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Application Of Haar Wavelet Transform For Accurate Tumor Cells Detection And Diagnosis.

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ABSTRACT

Image fusion is one of the most important processes in digital image processing technique, in which two or more images are combined into a single image retaining the important features of original image and produce high quality images. Fused image contain more information for the purposes of interpretation, classification, segmentation and compression etc. In the present study magnetic resonance imaging (MRI) and positron emission tomography (PET) was used by using Haar wavelet transform and Pillar K-mean clustering algorithm. The main objective of proposed technique is to maximally combine useful information present in MRI and PET images for the sake of diagnosis. The goal of image fusion is to impose a structural and anatomical framework in functional images. Often in a functional image there is not enough anatomical detail to determine the position of tumor cells or lesions. Generally functional images have low spatial resolution and anatomical images have high spatial resolution. So the anatomical images could be used to detect the lesions with an accuracy of millimeters. Simulation results showed that the proposed scheme produces significantly better results to detect the tumor cells when compared to previous methods.

Keywords: Image fusion, Haar wavelet transform, orthogonal wavelet, Pillar K-mean clustering

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INTRODUCTION

In modern radiology imaging modalities, three-dimensional medical visualization of anatomy and function are in clinical use. Various physical quantities measured by the interaction of X-rays, magnetic fields or ultra sound with the human body provide modality inherent information in general information is complimentary. For instance, a 3D map of physiological processes is reconstructed in positron emission tomography (PET). Specific radio-chemicals label metabolic processes have been used for the emission of positrons (β+-particles). The positrons are localized by the detection of the coincident photons emitted in opposite directions after electron-positron annihilation. Magnetic resonance imaging (MRI) uses nuclear spin interaction with the magnetic field and resonance phenomena to generate an image of the tissue of the human body. With more available multimodality medical images in clinical applications, the idea of combining images from different modalities become very important and medical image fusion has emerged as a new promising research field [1& 2].

A complete medical image fusion technique should include imaging equipment, processing equipment and the total fusion method. With the medical and continuous development of science and technology, medical imaging provides a variety of modes of image information for clinical diagnosis, such as CT, X ray, MRI, PET, SPECT etc. Different medical images have different characteristics, which provide structural information of different organs. For instance, CT and MRI with high spatial resolution can provide anatomical structure information of organs. PET and SPECT is relatively poor spatial resolution, but it would provide information on organ metabolism. Thus, a variety of imaging can be generated for the same organ, they are contradictory, but complementary and interconnected. Therefore the appropriate image fusion of different features becomes early requirement for clinical diagnosis. Medical image fusion, as the characteristics areas open to the clinical diagnosis, extend the new ideas and new standards and becomes contemporary focus and insist of current study on medical image. Fusion techniques include the simplest method of pixel averaging to more complicated method such as principal component analysis and wavelet transform fusion. Several approaches to image fusion can be distinguished, depending on whether the images are fused in the spatial domain or they are transformed into another domain, and their transforms fused [3].

Remotely sensed images some have good spectral information and others have geometric resolution, how to integrate the information of these two kinds of images into one kind of images is a very attractive thing in image processing, which is also called the image fusion. For the purpose of realization of this task, we often need some algorithms used to fuse the information of these two kinds of images. In the present study we find few such algorithms to fuse the images. In past few decades, a new mathematical theory called “wavelet theory” [4] has gradually been used in the fields of graphics and imagery, and been proved to be an effective tool to process the signals in multi scale spaces. Wavelet transform fusion is more formally defined by considering the wavelet transforms of the two registered input images together with the fusion rule. Then, the inverse wavelet transform is computed and the fused image is reconstructed. The wavelets used in image fusion can be classified into three categories Orthogonal, Bi-orthogonal and A’trous’wavelet. Although these wavelets share some common properties, each wavelet has a unique image decompression and reconstruction characteristics that lead to different fusion results [5]. In the present investigation, image fusion algorithm based on wavelet transform is proposed to improve the geometric resolution of the images, in which two images to be processed are firstly decomposed into sub images with the same resolution at the same levels and different resolution among different levels. Afterwards the information fusion is performed using high frequency sub images under the” gradient” criterion. Finally these sub images are reconstructed into the result image with plentiful information. Since the geometric resolution of the image depends on the high frequency information in it.

