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Performance Analysis of Image Fusion Using CT and MRI Images

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Abstract - Image combination alludes to the way toward joining the Information from at least two pictures into a Single exceptionally educational picture The subsequent intertwined picture contains more data than the information pictures. In this paper, two medicinal pictures are melded in light of the Wavelet Transform (WT) and Curvelet change utilizing distinctive combination systems. The target of the combination of a MR picture and CT picture of a similar organ is to get a solitary picture containing however much data as could be expected about that organ for determination In this paper ,the information CT and MR pictures are enlisted and wavelet, curvelet, framelet and contourlet changes are connected on it. At long last, the outcomes are assessed utilizing combination methods. The parameters like PSNR, and MSE are assessed.

Keywords-- Curvelet Transform, Wavelet Transform, Image Fusion, Peak Signal to Noise Ratio(PSNR), Root Mean Square Error(RMSE).

I. INTRODUCTION

With the continues Development of sensor technology, people have more and more ways to obtain images, and the image fusion types are also increasingly rich, such as the Image fusion of same sensor, the multispectral image fusion of single-sensor, the image fusion of the sensors with different types, and the fusion of image and non -image. Traditional data fusion can be divided into three levels, which are pixel-level fusion, feature-level fusion and decision level fusion. The different fusion levels use different fusion algorithms and have different applications, generally, we all research the pixel-level fusion. Classical fusion algorithms include computing the average pixel-pixel gray level value of the source images, pyramid, Contrast pyramid, Ratio pyramid and Discrete Wavelet Transform(DWT). However, computing the average pixel-pixel gray level value of the source images method desirable side effects such as contrast reduction. Wavelet based image fusion method provide high spectral quality of the fused satellite images. However, the fused image by Wavelets has much less spatial information than those by the Bro vey, IHS, and PCA methods. The spatial information of fused image is an important factor as much as the spectral information in many remote sensing applications. In particular, this In other words, it is necessary to develop advanced image fusion method so that the fused images have the same spectral resolution as the multi spectral icons As contiguous proposal be cause the panchromatic icon ne This approach say after life forceful. However, wavelets seriously change can simplest manifest "through" corner tones, but cannot communicate "along" corner tones. At a similar show, the wavelet seriously change can not squarely exhibit the perimeter orientation because it adopts isotropy. According to the inhibition of your wavelet seriously change, was scheduled the idea of Curvelet seriously change, whatever uses brinks as essential elements, possess capability, and might tailor adequately to the icon temperaments. Moreover, Curvelet Transform has anisotropy and has correct orientation, can give additional info to figure processing. Through the primary of Curvelet radically change we realize that one: Curvelet radically change has orientation symptom, and its depraved term satisfies substance anisotropy association, apart from experience multi mount wavelet seriously change and native temperament capability, and might tailor adequately to the icon temperaments. .More over, Curvelet Transform has anisotropy and has correct orientation, can give additional info to figure processing. Through the primary of Curvelet radically change we realize that one: Curvelet radically change has orientation symptom, and its depraved term satisfies substance anisotropy association, apart from experience multi mount wavelet seriously change and native temperament image and smoothness area in the same precision of inverse transform.

The low-bands coefficient adopts NGMS method and different direction Curvelet transform can represent appropriately the edge of high bands coefficient adopts LREMS method was proposed after researching on fusion algorithms of the low-bands coefficient and high-bands coefficient in Curvelet Transform. Image fusion is a useful technique for merging similar sensor and multi sensor images to enhance the information content present in the images. Image fusion has several applications in various areas such as Medical Imaging, Satellite Imaging, Remote sensing, Robotics, Military applications and so on [1-4]. Computer Tomography (CT) and Magnetic Resonance (MR) are the most important modalities in Medical Imaging, used for clinical diagnosis. CT provides more information about Bone structures and less information about soft tissues. Magnetic Resonance (MR) imaging provides more information about the Soft tissues and less information about the bone structures .Image fusion has the following

ADVANTAGES:-

1. It improves the reliability by taking care of the redundant information.

2. It improves the capability as it keeps complementary information. Image fusion is a sequel to data fusion. The basic limitation of the wavelet fusion algorithm is in fusion of curved.

