(t)2dt = 1 \quad (2)$$

The wavelet function of 1D Signal is given as

$$W(a,b)f(x)=\int_{-\infty}^{+\infty} f(x)\varphi(a,b)(x)dx \quad (3)$$

Translation and dilation of original signal is

$$\varphi(a,b)(x) = \frac{1}{\sqrt{a}}\varphi\left(\frac{(x-b)}{a}\right) \quad (4)$$

Where ,a= Dilation factor is given as

$$a=2^m \quad (5)$$

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b= Translation factor

$b=n2^m$ (6)

m and n are integer values

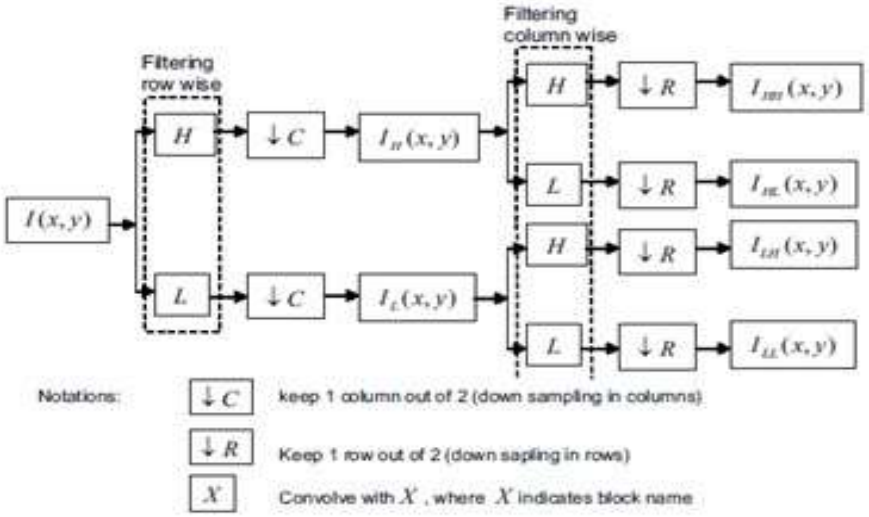

Figure 1.Two D Image Decomposition

In wavelet transform of 2D signals filters and down samplers are used signals are sampled in vertical and horizontal directions. Source image is X(a,b) is filtered by low pass filter L and high pass filter H in horizontal direction and then it is down sampled by factor of 2 to get matrix of coefficient as $X_L(a,b)$ and $X_H(a,b)$ further it is filtered and downsampled into a facto of two to get sub bands as $X_{LL}(a,b)$, $X_{LH}(a,b)$, $X_{HH}(a,b)$,$X_{HL}(a,b)$ these each sub-bands consist of detailed sub images of horizontal and vertical information figure 1 shows an wavelet transform based decomposition of 2D Signals and figure 2 shows reconstruction of original image

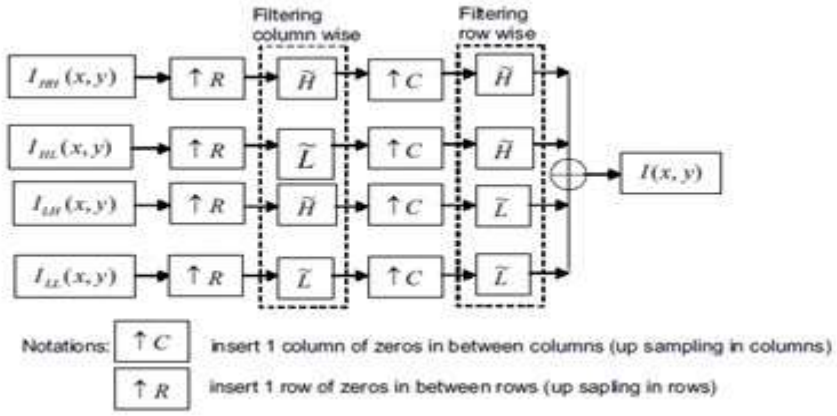

Figure 2. Reconstruction of original signal

Image fusion by wavelet transforms

Flow diagram of wavelet based image fusion is given in figure3 as explained in figure 3 in wavelet transform image fusion scheme an original signal is decomposed into different coefficients which represents vertical and horizontal components of original signal by using discrete wavelet transform further these components are mapped with fusion rules and we get more informative integrated fused image.