MATERIALS AND METHODOLOGY

Existing method

The previous method used basics of wavelet transform to fuse two registered images, but the result was very slow and less accurate.

Proposed method

In the proposed method Orthogonal, Bi-orthogonal and A'trous'wavelet and Pillar K-mean clustering is used to fuse the images. After fusing the images tumor is to be isolated by using GUI from MAT LAB.

The main objective of the present work is to obtain a high resolution image with as much details as possible for the sake of diagnosis MRI and PET imaging are of main concern for diagnostic purposes. Both techniques give special sophisticated characteristics of the organ to be imaged. So, it is expected that fusion of MRI and PET images of the same organ would result in an integrated image of much more details.

The goal of image fusion is to impose a structural anatomical framework in functional images. Often in a functional image there is not enough anatomical detail to determine the position of tumor or lesion. Generally functional images have low spatial resolution and anatomical images have high spatial resolution. So, with anatomical images, a lesion can be detected with an accuracy of millimeters. With the functional images this is not possible, but they have ability to detect lesions before the anatomy is damaged. The fusion of both types of images could avoid undesired effects.

Technique used

The present study is based on the technique of using Haar wavelet transform for the decomposition of PET-MRI images, which is to simply write a loop and compute the low pass portion and the high pass portion in the same loop. For gathering the similarity of PET-MRI image, we used clustering technique. Clustering is to identify natural grouping of data from a large data set to produce a concise representation of a system's behavior, optimizing the initial centroid of the tumor by using Pillar algorithm. Pillar algorithm is an algorithm to optimize the initial centroid for k-mean clustering. It is very superior for the initial centroids optimization for K-mean by positioning all centroids far separately among them in the tumor [6].

Wavelet based image fusion

In this procedure first apply the histogram match process between panchromatic image and different bands of the multispectral image respectively and obtain three new panchromatic images. Next step use the wavelet transform to decompose new panchromatic images and different bands of multispectral image twice respectively. Then add the detail images of the decomposed panchromatic images at different levels to the corresponding details of different bands in the multispectral image and obtain the new details component in the different bands of the multispectral image. Finally perform the wavelet transform on the bands of multispectral images, respectively and obtain the fused image.

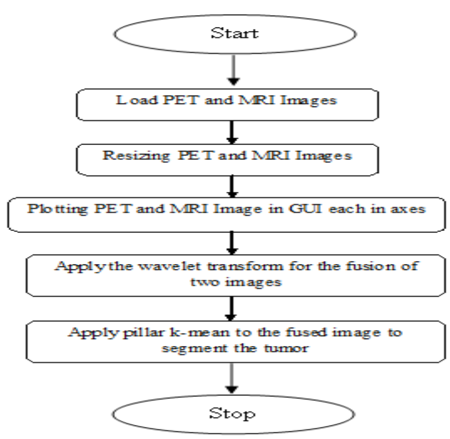

Figure 1: Flow chart of simplification Mat lab program

Orthogonal wavelet fusion technique

First we define Haar wavelet transform, it is to simply write a loop and compute the low pass portion and the high pass portion in the same loop. Then use Haar wavelet transform we replace the LLP in the panchromatic decomposition with the LL1 of the intensity decomposition, add the detail images in the panchromatic decomposition to the corresponding detail image in the panchromatic decomposition to the corresponding detail images of the intensity and obtain LL1, LHP, HHP and HLP. Perform an inverse wavelet transform, and generate a new intensity. Transform the new intensity together with hue, saturation components or PC1, PC2, PC3 back into RGB space. The Eigen vectors are sorted according to corresponding eigen values in descending order. The Eigen vector associated with the largest Eigen value is one that reflects the largest variance in the image

K means clustering algorithm

A fundamental problem that frequently arises in a great variety of fields such as pattern recognition, image processing, machine learning and statistics is the clustering problem. In its basic form the clustering problem is defined as the problem of finding homogeneous groups of data points in a given data set. Each of these groups is called a cluster and can be defined as a region in which the density of objects is locally higher than in other regions. The most widely used criterion is the clustering error criterion which for each point computes its squared distance from the corresponding cluster center and then takes the sum of these distances for all points in the data set. A popular clustering method that minimizes the clustering error is the k-means algorithm. However, the k-means algorithm is a local search procedure and it is well known that it suffers from the serious drawback that its performance heavily depends on the initial starting conditions [6].