shapes and this can be accurate by the application of the Curve let transform, would result in the better fusion efficiency. Curve let transform involves the segmentation of the whole image into small overlapping tiles. Then the ridge let transform is itself a 1-D wavelet transform applied on the Radon transform of each tile, which itself is a shape detection tool. The purpose of segmentation process is to approximate curved lines by small straight line. The overlapping tiles aims at avoiding edge effects. Initially, Curve let transform was proposed for image denoising. It is expected that the Curve let transform would produce better fusion results than those obtained using the Wavelet transform. In this paper, we propose the effective and better results by using the medical CT images and MR images by Artificial Neuro- Fuzzy Inference System (ANFIS) than the previous results. We have selected wavelet here, because it passes single wavelets by its features such as orthogonality, short support, symmetry, and high degree vanishing moments and another curvelet, which deals with the curved shapes. The proposed technique is comprised of training and testing phase. This paper is organized as follows. Section II gives detail about discrete wavelet transform. In section III, Curvelet wavelet are presented.

DISCRETE WAVELET TRANSFORM

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. Wavelet transfer of the wavelet fusion algorithm of two registered images P1 ($x1$, $x2$) and P2 ($x1$, $x2$) .It can be represented by the following equation: I(x1, x2) = W−1(ψ(W(P1 (x1, x2)),W(P2 (x1, x2))))Where W, $W-1$and ψ are the wavelet transform operator, the inverse wavelet transform operator and the fusion rule, respectively. There are several wavelet fusion rules that can be used for the selection of wavelet coefficients from the wavelet transforms of the images to be fused. The most frequently used rule is the maximum frequency rule which selects the coefficients that have the maximum absolute values. The wavelet transform concentrates on representing the image in multi-scale and it is appropriate to represent linear edges. For curved edges, the accuracy of edge localization in the wavelet transform is low. So, there is a need for an alternative approach which has a high accuracy of curve localization such as the curvelet transform. Algorithm for wavelet transform is:

1. The two input images are registered

2. The wavelet transform steps are performed for both images

3. The maximum frequency fusion rule or any other rule is used for the fusion of the wavelet coefficients.

BLOCK DIAGRAM

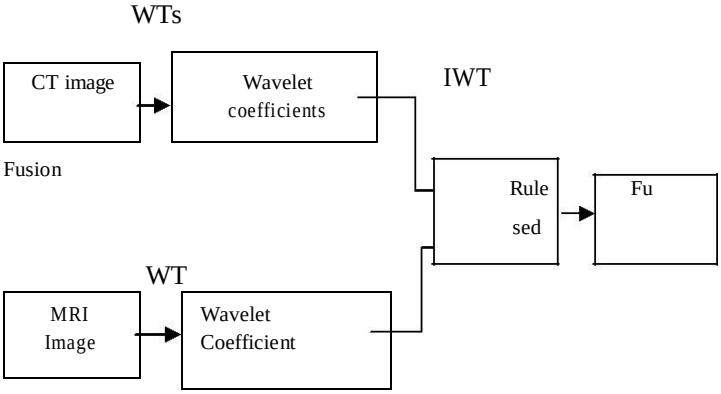


Figure.1.Wavelet Transform based image fusion

The source of DWT primarily based structures undergo carry out decompositions on every single expert perception, after which link most of these decompositions to purchase conglomerate portrayal, from the

CURVELET TRANSFORM

The Curvelet change (CVT) is a multi-scale change proposed by Candes and Donoho and is gotten from the Ridgelet change. The Curvelet change is suited for objects which are smooth far from discontinuities crosswise over bends. Fourier Transform does not deal with point's discontinuities well in light of the fact that a brokenness point influences all the Fourier Coefficients in tt he space. In addition, Wavelet change handles point discontinuities well and doesn't deal with bend discontinuities well. Curvelet change handles Curve discontinuities well as they are intended to handle curves using only a small number of coefficients. Curvelet transform has several applications in various areas such as image denoising, image fusion, Seismic exploration, Turbulence analysis in fluid mechanics.