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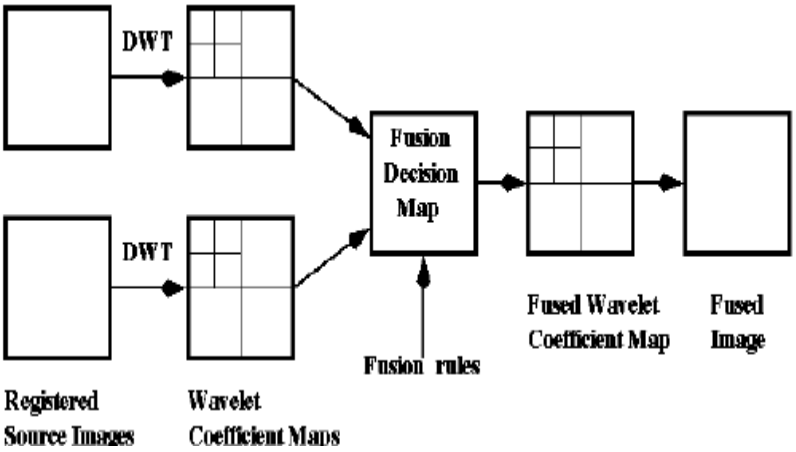

Figure 3. Wavelet Based Fusion Method

The approximated original fused image is reconstructed by IDWT as;
IDWT=[DWT A(x,y), B(x,y)] (7)

Principle component analysis

In PCA number of correlated components are converted into uncorrelated variables is referred principle component analysis. PCA is non-parametric methodwhich extract relevant information from complex data sets. PCA is mathematical tool which is mostly applicable in face recognition and image compression PCA is used to analyse large data sets it uses vector space transformation which reduces large data set into dimensionally reduced data set. PCA is also called as Karhunen–Loeve or hoteling transform PCA does not have fixed set of basic vectors like FFT, DCT and wavelet.

PCA algorithm:

Let the source image which is to be fused are arranged into two column vector following steps are followed two project this data into 2D fused image

1. Arrange data into column Z matrix of 2*n dimension.
2. Evaluate Mean Value of Each Column Me.
3. Subtract each Me from Matrix Z which gives a new matrix X which is of 2*n dimension.
4. Calculate Covariance matrix C of X i.e. cov(X).
5. Find eigen vector V and eigen value D of C and arrange them in decreasing order with 2*2 dimension.
6. Consider first higher value column to get P1 and P2 as,

$$P1=\frac{V(1)}{\sum V} \quad \text{and} \quad P2=\frac{V(2)}{\sum V} \qquad (8)$$

Image Fusion Using PCA

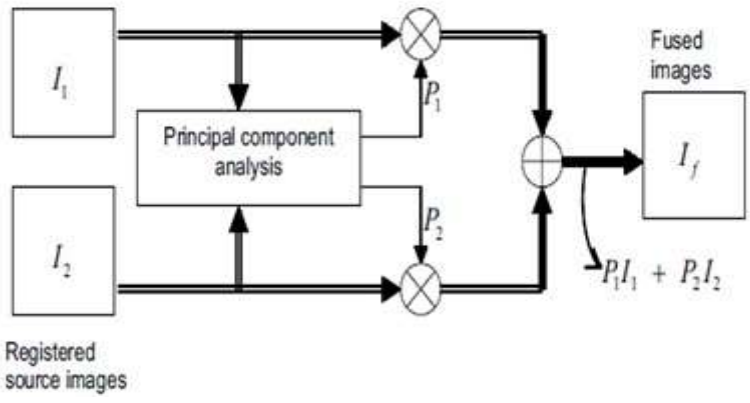

Figure 4. Flow Diagram PCA

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Principle Component analysis is explained in above figure 4 in which two images are represented in column form first with their vector values and corresponding eigen values further these eigen values and vectors arranged in decreasing order from larger to lower after normalized components are calculated by subtracting mean values from original matrix Z then normalised components(P1 and P2) are calculated and we get final fused image as:

$$If(x,y)=(P1I1(x,y)+P2I2(x,y)) \quad (9)$$

Conclusion

From above discussion we can conclude that PCA fusion algorithm are applicable in application where high quality and precision has secondary importance whereas wavelet transform gives high quality fused image.

References

1. VPS Naidu and J.R. Raol . "Pixel Level Image Fusion Using Wavelet and Principle Component Analysis "Defence Sci. Journal ,Vol.58 ,No.3 May 2008 pp.338-352 02008,DESIDOC.
2. Gonzalo ,Pajares and jesus Manuel ,De La Cruze ."wavelet based Image Fusion Tutorial Pattern Recognition" 2004 , 37 1855-872.
3. S.S. Hana ,H.T.Lia , H.Y.Gua "The Study on Image Fusion of remotely sensed Images" International Journal On Remote Sensing.
4. Rajiv Singh, AshishKhare"Fusion of multimodal Images using Doubenchis Complex Wavelet Transform –A Multiresolution Approach"
5. V.P.S. Naidu "Discrete Cosine transform based image fusion techniques "Journal of Communication Navigation and Signal Processing January 2012 Vol.I pp.35-45.