Mat lab GUI tool

Mat lab GUI tool have been used for the comparison of images by the method followed by Krasula et al [7].

RESULTS AND DISCUSSION

In the MRI image the inner contour missing but it provides better information on soft tissue. In the PET image it provides the best information on denser tissue with less distortion, but it misses the soft tissue information. When constructing each wavelet coefficient for the fused image determine which source image describes this coefficient better. This information will fuse the technique which is by combining of MRI and PET images

The flowchart of the simplified Mat lab program is depicted in Fig. 1, which is used to locate and detect the tumor in the patient by using the wavelet transforms and pillar k-mean. This information becomes significant in finding the specification of the fusion image, which will lead the specialists to diagnose the tumor.

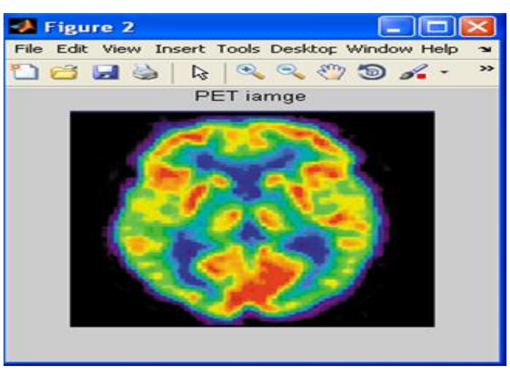

Figure 2: PET image of tumor

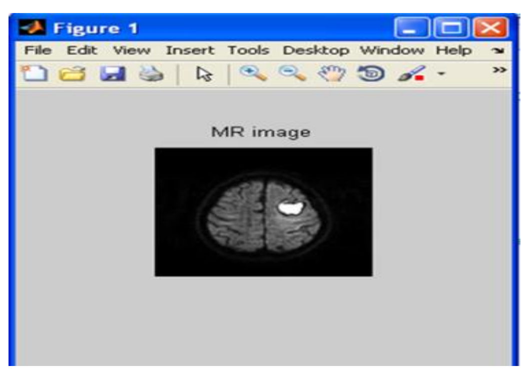

Figure 3: MRI image of tumor

An input image of PET and MRI image is depicted in Figure 2 and 3 of same person. Figure 4 showed the result of orthogonal wavelet image. The orthogonal wavelet fused image has information of both images but have more aliasing effect. The result of pillar K means clustering image is displayed in Figure 5 in which tumor is recognized. The fusion results of pillar K means clustering have information on soft tissues and denser tissues.

