

Analysis and implementation of image fusion technology based on simulation software

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Abstract. Affected by the environment and equipment, it is not possible to use the camera or sensor to complete the expression of environmental information, if multiple images are used, a large amount of image information will be generated, which is not conducive to data processing, and image fusion technology can solve this problem. In order to improve the image fusion effect, the main PCA analysis algorithm was adopted in the extraction of image information fusion. Through the multi image information extraction and matching, the fused image can be more complete expression of the main information of multiple images. In order to verify the reliability of the algorithm, Matlab software simulation software has been used in different gray level image fusion, the fusion has been preserving image details better, and the image fusion effect is even higher than that of the original definition to any image, which can verify effectively the reliability of PCA image fusion algorithm.

Introduction

Due to the restriction of environmental factors and digital products, it is impossible to record all the information in the actual scene with a camera or a sensor. For example, the brightness of the scene and the camera's sensitivity range is very large, the color of the scene is also much higher than the camera. In order to solve this problem, on the one hand, we can improve the photosensitive range And the color richness of digital products through continuous technical upgrading, but the cost of this method is enormous. On the other hand, it can also make the processed image contain more information and improve the quality of the image through image fusion. The PCA analysis method is to obtain the main information of the image through image segmentation and data processing, which provides more effective information for image fusion and matching. It is of great significance to the processing of gray level images.

The basic principle of multi exposure image fusion

It is different that information amount contained in each image of the multi exposure image. If the image with different amount of information is fused, the more complete information fused image can be obtained, if this method is applied to remote sensing information acquisition and image processing technology, it will greatly improve the speed and efficiency of information collection. Image fusion technology is generally the synthesis of two images, most theoretically can make n images synthesis, the basic principle is shown in figure 1.

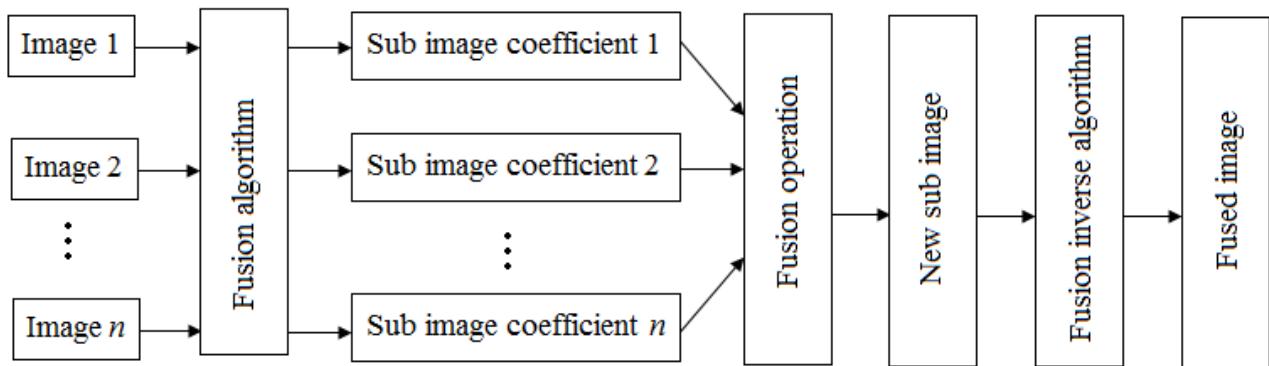


Fig. 1 The basic principle block diagram of image fusion

Figure 1 shows the basic block diagram of image fusion technology, the algorithm is divided into a number of steps, the main steps are as follows:

(1) preprocessing image by image thinning, denoising and enhancement processing to unified format, the image size and resolution is set to the same, which is convenient for 3D reconstruction, according to the mathematical model of reconstruction, fusion target setting.

(2) the feature points are selected to be fused and matched, and the fused image is segmented by region. The image is divided into small areas according to the feature points.

(3) the image principal component analysis (PCA) is used to register the image, and the threshold of registration error is set on time.

(4) to create a fusion image, in the same information coordinate system, to create the fusion image of the two and more images, so that the information of multiple images together to make the image more clear.

(5) from the qualitative and quantitative analysis of image fusion, the image fusion effect is evaluated, and the improved scheme is proposed.

PCA fusion algorithm for exposure image processing

In order to make multiple exposure images can be fused, we need to extract the principal components of each image, that is PCA conversion. The principle of this method is orthogonal transformation, it can handle a variety of variables. In dealing with practical problems, there may be many variables, this increases the difficulty of image fusion, but in image fusion, there is a certain relationship between many variables. Assuming that the source data fusion image information can be stored as matrix form, specifically as follows:

$$X = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mm} \end{bmatrix} = [x_{ik}]_{m \times n} \quad (1)$$

The source data of the fused image information can be processed as a matrix, and the image can be processed by linear transformation

$$Y = TX \quad (2)$$

In formula (2), Y is the transformed matrix, T is the linear transformation of the matrix, the main components of the image can be extracted through the transformation.

In order to verify the effect of image fusion, we need to evaluate the effect of image fusion, and the evaluation result can be tested by the root mean square error (RMSE) between the fused image and

the standard image.

$$RMSE = \sqrt{\frac{\sum_{i=1}^m \sum_{j=1}^n (R(i, j) - F(i, j))^2}{M \times N}} \quad (3)$$

In formula (3), M and N respectively represent the image number of rows and columns, respectively, the source image and the fused image, if the numerical calculation is small, it means better image fusion effect, to further investigate whether the image contains noise, but also through the peak detection ratio, the expressions for noise peak ratio is the formula (4).

$$PSNR = 10 \lg \frac{255 \times 255}{RMSE^2} \quad (4)$$

The higher the PSNR value, the better the fusion effect.

Simulation of image fusion based on Matlab software

In order to verify the effect of different gray level multi exposure image fusion, the Matlab software is used to fuse the image, and the algorithm is verified. Before the fusion process, four completely different exposure images were selected, as shown in figure 2.



Fig. 2 Multi exposure images with different gray levels

As shown in Figure 2, using Matlab simulation software, the PCA algorithm is used to fuse the multi exposure images with different gray levels. The fusion of 4 images is realized by numerical simulation, the fusion image is shown in figure 3.



Fig. 3 Effect of fused image

As shown in Figure 4, using Matlab image fusion, the fusion effect is very good, its clarity and light are better than any one of the 4 images. This shows that the fused image, the fusion image contains information than any one image, which verified the feasibility of PCA algorithm in image fusion, provides a reliable method for the application of image fusion algorithm in practical engineering.

Conclusion

In order to solve the problem of multi exposure image information loss, a PCA principal component extraction and analysis algorithm is introduced, and it is used in multi exposure image information fusion algorithm to realize the fusion of multi exposure images. In order to verify the feasibility of using PCA algorithm in image fusion, the algorithm is simulated by Matlab simulation software. Based on the principle of image fusion, the fused image is obtained by principal component extraction and multi image fusion. Through the analysis of the fused image, it is found that the information contained in the fused image is more complete and the image is clearer.

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