Multimodal Medical Image Fusion Simulation Based on Matlab

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Abstract:

It is a prominent research topic in the area of medical image processing to explore medical image registration and fusion technology, which is based on medical image registration. Aside from being able to overcome the limitation of just using a single photo, it properly depicts the medical image information of the patient.more organically, and it provides a plethora of information, such as human anatomy, about the different image settings.Anatomy, physiology, pathology, and other related subjects are all addressed in this course. As a consequence, more detailed image information for clinical applications is provided.an approach to diagnosing and treating that increases the effectiveness and accuracy of diagnosis and therapy in the realm of medicine.in order to make clinical diagnosis and treatment easier to understand Multimedia medical image fusion is a relatively new method that was developed in the 1990s.A system that combines medical image processing and medical image diagnostics into a single package is known as medical image fusion. It's a rather short process.The growth of medical imaging technology and clinical practise is significantly influenced by developments in the field of development.The importance of diagnosis and treatment cannot be overstated. It is described in this study how typical techniques to multimedia medical image fusion might be improved upon.Incorporated into the Matlab environment to carry out simulation studies; this acts as a reference for other simulation investigations.Professionals and non-professionals in related areas are both invited to participate.

1. Introduction

In recent years, the rapid advancement of computer technology, along with the onset of the information age, has led in medical imaging becoming an increasingly significant component of current medical technology. In addition, In part due to the fact that the imaging principles used by different types of imaging equipment are varied, the images generated by different modes have their own individual properties.There are pros and cons to doing business online. When working in this environment, it is critical to make full use of the present imaging equipment to its fullest capacity.Image fusion technology, which can combine visual information from a range of disparate sources, should be investigated.It has long been acknowledged that the capacity to visualise items and represent them as a whole is highly valued by those working in related fields. The objective of this research is to find out more aboutThis section contains an examination of common multimodal medical image fusion methodologies, as well as simulations of real-world medical picture fusion scenarios.For the purpose of conducting the search for professionals in relevant areas, a Matlab environment was employed. A reference has been provided by a member of the staff.as well as fans who are not professionals

2. A strategy for merging multimodal medical images in a single image.

There are three layers to the technique used in medical picture fusion: at the pixel level, at the feature level, and at the decision-making level. AtPixel-level fusion is currently widely used in a variety of applications. At the same time, it acts as a basis for the two fusions that come after it.methods. As the name implies, the major emphasis of this investigation is on the pixel level method. Fusion operations are carried out in accordance with the material's qualities.Based on its essential concepts, it may be separated into two groups: the method of spatial domain fusion and the technique of spatial domain fusion.Transformation of the domain using a method There is no connection between these two operations, and they are absolutely different from one another.It is possible that, in many algorithms, a combination of the two procedures will provide a better fusion result than each strategy alone.

2.1 Methods of multimodal medical image fusion that are often used in clinical practise.

A number of methodologies may be used to achieve multimodal medical picture fusion. Here are some examples. This varies depending on the topic matter of the article.In the field of spatial domain fusion, there are two kinds of approaches available: spatial domain fusion technique and transform domain fusion methodology.method.A difference between the spatial domain fusion approach and other techniques is that it acts directly on the pixel value of the image. This is the kind of thingThere is nothing complicated about this method; it is obvious and easy to understand. Pixel techniques are the most often used approaches.There are many different fusing techniques, but some of the more common ones include the maximum/minimum fuse technique, the weighted fuse method, and the TOET fuse method. The pixel is a tiny square of colour that is used to represent information.It is decided by applying the maximum / minimum value fusion approach, which takes the maximum / minimum value as its input, that the pixel value is calculated.

as a result, in line with the fusion representation Using a weighted coefficient that is equal to or greater than the value of the second picture, it is possible to merge two photos; however, this method is time-consuming and requires specialised knowledge. combine two photographs by using various portions of both images as backdrops and highlighting the most interesting elements from each image Using a weighted coefficient with the same value as the first picture, you may blend two photos together. If you want to combine two photos, use two images; if you want to combine two images, use two imagesthen assembles the components using a variety of weights to get the desired picture attributesIn order to fuse the fusion image in the transformation domain approach, as previously mentioned, it is required to modify it before fusing it.For the fusion rules to provide the required outcomes, they make use of a variety of transformation factors.

