# Multimodal Medical Image Fusion Simulation Based on Matlab

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**Abstract:** Multimodal medical image registration and fusion technology is an important research content of medical image processing, which based on medical image registration. It overcomes the limitation of using a certain image alone, effectively reflects the medical image information of different modes on an image more intuitively, and provides abundant information such as human anatomy, physiology, pathology and so on. So provide more perfect image information for clinical diagnosis and treatment and improve the effectiveness and accuracy of diagnosis and treatment in order to facilitate clinical diagnosis and treatment. Multimedia medical image fusion is a new technology, which integrates medical image processing and medical image diagnosis. Its rapid development has a profound impact on the progress of medical imaging technology and clinical diagnosis and treatment. In this paper, several typical methods of multimedia medical image fusion used to carry out simulation experiments in Matlab environment, which provides a reference for professionals and non-professional followers in related fields.

## 1. Introduction

With the rapid development of computer technology and the arrival of information age, medical imaging has become an indispensable part of modern medical technology. Because the imaging principle of various imaging equipment is different, the images of different modes have their own advantages and limitations. In this context, making full use of the existing imaging equipment to study an image fusion technology, which can integrate the image information from different imaging devices and express it as a whole has been highly valued by the related fields. In this paper, the typical methods of multimodal medical image fusion analyzed, and the simulation experiments carried out in Matlab environment for professionals in related fields. Reference provided by staff and non-professional followers.

## 2. Fusion method of multimodal medical images

Medical image fusion method can divided into pixel level, feature level and decision level. At present, pixel level fusion is widely used. At the same time, it is the basis of the latter two fusion methods. This paper mainly studies pixel level method. According to its characteristics, fusion steps and basic principles, it can divide into two categories: spatial domain fusion method and transformation domain method. These two methods are independent of each other, and the combination of the two methods can achieve better fusion effect in many algorithms.

### 2.1 Commonly used multimodal medical image fusion methods.

There are many methods of multimodal medical image fusion. According to the domain of the image, it can divide into two categories: spatial domain fusion method and transform domain fusion method.

The spatial domain fusion method is to operate the pixel value of the image directly. This kind of method is simple, intuitive and easy to understand. The commonly used methods are pixel maximum / minimum fusion method, weighted fusion method and TOET fusion method. The pixel value maximum / minimum fusion method takes the maximum / minimum value as the pixel value



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of the fusion image respectively. the pixel value weighted fusion method is to multiply the pixel value of the fusion image by a weighted coefficient as the pixel value of the fusion image; the TOET fusion method takes the different parts of the two images as the background, highlights the image features, and fuses the features with different weights.

The transformation domain method is to transform the fusion image first, and then to fuse the fusion rules with different transformation coefficients. Finally, the fusion image has obtained by inverse image transformation. The commonly used image transformation methods are Fourier transform, wavelet transform, non-down sampling Contour let transform (nonsubsampled contour let transform, NSCT and so on.

### 2.2 Commonly used multimodal medical image fusion evaluation methods.

Subjective evaluation and objective evaluation are two kinds of evaluation methods commonly used in multimodal medical image fusion. Subjective evaluation is mainly through the human eye to evaluate the image quality after fusion; this evaluation method is simple and intuitive, but affected by the visual performance of the observer, emotional hobbies, knowledge status and other factors, with great subjectivity and uncertainty. Objective evaluation is the data measurement and statistical analysis of the fusion image. The evaluation method is relatively objective and accurate, but there is no general standard suiTable for all methods. The commonly used objective evaluation indexes are entropy based on information, cross entropy, mutual information, mean value based on statistical characteristics, standard deviation, and Average gradient, spatial resolution and other evaluation indicators. Among the above seven objective indexes, the greater the entropy and mutual information value, the richer the information contained in the fusion image, the better the fusion effect, and the smaller the cross entropy, the more information the fusion image obtains from the source image, the better the fusion effect. For the two indexes of mean value and standard deviation, the mean value is moderate, which indicates that the better the fusion effect is, the larger the standard deviation is, the more scattered the gray distribution of the fusion image is, the greater the contrast of the image is, and the better the fusion effect is. Each of the above two evaluation methods is excellent. The shortcomings can combine to evaluate the fusion image.

