# Research on a Biological Image processing algorithm based on big data Technology

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**Abstract:** In order to solve the problems of serious loss of detail and poor visual effect in the process of medical image fusion, a pulse coupled neural network medical image fusion algorithm based on non-subsampled contour transform and discrete wavelet transform is proposed in this paper. First of all, the medical source image is transformed by non-subsampling contour transform, and the corresponding low-frequency and high-frequency subbands are obtained, and the low-frequency subbands are transformed by discrete wavelet transform. Then, the pulse coupled neural network is used to fuse the low frequency subband, and the average gradient and the improved Laplace energy sum are taken as the input items of the pulse coupled neural network, and the fusion method of information entropy and matching degree is used for the high frequency subband. Finally, the fused low-frequency subband and high-frequency subband images are transformed by multi-scale inverse transform to get the fused image. The experimental results show that this method can effectively improve the contrast of the fused image and retain the details of the source image, and has excellent performance in both subjective and objective evaluation.

## 1. Introduction

Multimodal image fusion provides more comprehensive and complex information for modern medical diagnosis, remote sensing, multi-focus image, video surveillance and so on. As a powerful basic tool, medical image plays an irreplaceable role in modern medical diagnosis and treatment. Computed tomography (CT), magnetic resonance imaging (MRI), positron emission computed tomography (PET)) and single photon emission computed tomography (SPECT) are several common medical imaging modes, which are often used to deal with different conditions of lesions [2-3].

In order to make the fused medical image contain more valuable information, a PCNN medical image fusion algorithm based on NSCT and DWT is proposed in this paper. NSCT has a good effect in dealing with image texture edges, and DWT has a strong ability to express image details. These two multi-scale decomposition methods are complementary. The combination of NSCT and DWT is used to effectively retain image texture edges and details. In addition, the pulse-coupled neural network is used to fuse the low-frequency subband, and the average gradient (AG) and the improved Laplace energy sum (ISML) are used as the inputs of the pulse-coupled neural network to improve the overall visual effect of the fused image. For the high-frequency subband, a fusion scheme combining matching degree and information entropy is adopted to enhance the detail features of the fused image.

## 2. Image fusion algorithm

The flow chart of the algorithm proposed in this paper is shown in figure 1, in which one source image is An and the other is B. First of all, after NSCT transform, medical source images An and B can get the corresponding low-frequency and high-frequency subbands. Because the low-frequency subbands contain a lot of information, combined with the advantages of DWT in processing detailed information, the low-frequency subbands are decomposed by DWT to retain the information that is easy to be ignored by NSCT decomposition. Then, combined with the advantages of PCNN in image global feature fusion, a fusion scheme using PCNN in low frequency subband is proposed, and ISML and average gradient are taken as the input items of PCNN. The fusion rule is determined by comparing the difference of ignition times with the set threshold. If the difference of ignition times is less than the threshold, the fusion low frequency subband adopts adaptive weighted average, otherwise, the fusion low frequency subband is selected with larger ignition times. The high-frequency subband adopts the fusion scheme of the combination of information entropy and matching degree to retain the edge details of the image. finally, the fused low-frequency subband and high-frequency subband are processed by multi-scale inverse transformation. it makes the edge details of the fused image richer and has a good visual effect.