Finally, the fusion picture has been created by fusing together a large number of diverse photographs.The process of reversing the direction of a picture is known as inverse image transformation. Fourier transforms are among the most widely used techniques in the area of image processing, accounting for around a quarter of all applications.To mention a few examples of transformations, there are the transform, the wavelet transform, and the non-down sampling method. contours allow for metamorphosis to take place (contour that is not subsampled)The phrases transform, NSCT, and other similar expressions are acceptable.Methods for multimodal medical image fusion assessment, which are often utilised, are detailed in Section 2.2 of this document.Generally speaking, there are two basic types of evaluation methods: subjective assessment and objective assessment, and each has its own advantages and disadvantages.a strategy for integrating multimodal medical imaging that is utilised in medical imaging The bulk of subjective judgments are made with the aid of the human eye, which is the most powerful tool available.examine and evaluate the picture quality after fusion. This examination and evaluation approach is simple and straightforward, but it is hampered by the fact that the image quality after fusion is not consistent.in accordance with a variety of factors such as the spectator's visual performance, emotional interests, knowledge level and other factorsthat is markedly subjective and ambiguous in its presentation The objective evaluation approaches that were employed in this research were statistical analysis and data measurement.the evaluation of the fusion image the analysis of the fusion image Despite the fact that the assessment approach is largely neutral and trustworthy, there are certain limitations to the method of evaluation.Unfortunately, there is no suiTable that is universally applicable and can be used to all techniques. According to the most widely accepted practise, the objective assessment indicators listed below are used to make decisions:It is possible to quantify entropy in a number of different methods, including information-based entropy, cross-entropy, mutual information, and the mean value of statistical data.

The features, standard deviation, average gradient, spatial resolution, and other assessments are all covered, as well as the standard deviation and average gradient.indicators. In general, the bigger the entropy and mutual information, which are two of the seven objective indices listed above, the greater the amount of information available.The higher the quality of the fusion, the larger the information value of the fusion image and the greater the level of detail of the information included in the fusion picture. fusion picture image of fusionThey give more information when fusion images are formed from source data with low cross entropy than when fusion pictures are created from source data with high cross entropy.The quality of the source picture has a direct influence on the quality of the fusion result, as does the amount of noise in the source image. It is important to compute the mean value and the standard deviation, which are two separate markers of statistical significance.Assuming that the mean value is only moderate, it follows that the greater the efficiency of the fusion effect, the greater the mean value will be.The bigger the standard deviation of the fusion image and the more scattered the grey distribution of the fusion image are, the more extensive the grey distribution of the fusion image is.According to the fusion effect, the efficiency of the effect is proportional to the amount of contrast present in the image that is being processed. Each of the two evaluations mentioned above is a separate evaluation in its own right.Methods is a fantastic technique to put to use. In order to generate a more full view of the fusion picture, it is possible to merge many faults.

3. Multimodal Medical Image Fusion matlab Simulation Program

In this study, the simulation experiments of multimodal medical picture fusion are carried out for the fusion techniques listed below, and the results are presented. The following are the findings of the experiments: It has been determined that two magnetic resonance imaging and computed tomography (CT) pictures have been registered, as illustrated in Figs. 1 and 2.

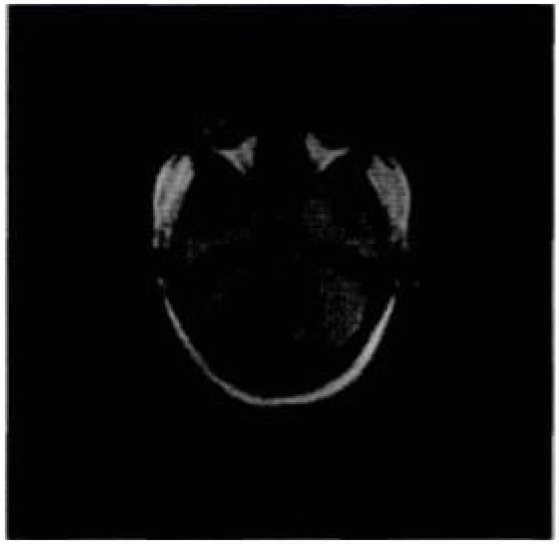
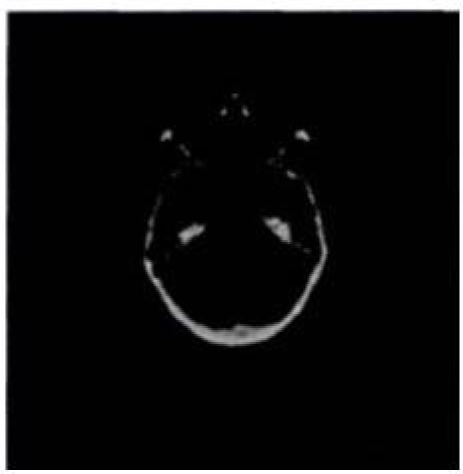


