Pixel Based Image Fusion Using Fast Discrete Curvlet Transform With Graphical User Interaction

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Abstract: Image fusion is very important technique used to extract the useful information from several images into a single image. 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 accurated by the application of the Curvelet transform(FDCT),would result in the better fusion efficiency. Image fusion algorithms can be categorized into different levels: pixel, feature, and decision levels. Pixel level fusion works directly on the pixels of source images while feature level fusion algorithms operate on features extracted from the source images. The proposed image fusion algorithm is implemented for fusion of medical images. In medical imaging, MRI and CT images are of main concern for diagnosis of brain, chest and spines related diseases. This process can be implemented through graphical user inter-action. The results are analyzed and tested using GUI.

Keywords: Pixel Based, GUI, MRI and CT Images, FDCT,fusion,wavelet.

I.INTRODUCTION

Image fusion can be traced back to the mid-eighties. Multi sensor data fusion has become a discipline which demands more general formal solutions to a number of application cases. Several situations in image processing require both high spatial and high spectral information in a single image. This is important in remote sensing. However, the instruments are not capable of providing such information either by design or because of observational constraints. One possible solution for this is data fusion.

Image fusion has become a common term used within medical diagnostics and treatment. The term is used when multiple images of a patient are registered and overlaid or merged to provide additional information. Fused images may be created from multiple images from the same imaging modality,[4] or by combining information from multiple modalities,[5] such as magnetic resonance image (MRI), computed tomography (CT), positron emission tomography (PET), and single photon emission computed tomography (SPECT). In radiology and radiation oncology, these images serve different purposes. For example, CT images are used more often to ascertain differences in tissue density while MRI images are typically used to diagnose brain tumors.

For accurate diagnoses, radiologists must integrate information from multiple image formats. Fused, anatomically consistent images are especially beneficial in diagnosing and treating cancer. With the advent of these new technologies, radiation oncologists can take full advantage of intensity modulated radiation therapy (IMRT). Being able to overlay diagnostic images onto radiation planning images results in more accurate IMRT target tumor volumes.

Often the ideal fused image is not known or is very difficult to construct. This makes it impossible to compare fused images to a gold standard. In applications where the fused images are for human observation, the performance of fusion algorithms can be measured in terms of improvement in user performance in tasks like detection, recognition, tracking, or classification.

II.RELATED WORK

A.EXISTING METHOD

DISCRETE WAVELET TRANSFORM

A discrete wavelet transform (DWT) is any wavelet transform for which the wavelets are discretely sampled. As with other wavelet transforms, a key advantage it has over Fourier transforms is temporal resolution: it captures both frequency and location information (location in time).

Calculating wavelet coefficients at every possible scale is a fair amount of work, and it generates an awful lot of data. If the scales and positions are chosen based on powers of two , the so called dynamic scales and positions then calculating wavelet coefficients are efficient and just as accurate. This is obtained from discrete wavelet transform (DWT).

Wavelet Toolbox provides functions for the dyadic-scale analysis of signals and images. Obtain both decimated and non decimated wavelet transforms of signals and images including the dual-tree complex and double-density wavelet transform. Fuse

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images based on their wavelet decompositions. Explore the multi scale correlation structure of multiple signals using wavelet multi signal analysis. Use a lifting scheme to implement 1-D and 2-D wavelet transforms.

B.CURVELET TRANSFORM

The Curvelet transform (CVT) is a multi-scale transform proposed by Candes and Donoho and is derived from the Ridgelet transform. The Curvelet transform is suited for objects which are smooth away from discontinuities across curves. Fourier Transform does not handle point's discontinuities well because a discontinuity point affects all the Fourier Coefficients in the domain. Moreover, Wavelet transform handles point discontinuities well and doesn't handle curve discontinuities well.

Curvelet transform handles curve discontinuities well as they are designed 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 and so on.

Fast Discrete Curvelet Transform

Fast discrete curvelet transform based on wrapping is a multi-scale pyramid consisting of different orientations and positions in frequency domain. It uses advantages of Fast Fourier transform (FFT) in special spectral domain Discrete Wavelet Transform (DWT) is the most useful transform successfully applied in image fusion field.