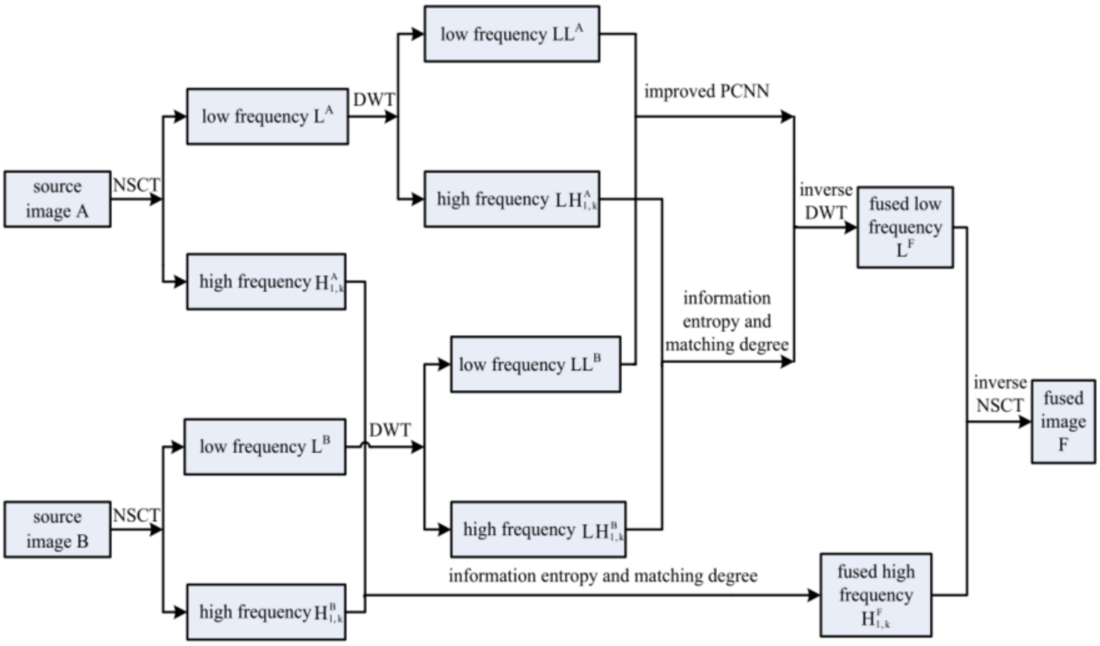


Figure 1 The algorithm flow chart of this paper

## 3. Results and analysis of experimental results

### 3.1 Experimental setting

In order to verify the feasibility and effectiveness of this algorithm, two types and six different groups of human brain tissues are selected from the whole brain atlas (The whole Brain) of Harvard Medical College as source images: (1) CT/MRI gray image fusion, (2) MRI/PET color image fusion, the sizes of medical images used in the experiment are 256x256 and have been accurately registered. The experiment in this paper is simulated under the operating system environment of Intel Core I5-9400FCPU and 64-bit Win7, and the programming environment is Matla2016b.

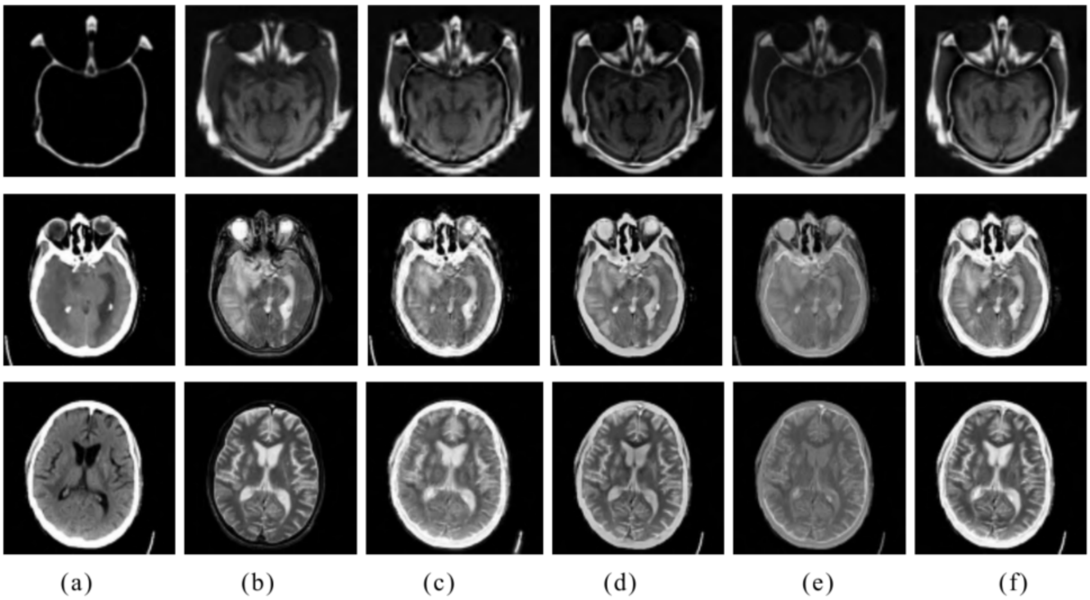

Figure 2 CT/MRI source image and image fusion results of different methods (a) CT image (b) MRI image (c) algorithm-(d) algorithm two (e) algorithm three (f) algorithm

