A Survey on Image Fusion Techniques

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Abstract— the amalgamation of different images having similar features to create a new image having the important characteristics of the original image is known as the Image fusion. A lot of work is being done nowadays in the field of image fusion especially in the field of medical imaging and science. Out of the various techniques that are being used for the purpose of image fusion, Wavelet Transform is an important one. This paper shall discuss about the Wavelet Transform with its advantages and disadvantages.

Keywords — *Put your keywords here, keywords are separated by comma.*

I. INTRODUCTION

Image Fusion is a process by which different images can be amalgamated to create a new image. The new images still have the necessary features and properties of the original images. Image fusion has proved to be a citadel in the area of medical imaging helping medical experts in diagnosis of a patient. [1] 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. The advancement in image fusion has also saved a lot of time in the treatment of patient. In the field of medical science, two very important discoveries which are CT scan and MRI (Magnetic Resonance Imaging) are great example of the success of the Image Fusion. But they have their limitations too. Multiple images are captured and then amalgamated to arrive at any conclusion. The advantages these images may be fully exploited by integrating the complementary features seen in different images through the process of image fusion that generates an image composed of features that are best detected or represented in the individual images. MRI image provides better information about soft tissue and CT image provides detail information about dense structure such as bones. These two images provide complementary information. The main purpose of medical image fusion is to obtain a high resolution image with as much details as possible for the sake of diagnosis. So if these two images of the same organ are fused then the fused image contains as much information as possible for diagnosis of that organ [2]. Image fusion has several applications in various other areas such as Satellite Imaging, Remote sensing, Robotics, Military applications and so on. [3-6]. Wavelet Transform, shown in fig 1. has become a significant aspect of fusion of images because of the merits of multi resolution and multi scale.

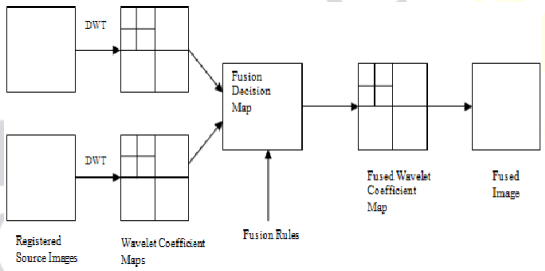

FIG. 1 IMAGE FUSION USING WAVELET TRANSFORM

II. RELATED WORKS

Kanisetty Venkata Swathi et al. [7] proposed a new approach of multimodal medical image fusion on Daubechies wavelet transform coefficients. The fusion

process starts with comparison of block wise standard deviation values of the coefficients. Here the standard deviation can be used to characterize the local variations within the block. The performance of proposed image fusion method is compared with existing algorithms and evaluated with mutual information between input and output images, entropy, standard deviation, fusion factor metrics.

j. Srikanth et al. [8] presented the wavelet transforms of the input images are properly pooled the new image is achieved by taking the inverse wavelet transform of the fused wavelet coefficients. The suggestion is to progress the image content by fusing images like computer tomography (CT) and magnetic resonance imaging (MRI) images so as to recommend more information to the doctor and clinical treatment planning system. They demonstrate the application of wavelet transformation to multi- modality medical image fusion. This work covers the selection of wavelet function, the use of wavelet based fusion algorithms on medical image fusion of CT and MRI, implementation of fusion rules and the fusion image

quality evaluation. The fusion performance is estimated on the basis of the root mean square error.

Ch.Bhanusree et al. [9] analysed the characteristics of the Second Generation Wavelet Transform and put forward an image fusion algorithm high frequency coefficients according to different frequency domain after wavelet. In choosing the low- frequency coefficients, the concept of local area variance was chosen to measuring criteria. In choosing the high frequency coefficients, the window property and local characteristics of pixels were analyzed. Finally, the proposed algorithm in this article was applied to experiments of multi-focus image fusion and complementary image fusion. In this a hardware implementation of a real-time fusion system is proposed. The system is based on Xilinx Spartan 3 EDK FPGA and implements a configurable linear pixel level algorithm which is able to result in color fused images using System C language.