FRAMELET TRANSFORM

The term wavelet transform can be described as wave that contains low and high frequency components. High frequency components are divided into, horizontal, vertical and diagonal direction information. If these directions can be increased the accuracy of results can be enhanced. By using expansive wavelet transform, the drawbacks of DWT can be minimized to a great extent .In case of DWT large differences can be seen in wavelet coefficients by making small changes in the input. Aliasing also occurs because of down sampling. The effect of aliasing can be complimented by using Inverse only if the coefficients of wavelet and scaling are not changed. The other disadvantage of DWT is poor directional selectivity (e.g., in ability features). Such kind of problems of DWT can be solved using framelet transform.

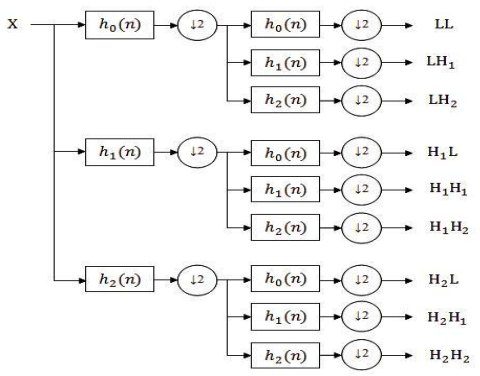


Fig. 1: Analysis Stages of a 2-D Single Level

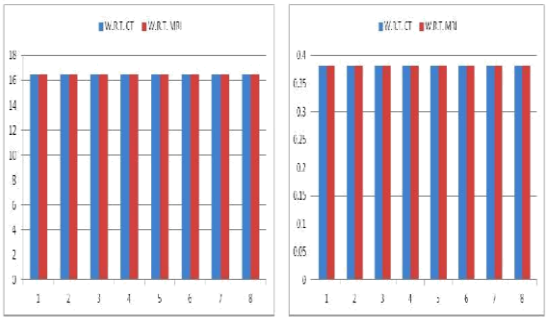
The Mean Square Error (MSE) indicates the accuracy of the proposed algorithm in terms of the mean error. The Less value of MSE indicates better results in compare to other methods. Here, the error is a difference between the original and estimated values, which define the values of the original image, differ from the processed image. As the MSE increases, image quality decreases. Therefore, our approach is to minimize the MSE of images.

$$MSE = \frac{1}{mn}\sum_{x=0}^{\infty}[I(i,j) - P(i,j)]^2$$

Where, *I(i, j)* is the input image of size $m \times n$ and *P(i, j)* is processed image.

The Peak Signal to Noise Ratio (PSNR) is an important role to estimate the accuracy of the algorithms. Higher PSNR shown the better results in compare to existing schemes. The PSNR formula can be expressed as:

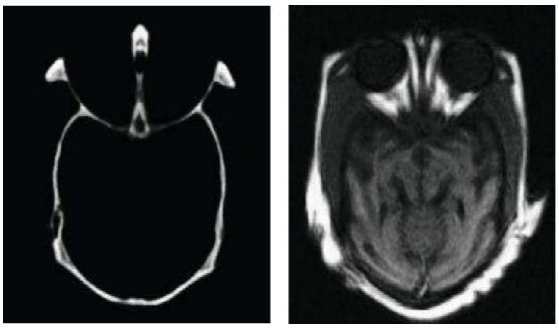
$$PSNR = 10\log_{10}\left(\frac{255^2}{MSE}\right)$$



Fig,2 Graphical Representation

CONCLUSION AND FUTURE WORK

We have combined the wavelet transform and various fusion rules to fuse CT and MRI images. This method gives encouraging results in terms of smaller RMSE and higher PSNR values. Among all the fusion rules, the maximum fusion rule performs better as it achieved least MSE and highest PSNR values. Using this method we have fused other head and abdomen images. The images used here are gray scale CT and MRI images. However, the images other modalities(like PET, SPECT, X-ray etc) with their true color nature may also be used fusing the same method. other modalities (like PET, SPECT, X-ray etc) with their true color nature may also be used fusing the same method.



Fig,3 CT and MRI image

The results of image fusion using CT and MRI image fused in different transform methods To perform the parameters of PSNR, RMSE, and average of maximum and minim

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