### 3.2 Grayscale image fusion

The algorithm in this paper and other image fusion algorithms proposed in recent years are simulated respectively, and evaluated from both subjective and objective aspects through comparative analysis. Three contrast algorithms are used in the experiment, which are: algorithm 1: medical image fusion algorithm based on NSCT transform, which selects local Laplace energy sum for low frequency subband fusion and directional contrast for high frequency subband fusion [23]. Algorithm 2: medical image fusion algorithm based on NSST transform, this algorithm applies the region maximum comparison method to the fusion of low frequency subbands, and takes the improved edge intensity method and edge energy method as the fusion of high frequency subbands; algorithm three: medical image fusion algorithm based on DWT transform, which adopts the fusion rule of local energy for low frequency subbands, and uses the coefficient comparison method as the fusion of high frequency subbands. The algorithm of this paper is as follows: based on the PCNN medical image fusion algorithm of NSCT and DWT, a fusion scheme of low-frequency subband using PCNN is proposed, ISML and average gradient are taken as the input of PCNN, and the fusion scheme of information entropy and matching degree is adopted in high-frequency subband.

In the experiment, three different groups of CT/MRI source images are selected and fused with the above three algorithms and this algorithm respectively, and the fusion results are shown in figure 2. First of all, the quality of the fused image is evaluated subjectively: figure (c) is the effect image realized by algorithm one. The fused image is relatively clear as a whole, but there is obvious blur at the edge of the target. The enlarged image can be seen to have Gibbs distortion through the human eye, so the details of the focus can not be displayed correctly. Figure (d) is an effect image realized by algorithm 2. From the fusion results, it can be seen that the brightness of the bone region is low and the contrast of the fused image is low, which can not truly reflect the overall information of the source image. Figure (e) is a fusion image realized by algorithm 3. From the fusion results, it can be seen that the fusion image quality of this method is slightly lower than that of the former two methods. Compared with the original CT image, the fusion result is blurred, the edge of the fusion image is distorted, and the human visual effect is poor, which is easy to affect the doctor to make an accurate judgment of the disease. Figure (f) is the fusion image realized by this algorithm, it can be seen that the algorithm can effectively extract the texture and edge details of the source image, can comprehensively integrate the content of CT image and MRI image, has a good overall visual performance, and achieves a better fusion effect.

Subjective evaluation is subjective and visual sensitivity varies from person to person. Although the fusion result can be judged directly, the evaluation result is one-sided and needs to be judged by comprehensive objective evaluation indicators. This paper selects four indicators: information entropy (IE), average gradient (AG), spatial frequency (SF) and standard deviation (SD) to evaluate, and they are all positive indicators. The performance of the above three groups of fused images in objective evaluation indicators is shown in Table 1.

Table 1 The first group of image evaluation indicators

| Method | Evaluation Indicators | | | |
|---|---|---|---|---|
| | IE | AG | SF | SD |
| Algorithm 1 | 6.5498 | 6.8525 | 16.5593 | 58.6421 |
| Algorithm 2 | 6.3269 | 6.4023 | 16.8470 | 50.7436 |
| Algorithm 3 | 5.8516 | 4.7560 | 9.4149 | 43.6581 |
| Proposed | 6.8415 | 7.2316 | 17.1296 | 57.6361 |

## 4. Conclusion

In this paper, a PCNN medical image fusion algorithm based on NSCT and DWT is proposed. Using the PCNN method to fuse the low-frequency subband can improve the overall visual effect of the fused image; for the high-frequency subband, the fusion method of the combination of information entropy and matching degree is used to enhance the detail features of the fused image. The experimental results show that this method has certain advantages in many objective evaluation indexes such as IE, AG and SD, and is more consistent with the image observation of human vision system in visual effect. It is an effective medical image fusion method and can provide more sufficient and reliable information for clinical diagnosis.

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