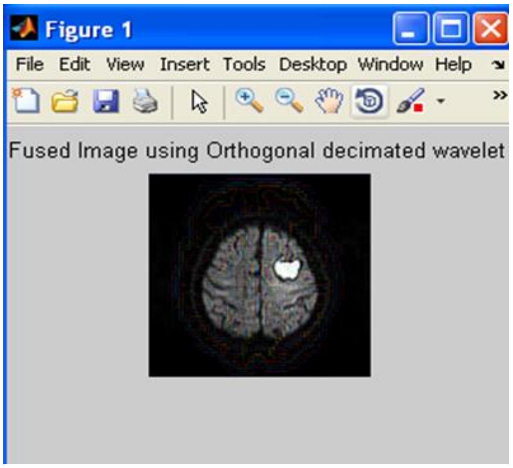

Figure 4: Orthogonal wavelet fused image

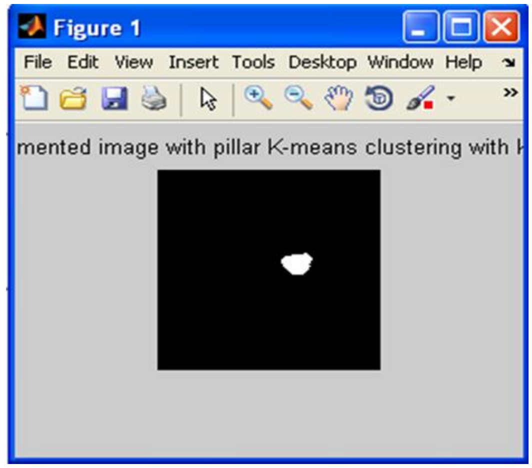

Figure 5: Pillar K means clustering image

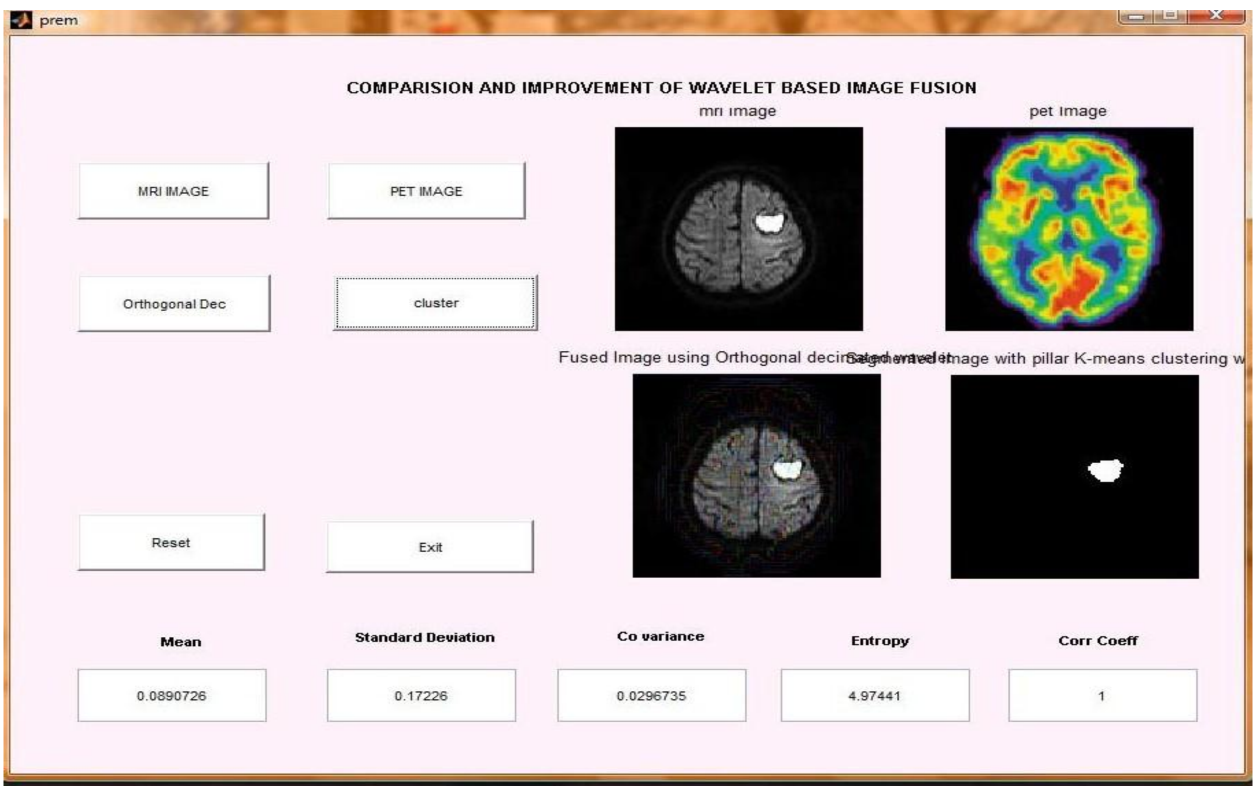

Figure 6: Comparison and improvement of wavelet based image fusion in GUI

Comparison and improvement of wavelet based image fusion was done by graphical user interface (GUI) tool. Thus the tumor can be detected and calculated in the pillar k-mean axes based on various parameters. The result is shown in Figure 6. The output image shows better accuracy when compare to other methods.

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CONCLUSION

In this study comparison between wavelet based and wavelets integrated fusion methods visually and statistically performed. Comparison and improvement of wavelet based image fusion is done using Graphical User Interface (GUI). Results showed that the method effectively retains the basic information and details of original image. The enhanced information carries of fused image and reduces the execution time as well as memory requirements. Future stage of this work will target on simulation to propose more effective fusion method applied on medical image fusion technique for optimization and evaluation criteria.

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