Image Fusion Using Biorthogonal & Fast Discrete Wavelet Transform

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Abstract – The proposed method of image fusion uses the biorthogonal wavelet transform for decomposing and reconstruction of the source images. The overall fusion scheme based on biorthogonal wavelet transform .Firstly, we decompose source images of same scene using Biorthogonal wavelet transform (BWT) and then coefficients obtained are merged using absolute maximum selection fusion rule. We have used wavelet and scaling functions used in BWT for decomposition of source images. The selection of proper wavelet for decomposition varies from application to application. Although vanishing moment and regularity (smoothness) of wavelet can be considered to decide wavelet function. For image fusion application, selection of wavelet with sufficient vanishing moment is desired. Therefore, we have used biorthogonal filters to get desired number of vanishing moments. The coefficients obtained by decomposition of source images are fused using absolute maximum fusion rule. Image fusion is to combine relevant information from two or more images of the same scene into a single composite image which is more informative and is more suitable for human and machine perception. More efficient algorithm involving only real operations for computing the Fast Discrete Cosine Transform (FDCT) of N points.

Index Terms – Image Fusion, Biorthogonal Wavelet Transform, Fusion Rules. Fast discrete wavelet transform.

1. INTRODUCTION

Sometimes Texture Identification is not done accurately when images are captured from no. of sensing devices. So, there is requirement of such a technique of identification which can identify texture correctly even when images captured from many sensing devices. Images of the same scene from sensors with different characteristics and different resolution at different time may provide complementary information about the scene. Image fusion is an advanced image processing technology, which could produce a new integrated image while retaining the important feature of these images. Image fusion is used to combine relevant information from two or more images of the same scene into a single composite image which is more informative and is more suitable for human and machine perception This paper makes the modest suggestion that Biorthogonal Wavelet Transform based Image Fusion is such a beneficial technique of image fusion which produces a new integrated image and retaining the important feature of these images. Research into getting a new integrated composite image using image fusion with the help of various wavelet transform methods such as Biorthogonal Wavelet Transform is required and hopes to have inspired others to use image fusion in for effective and accurate image identification.

2. PROPOSED SCHEME

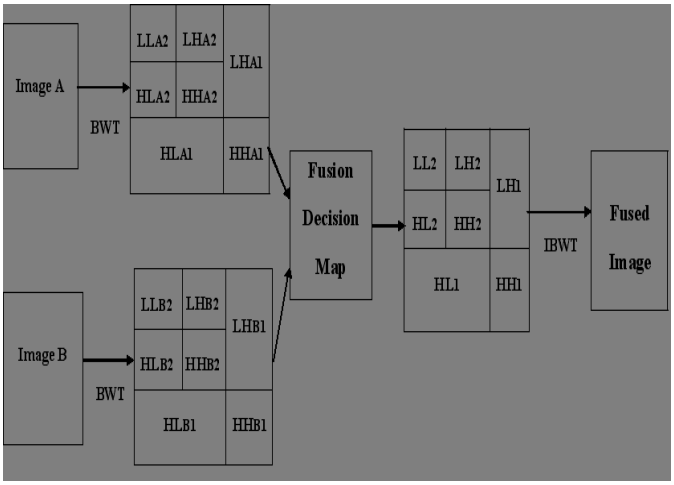

Fig.1: Block diagram of proposed system

Fig. 1 shows block diagram of the proposed system. Low resolution image obtained is passed for wavelet transform like discrete wavelet transform and stationary wavelet transform which will give sub band coding.diffrent bands like LL, LH, HL, HH all bands are interpolated with bicubic and linear interpolation technique to increase resolution with pixel based improvement then estimated bands are passed to inverse discreet wavelet transform for reconstruction of high resolution of image. Discrete wavelet transform gives multi resolution analysis.

Fig.2 Image processing before passing to wavelet transform

2.1 BWT (Biorthogonal Wavelet Transform)

For biorthogonal transform, perfect reconstruction is available. Orthogonal wavelets give orthogonal matrices and unitary transforms; biorthogonal wavelets give invertible matrices and perfect reconstruction. For biorthogonal wavelet filter, the Low pass and high pass filters do not the same length. The low pass and high pass filters do not have the same length. The low pass filter is always Symmetrical, while high pass filter could be either symmetric or anti symmetric. The method allows unusual flexibility in choosing a filter for any task involving the multiresolution analysis and synthesis. Using our method, one can choose any low pass filter for the multiresolution filtering. Firstly we decompose source images of same scene (can have different focusing and modality) using Biorthogonal wavelet transform (BWT) and then coefficients obtained are merged using absolute maximum selection fusion rule. We have used wavelet and scaling functions used in BWT for decomposition of source images. The selection of proper wavelet for decomposition varies from application to application. No general selection criteria for wavelet and scaling function is available in literature. Although vanishing moment and regularity (smoothness) of wavelet can be considered to decide wavelet function.