## 3. Multimodal Medical Image Fusion matlab Simulation Program

In this paper, the simulation experiments of multimodal medical image fusion carried out for the following fusion methods. The experimental results are as follows: two MRI and CT images have registered, as shown in Fig. 1 and Fig. 2.

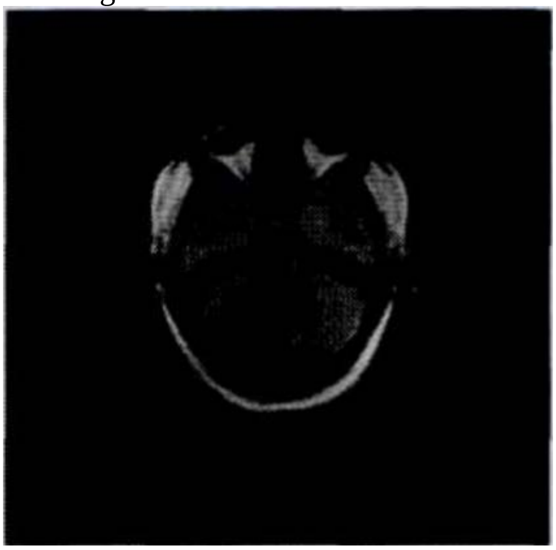

Figure 1. MRI images used in the experiment

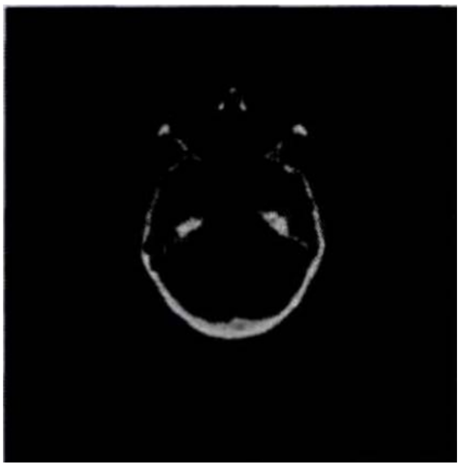

Figure 2. CT images used in the experiment

The program implementation and experimental results have described in detail below.

### 3.1 Pixel gray value maximum / minimum fusion method

```
% Image pixel gray value maximization method
for i=1:m1
for j=1:n1
If(abs(M1(i,j)) >= abs(M2(i,j)))
M3(i,j) = M1(i,j));
else if (abs(M1(i,j)<abs(M2(i,j)))
        M3(i,j)=M2(i,j);
end
end
end
```

### 3.2 Fourier transform method

The program code is as follows:

```
% Two-dimensional Fourier transform of image
     y1 = fft2(M1);
y2 = fft2(M2);
%Weighted fusion of transformation coefficients
y3=0.5*y1+0.5*y2;
y4=0.3*y1 +0.7* y2;
 % Fourier inversion
M3 = ifft2(y3);
M4= ifft2(y4);
% Data type conversion
M3 = im2uint8(M3);
M4 = im2uint8(M4);
```

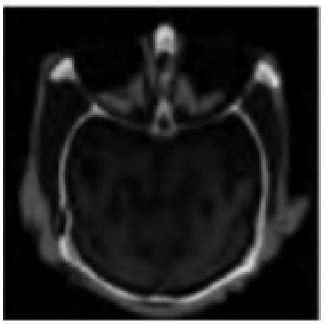

Figure 3. Fourier transform method

After the fusion method is determined, it realized concretely. Taking the wavelet transform fusion method as an example, the wavelet basis, the number of wavelet decomposition layers, the parameters of low frequency and high frequency fusion rules are obtained at first, and then the wavelet coefficients are obtained by wavelet decomposition of the fusion image under the corresponding parameters. Finally, the wavelet coefficients are fusion.