It preserves time and frequency details of the image. In discrete wavelet transform image data are discrete and the spatial and spectral resolution is dependent on the frequency. Show the output using graphical user interface tool for the application. UIs created using MATLAB® tools can also perform any type of computation, read and write data files, communicate with other UIs, and display data as tables or as plots.

III.IMPLEMENTATION WORK

C.IMAGE FUSION

Here fusion of these two images plays a very important role which combines both CT and MRI images into a single fused image which contains accurate information about bones as well as soft tissue details. Thus, the fusion of these two images of same organ provides very useful information about that organ which helps physicians for better diagnosis.

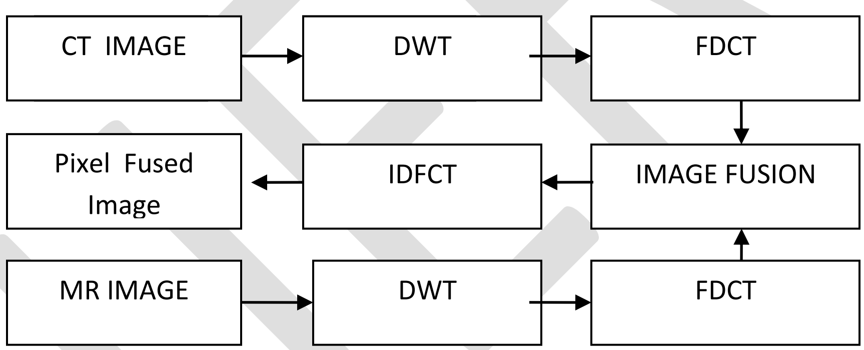

Fig 1: Pixel based image fusion technique

LEVELS OF FUSION:

Analogous to other forms of information fusion, image fusion is usually performed at one of the three different processing levels: signal, feature and decision .

Signal level(pixel-level) image fusion:

It is also known as **pixel-level image fusion**, represents fusion at the lowest level, where a number of raw input image signals are combined to produce a single fused image signal.

Object level image fusion:

It is also called feature level image fusion, fuses feature and object labels and property descriptor information that have already been fusion of probabilistic decision information obtained by local decision makers operating on the results of feature level processing on image data produced from individual sensors extracted from individual input images

The highest level, decision or symbol level image fusion:

It represents fusion of probabilistic decision information obtained by the local decision makers operating on the results of feature level processing on image data produced from the individual sensors.

PROPOSED IMAGE FUSION ALGORITHM :

The steps involved in proposed algorithm can be summarized as follows:

1. Read the MRI as image1 [M1, N1] and CT as image2 [M2, N2] which is to be fused.
2. Resample and register both these images, so that wavelet coefficients of similar component will stay in the same magnitude.
3. Apply 2D-discrete wavelet transform to these images which decompose it into four sub-bands (LL, LH, HL and HH). These four sub-bands are sensitive to low frequency approximate component and three high frequency detailed components.
4. The wavelet coefficients from both the input images are obtained which gives high spatial resolution and high spectral quality contents from input images.
5. Further Fast discrete curvelet transform using frequency wrapping is applied to obtain curvelet coefficients.
6. The steps for FDCT using frequency wrapping algorithm are explained as follows-
   - Apply 2D FFT transform to both input images and obtain fourier samples of both images as I1[n1,n2] and I2[n1,n2] where $-n/2 < n1,n2 < n/2$.

   The obtained frequency samples of both images are periodized.
   - For each scale j and angle a the periodization of widowed data is done which form the product for input image I1[n1,n2] as K1[n1,n2]= Uj,a[n1,n2] I1[n1,n2] (1)

     And input image I2[n1,n2] as K2[n1,n2]= Uj,a[n1,n2] I2[n1,n2] (2)
   - The obtained windowed data, wrappedK1[n1,n2]and K2[n1,n2] around the origin to restrict the rectangular window length L1,j and L2,j near the origin. The product obtained is

$$I1j,a[n1,n2] = W(Uj,a\ I1)[n1,n2] \quad (3)$$
$$I2j,a[n1,n2] = W(Uj,a\ I2)[n1,n2] \quad (4)$$

Where the range for n1, n2 is $0<n1<L1,j$, $0<n2<L2,j$ (for $-\pi/4< \theta< \pi/4$).