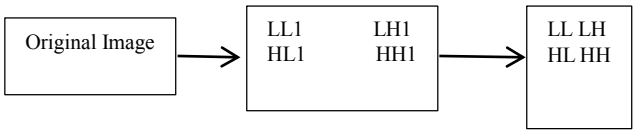

Fig.3 Process of decomposing using BWT of an image

The symbols L and H refer to low-pass and high-pass filter respectively. LL represents the approximation sub-band & LH, HL and HH are the detail sub-bands. LL is the low frequency sub-band gives global description of an image with directional features. Horizontal coefficients (LH) correspond to the low-frequency component in the horizontal direction and high-frequency component in the vertical direction.DWT based wavelet transform gives good multiresolution analysis compared to other wavelet transform. Wavelet Transform has good time frequency characteristics. It was applied successfully in image processing field. Nevertheless, its excellent characteristic in one dimension can't be extended to two dimensions or multi-dimension simply.Separable wavelet which was spanning by one dimensional wavelet has limited directivity. The most common form of transform type image fusion algorithms is the wavelet fusion algorithm due to its simplicity and its ability to preserve the time and frequency details of the images to be fused. Some generic requirements can be imposed on the fusion result. The fused image should preserve as closely as possible all relevant information contained in the input images. The fusion process should not introduce any artifacts or in consistencies which can distract or mislead the human observer or any subsequent image processing steps. In the fused image irrelevant features and noise should be suppressed to a maximum extent. When fusion is done at pixel level the input images are combined without any preprocessing. In the biorthogonal case, there are two scaling functions $\phi, \tilde{\phi}$, which may generate different multiresolution analyses, and accordingly two different wavelet functions $\psi, \tilde{\psi}$. So the numbers *M* and *N* of coefficients in the scaling sequences $a, \tilde{a}$ may differ. The scaling sequences must satisfy the following biorthogonality condition

$$\sum_{n \in \mathbb{Z}} a_n \tilde{a}_{n+2m} = 2 \cdot \delta_{m,0}$$

Then the wavelet sequences can be determined as

$$b_n = (-1)^n \tilde{a}_{M-1-n} \qquad (n = 0, \ldots, N-1)$$

$$\tilde{b}_n = (-1)^n a_{M-1-n} \qquad (n = 0, \ldots, N-1)$$

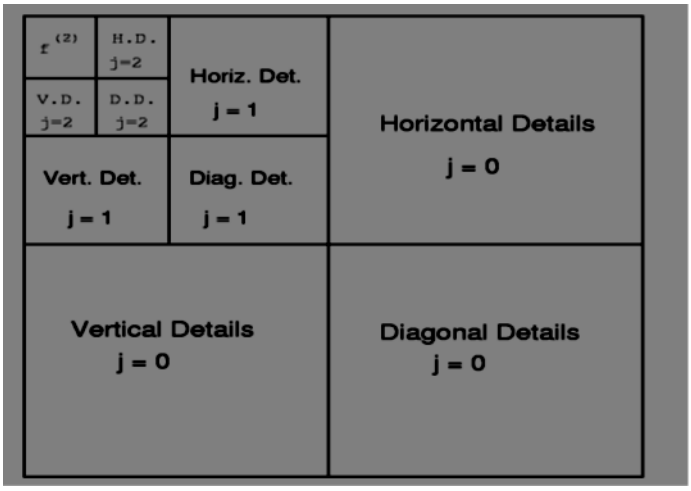

FIG.4 BWT PROCESSING

BWT is generalisation of the orthogonal wavelets. Two other spaces are introduced for the reconstruction.