The code is as follows:

elseif get(handles.radiobutton3,'value')//Select the radio button to perform wavelet transform fusion

wstyle = get_pop_String(handles.wavelet);//Get wavelet type

numstr = get_pop_String(handles.canshu);//Get wavelet basis

wname = strcat(wstyle,numstr);//By connecting the function of the string, the parameters of the wavelet basis are obtained.

levelm = get_pop_String(handles.level);//Get the number of wavelet decomposition layers

leveln = str2num(levelm);//Convert the decomposition layer digital string to a numerical value

appnum = get_pop_String(handles.approx);//Get low-frequency fusion rules

detnum = get_pop_String(handles.details);//Get high frequency fusion rules

tree_1 = wfustree(X1,leveln,wname);//Modal 1 wavelet decomposition

tree_2 = wfustree(X2,leveln,wname);//Modal 2 wavelet decomposition

[Isize,tree_F] = wfusdec(tree_1,tree_2,appnum,det一num);//Wavelet fusion

Finally, the fusion effect evaluation is carried out, and the sub functions of each evaluation index are calculated by calling the sub functions of each evaluation index in the callback function of the “effect evaluation” button. One index value and then pass the index value to each indicator text box.

## 4. System simulation results

CT and MRI are two common medical image modes. In CT images, the bone tissue with high density is clear and the soft tissue with lower density is dark. In MRI images, bone tissue imaging is darker and soft tissue imaging is bright. Therefore, the image information of these two modes is complementary. It is also the most widely used in medical image fusion. In this paper, the CT and MRI images of the brain after registration taken as examples to show the simulation results of the system. Fruit the fusion results under different methods shown in the figure below. From the subjective evaluation point of view, the fusion results of figs. 3, 4 and 5 contain rich information about CT and MRI, and the fusion effect is better. From the objective evaluation point of view, pixel maximum method, wavelet transform method in entropy, standard deviation, average gradient and spatial resolution of the four indicators obtained a higher value. Its mean value is also relatively moderate image pixel value range is (0255) pixels. Compared with other small values are more moderate, according to this index can be judged pixel value maximization method, wavelet transformation method is better, and the main image pixel value is relatively moderate. According to this index, the wavelet transform method has a better fusion effect with the main image. The evaluation is consistent. According to the mutual information index, the pixel maximum method has the best fusion effect, while according to the cross entropy index; the wavelet transform method has the best fusion effect.

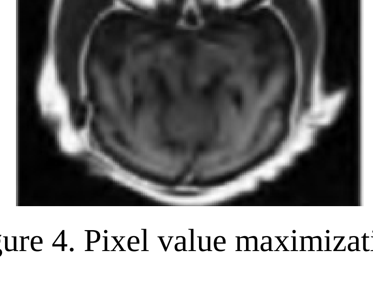

Figure 4. Pixel value maximization.

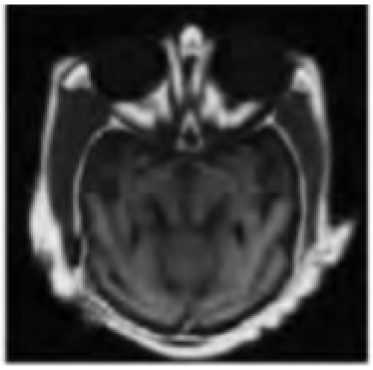

Figure 5. Wavelet transform method

## 5. Summary

Multimodal medical image fusion technology is an important branch of medical image processing technology. Multimodal medical image fusion is also an important research direction of medical image processing, which has a wide range of applications in clinical diagnosis, radiotherapy, surgical planning and so on. It has a wide range of application prospects in clinical diagnosis and treatment, computer-aided diagnosis, telemedicine, radiotherapy and surgical planning, and plays an important role in promoting the progress and development of medical imaging. Under this background, this paper analyzes the typical methods of multimodal medical image fusion, and gives a simulation example in Matlab environment, which is specialized in related fields. Industry personnel and non-professional followers have certain reference value. The system realizes the visualization of the commonly used multimodal medical image fusion methods and evaluation indexes, and has good interaction, practicability and expansibility. It can not only provide a reference for the teaching of medical image processing in biomedical engineering, medical imaging technology and other related specialties, but also provide the basis for clinical diagnosis of doctors.

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