Thus, the wrapping transformation is nothing but a simple re-indexing of the data.

- Apply the inverse 2D FFT to each I1j,a and I2j,a.
- The curvelet coefficients I1j,a and I2j,a of both the input images are obtained which contains high directionality.
- These coefficients are fused using maximum selection rule.
- For Maximum selection rule, fusion is done by taking the maximum valued pixels from I1[n1,n2] andI2[n1,n2] both sub images of input images.

  $Imax = \max (I1 [n1, n2], I2 [n1, n2])$ (5) Fused coefficients are obtained.

7. The fused image is obtained by applying inverse fast discrete curvelet transform on fused coefficients.
8. The final fused image is reconstructed by applying inverse discrete wavelet transform to fused image.
9. The final fused image can be represented by following equation:

$$I[n1,n2]=W1(\Psi(W(I1[n1,n2])),W(I2[n1,n2]))) \quad (6)$$

10. performance analysis is done by using 3 quality metrics parameters as Entropy, RMSE, PSNR.

D.GRAPHICAL USER INTERFACE:

A user interface (UI) is a graphical display in one or more windows containing controls, called *components*, that enable a user to perform interactive tasks. The user does not have to create a script or type commands at the command line to accomplish the tasks.

Designing the visual composition and temporal behavior of a GUI is an important part of software application programming in the area of human-computer interaction. Its goal is to enhance the efficiency and ease of use for the underlying logical design of a stored program, a design discipline known as usability. Methods of user-centered design are used to ensure that the visual language introduced in the design is well tailored to the tasks.

The visible graphical interface features of an application are sometimes referred to as "chrome" or "GUI" (Goo-ee). Typically, the user interacts with information by manipulating visual widgets that allow for interactions appropriate to the kind of data they hold.

IV.RESULT ANALYSIS

The output of this project is graphically shown in below figures. It contains pixel based fused image as output image.Here CT and MR images are input images. Then wavelet transform and DFCT are applied to inputs, the resultant corresponding images are shown. The resultant pixel based fused images are shown in graphical user interface window as well.