2.2 Image Fusion & its Techniques

Pixel level fusion deals with information associated with each

pixel. Each pixel value in the fused image is determined from the corresponding pixel values of source images. In feature level fusion, source images are segmented into regions and features (like pixel intensities, edges or texture features) and these features are used for fusion. Decision level fusion is a high level fusion which uses decisions coming from various fusing sensors. Decision level fusion methods are based on some statistics, voting, fuzzy logic, prediction and heuristics etc.Image fusion is used to combine relevant information from two or more images of the same scene into a single composite image which is more informative and is more suitable for human and machine perception. Sometimes Texture Identification is not done accurately when images are captured from no. of sensing devices. So, there is requirement of such a technique of identification which can identify texture correctly even when images captured from many sensing devices.**I**mages of the same scene from sensors with different characteristics and different resolution at different time may provide complementary information about the scene. Image fusion is an advanced image processing technology, which could produce a new integrated image while retaining the important feature of these images. This paper makes the modest suggestion that Biorthogonal Wavelet Transform based Image Fusion is such a beneficial technique of image fusion which produces a new integrated image and retaining the important feature of these images. There are different techniques of Image Fusion are available such as: Spatial Domain Method Principal Component Analysis (PCA), Sharpness Criteria, Linear Fusion, and Wavelet Domain Method. Wavelet domain methods are generally used because it gives multiresolution analysis.

2.3 IBWT (Inverse Biorthogonal wavelet transform)

After BWT sub band coding different low and high bands are obtained after low pass filtering and high pass filtering. these sub bands from two images are obtained and fused with image fusion technology and then pass for inverse biorthogonal wavelet transform to obtain reconstructed original image.

FDCT(Fast Discrte Wavelet Transform)

The Fast Wavelet Transform is a mathematical algorithm designed to turn a waveform or signal in the time domain into a sequence of coefficients based on an orthogonal basis of small finite waves, or wavelets. The transform can be easily extended to multidimensional signals, such as images, where the time domain is replaced with the space domain. The Discrete Cosine Transform (DCT) has been successfully applied to the coding of high resolution imagery .The conventional method of implementing the DCT utilized a double size Fast Fourier Transform (FFT) algorithm employing complex arithmetic throughout the computation Use of the DCT in a wide variety of applications has not been as extensive as its properties would imply due to the lack of an efficient algorithm. More efficient algorithm involving only real operations for computing the Fast Discrete Cosine Transform (FDCT) of N points.

3. APPLICATIONS

The object of image fusion of MRI and PET images is to achieve a high spatial resolution image with functional and anatomical information [7].In the forensic labs, image fusion is used to identify and recognize theft from different fingerprints images. In optical remote sensing fields, the multispectral (MS) image which contains color information is produced by three sensors covering the red, green and blue spectral wavelengths.

4. RESULTS

Proposed system is used when different images captured from the same scene using sensing devices and decomposed and fused using first some spatial domain methods and then Biorthogonal Wavelet Transform (BWT) in which Absolute Maximum Fusion Rule is we are going to use for fusion**.**

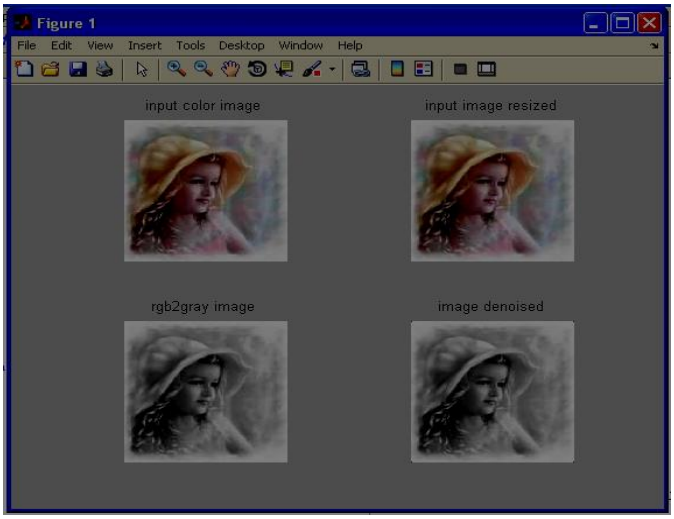

Fig 4. Results

Biorthogonal wavelet transform is applied on images to obation sub band coding which gives different low and high pass bands. As level of BWT increases then dimensionality reduction is obtained .Different transform like haar , daubeshian are also tested. Images are read. Resizing of the images into standard format is done. Applied functions to convert RGB to Gray Image. Padding zeros at the two dimensions of images is done. De-noised the images to remove the noise. BWT processing also happens with different levels and different transforms..Further processing is going on.

5. CONCLUSIONS

In this paper, we propose a pixel-level image fusion scheme using multi resolution Biorthogonal wavelet transform (BWT). Wavelet coefficients at different decomposing levels are fused using absolute maximum fusion rule. Two important properties wavelet symmetry and linear phase of BWT have been

exploited for image fusion because they are capable to preserve edge information and hence reducing the distortions in the fused image.

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