Kanaka Raju Penmetsa et al. [10] proposed a DT-CWT method which is used in de-noising of colour images. CDWT is a form of DWT in which complex coefficients (real and imaginary parts) are generated by using a dual tree of wavelet transform. The experiments on a amount of customary colour images carried out to approximate performance of the proposed method. Outcome shows that the DT-CWT method is better than that of DWT method in terms of image visual eminence. Patil Gaurav jaywantrao et al. [11] proposed the novel relevance of the shift invariant and directionally discerning Dual Tree complex Wavelet Transform (DT- CWT) to image fusion is now introduced. The flourishing fusion of images acquired from assorted modalities or instruments is of great significance in many applications such as medical imaging, infinitesimal imaging, remote sensing and robotics. With 2D and 3-D imaging and image indulgence becoming widely used; there is a growing need for novel 3-D image fusion algorithms accomplished of combining 2D & 3-D multimodality or multisource images. Such algorithms can be used in areas such as 2D & 3-D e.g. fusion of images in Target tracking system, Synthetic Aperture Radar (SAR) etc. In case of target tracking system the time is the very vital factor. So we take time as a comparison factor to compare unlike methods which we execute. In order to get better the competence of the project, a far time for the fusion to scuttle is being formulated. Pavithra C et al. [12] presented a method for fusing two dimensional multi-resolution 2-D images using wavelet transform under the combine gradient and smoothness criterion. The usefulness of the method has been illustrated using various experimental image pairs such as the multi- focus images, multi-sensor satellite image and CT and MR images of cross-section of human brain. The results of the proposed method have been compared with that of some widely used wavelet transform based image fusion methods both qualitatively and quantitatively. An experimental result expose that the proposed method produces better fused image than that by the latter. The use of mutually gradient and relative smoothness criterion ensures two fold effects. While the gradient criterion ensure that edges in the images are included in the fused algorithm, the relative smoothness criterion ensures that the areas of uniform intensity are also incorporated in the fused image thus the effect of noise is minimized. It should be noted that the proposed algorithm is domain-independent. Hasan Demirel et al. [13] Complex Wavelet Transform (CWT) is used in image processing. CWT of an image produces two complex-valued low-frequency sub-band images and six complex valued high- frequency sub-band images. DT-CWT decomposes original image into different sub-band images. Then high frequency sub-band images and original low frequency image are undergoes the interpolation. These two real-valued images are used as the real and imaginary components of the interpolated complex LL image, respectively, for the IDT-CWT operation. This technique does not interpolate the original image but also interpolates high frequency sub-band image resulting from DT-CWT. The final output image is high resolution of the original input image. quality and PSNR of the super resolved image is also improves in this method. There are some problems with wavelet domain also, it introduces artifacts like aliasing, any wavelet coefficient processing upsets the delicate balance between forward and inverse transform leading to some artifacts in the images. Also constructs lack of directional selectivity substantially make difficult modelling and processing of geometric image features like ridges and edges. One resolution to all these

problems in Complex Wavelet Transform (CWT). CWT is only somewhat like magnitude or phase, shift invariant and free from aliasing.

Singh R.et al. [14] proposed a new weighted fusion scheme using Daubechies complex wavelet transform (DCxWT). Shift sensitivity and lack of phase information in real valued wavelet transforms motivated to use DCxWT for multimodal medical image fusion. It was experimentally found that shift invariance and phase information properties improve the performance of image fusion in complex wavelet domain. Therefore, we used DCxWT for fusion of multimodal medical images. To show the effectiveness of the proposed work, we have compared our method with existing DCxWT, dual tree complex wavelet transform (DTCWT), discrete wavelet transform (DWT), non-sub contourlet transform (NSCT) and contourlet transform (CT) based fusion methods using edge strength and mutual information fusion metrics. Comparison results clearly show that the proposed fusion scheme with DCxWT outperforms existing DCxWT,

DTCWT, DWT, NSCT and CT based fusion methods.

Bull D.R. et al. [15] presented a new approach to 3-D image fusion using a 3-D separable wavelet transform. Several known 2-D WT fusion schemes have been extended to handle 3-D images and some new image fusion schemes (i.e. fusion by hard and soft thresholding, composite fusion, and fusion of the WT maxima graphs) have been proposed. The goal of this paper is to present the new framework for 3-D image fusion using the wavelet transform, rather than to compare the results of the various fusion rules. Wavelets transform fusion diagrams have been Introduced as a convenient tool to visually describe different image fusion schemes. A very important advantage of using 3- D WT image fusion over alternative image fusion algorithms is that it may be combined with other 3-D image processing algorithms working in the wavelet domain, such as `smooth versus textured' region segmentation, volume compression, where only a small part of all wavelet coefficients are preserved, and volume rendering, where the volume rendering integral is approximated using multi-resolution spaces. The integration of 3-D WT image fusion in the broader framework of 3-D WT image processing and visualisation is the ultimate goal of the present study.

The advantages and disadvantages of the proposed method are described in table 1 below

Table 1

S. No.	Authors	Approaches	Merits	Demerits
1	Kanisetty Venkata Swathi et al.	Daubechies wavelet transform	It is able to manage different images resolution	It consider only wavelet coefficient value
2	j. Srikanth et al.	Wavelet Transform	It reduces the storage cost	Not able to maintainedge information efficiently
3	Ch.Bhanusree et al.	Second Generation Wavelet Transform	It is multi scale dimensionality	It has poor directionality
4	Kanaka Raju Penmetsa et al.	DT-CWT method	Image visual eminence is better	Has limited directionality
5	Patil Gaurav jaywantrao et al.	Dual Tree complex Wavelet Transform (DT-CWT)	It is more flexible and better image visibility and reduces the time variant	It introduce artifacts like aliasing
6	Pavithra C et al.	wavelet transform using gradientand smoothness criterion	It is able to retain the edge information also minimize the noise	It is domain-independent
7	Hasan Demirel et al.	Complex Wavelet Transform (CWT)	magnitude or phase, shift invariant and free from aliasing	Most expensive and computational intensive
8	Singh R.et al	weighted fusion scheme using Daubechies complex wavelet transform (DCxWT)	It is better to retain the edge the information thanthe DT-CWT	Not able to achieve the expected performance
9	Bull D.R. et al.	3-D separable wavelet transform	It is able to enhance the quality of 3-D image	Poor selectivity for diagonally
10	Ai Deng et al.	discrete wavelet transform (DWT)	It effectively reduce the noise from image	It is a shift- invariantin nature

III. Conclusion

To acquire the crucial feature or attributes of the images of common features image fusion is widely used technology. The wavelet transform is one of the most efficient approaches to extract the features by the transformation of decomposition process. But this method is not efficient to retain the edge information. In this paper literature study of the fusion techniques are described with their shortcoming. In future work, design such algorithms can be designed which can efficiently retain the edge information.

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