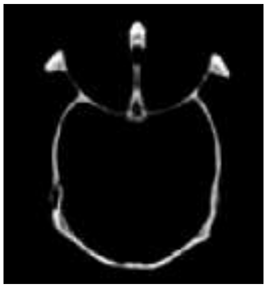

Fig 2: CT IMAGE

fig 3: DWT IMAGE OF CT

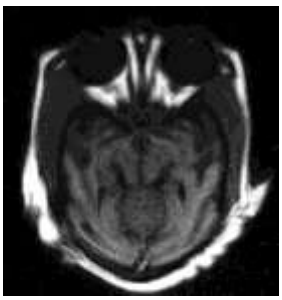

Fig 4:MR IMAGE

fig 5: DWT IMAGE OF MR

Fig 6:OUTPUT OF IDFCT

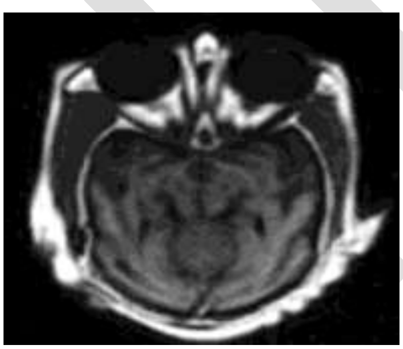

Fig 7:OUTPUT OF IDWT- PIXEL BASED FUSED IMAGE

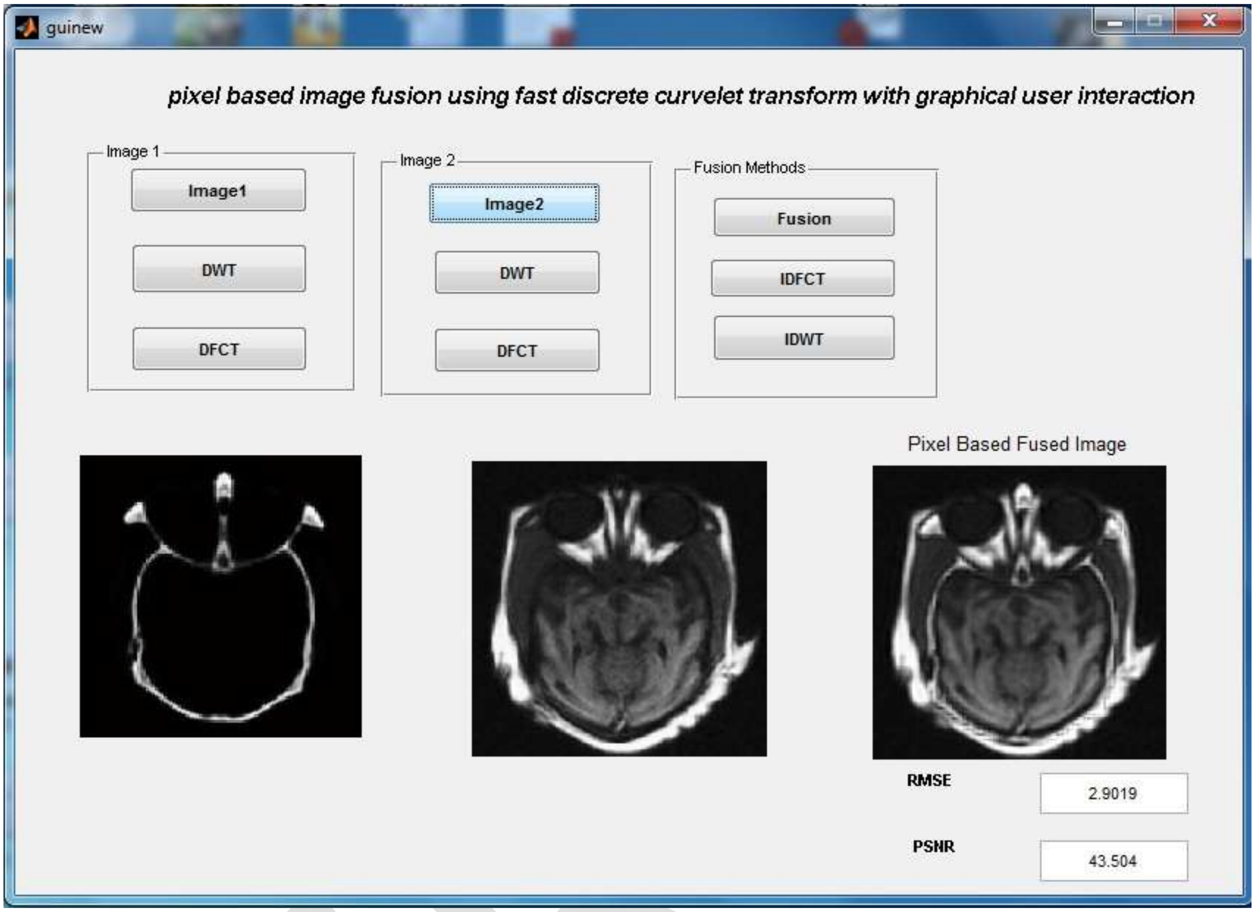

Fig 8: GUI window for pixel based fused image output

V.CONCLUSION

We envisage the design and deployment of more a real-time pixel based fused image which can analyze their own performance and feed back this information to adapt their behavior and to improve the quality of the fused images they produce. Graphical user interaction will help the detection of the object image easily and accurately and it gives the better FDCT images, IDFT and fused images. there is huge scope for research and development in the graphical user interaction with human. The results are implemented and tested successfully.

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