Figure 1. MRI images used in the experiment



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);
```

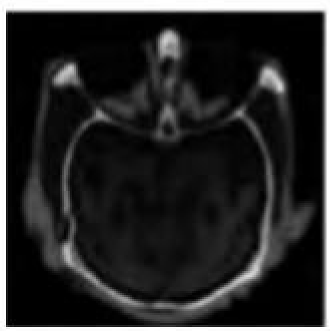


Figure 3. Fourier transform method

4. System simulation results

CT scanning and magnetic resonance imaging (MRI) are two examples of medical images that are often used. It is possible to view bone tissue with a high density in CT scans, but it is not possible to discern soft tissue with a low density in the images. In MRI images, bone tissue looks darker than soft tissue, whereas soft tissue appears brighter than bone tissue. Consequently, the visual information obtained from these two modalities is identical to one another.complimentary. Furthermore, it is the most widely used technique of medical image fusion in the world. The CT and MT are both mentioned in this piece of writing.Examples of MRI brain images after registration were used to highlight the simulation results of the study.system. As seen in the illustration below, the fusion of fruit may occur under a number of settings. In the aftermath of theThere is a considerable lot of information in the fusion results shown in figures 3, 4, and 5 when viewed from the standpoint of subjective judgement.When it comes to CT and MRI scans, the fusion result is much better than the individual scans. Pixels are essential from the perspective of objective evaluation.In terms of entropy, standard deviation, average gradient, and other metrics, the maximal approach and the wavelet transform technique outperform each other.It was discovered that the spatial resolution of the four indicators was larger than the other three indications. Its mean value is also regarded to be relatively low by most standards.When it comes to image pixel values, the (0255) range offers a limited selection. The significance of these numbers increases when contrasted to other small figures.It is possible to classify the pixel value maximisation strategy and the wavelet transform as moderate using this criteria.The transformation strategy is preferable, and the primary image pixel value has just a little amount of relevance in terms of the whole picture value. AccordingAccording to this measure, the wavelet transform strategy achieves a greater fusion effect with the main image than the other ways when compared to the others. TheThroughout the procedure, consistency is maintained. According to the mutual information index, the pixel maximum method has the greatest mutual information index of all the approaches.The wavelet transform approach has the best fusion effect, according to the cross entropy index; nevertheless, the wavelet transform methodology has the worst fusion effect, according to the fusion effect.the highest powerful fusion effect possible.

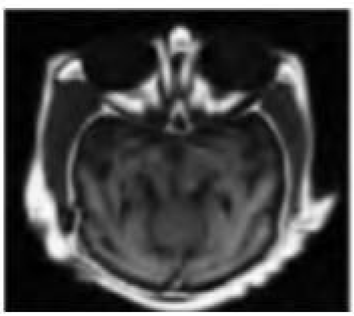


Figure 4.Pixel value maximization.

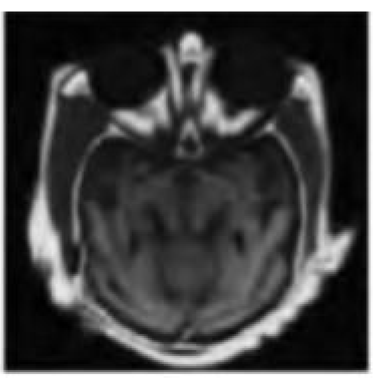


Figure 5.Wavelet transform method

5. Conclusion:

Multimodal medical image fusion technology is a branch of medical image processing technology that is becoming more important in today's world of information technology. In medical image processing, fusion of multimodal medical images has emerged as a key research topic. It has a variety of applications in clinical diagnostics, as well as in research and developmental activities.As an example, radiation therapy, surgical planning, and so forth. This compound has an extremely wide range of possible therapeutic uses in the therapeutic context.Diagnostics and treatment, computer-assisted diagnosis, telemedicine, radiation therapy, and surgical procedures are just a few of the disciplines that are offered to patients.It is essential in supporting the progress and development of medical research and technology, and it plays a crucial part in this process.imaging. In light of this setting, the purpose of this research is to investigate the most frequent methods of multimodal medical therapy.pictures, as well as a simulation example in the Matlab environment, which is highly specialised in this subject, are included.areas that are important to the discussion Both industry insiders and non-industry observers have a certain level of reference value. TheViewing of the most often used multimodal medical image fusion procedures in the medical profession is made possible via the usage of the system.It has high interactivity, practicability, and expansibility, but it also has high evaluation indices, which is a rare find in this field. It has the capacity to not only increase but also decreasea resource for the teaching of medical image processing at biomedical engineering colleges and universitiesAdditionally, they serve as the basis for clinical research, in addition to providing medical imaging technology and other relevant specialties.Doctors arrive at their conclusions.

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