An Improvised Multi Focus Image Fusion Algorithm Through Quadtree

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Abstract:The main motto of multi-focus image is to combined different partially focused image in single one throughout the image (means in fused image). Here Authors are proposing a new concept i.e quadtree-based algorithm where we divide the image into 4 equal parts for further processing. Here we will divide image into small block size for further process. The region can be detected with the help of focus-measured using weighted value. Finally, we will add all the small block which we processed previously with the help of modified Laplacian Mechanism. For comparison with previous fusion algorithm we compare with two important values i.e. SSIM & ESSIM value. After looking these values, we can say that proposed algorithm has better value.

Keyword: Multi-focus image fusion, Quadtree decomposition strategy, Quadtree structure, modified Laplacian, SSIM, ESSIM

I. INTRODUCTION

In scientific microscopic imaging or in a general photograph, a single image usually cannot represent all objects of interest, since an optical system is limited by depth of field [1]. Multi-focus image fusion is considered a good solution to this problem as it is suitable for generating a single image from multiple source images and is aimed at providing a more accurate description of certain objects, or a combination of information, to meet a particular human or machine perception requirement [2]. Meanwhile, multi-focus image fusion is also a hot research topic since many proposed multi-focus image

fusion methods have been efficiently applied in various fields such as remote sensing and medical imaging. During the last few decades, a large number of image fusion methods with various fusion frames have been proposed [3] that can be applied to multi-focus image fusion.

BASIC METHODS OF IMAGE DATA FUSION

The images get in the environment of ubiquitous computing, because of the complexity and their stronger relationship of image information itself, incomplete and inaccuracy, unstructured as well as difficulties in modelling will occur at all layers of the process of image fusion. Artificial intelligence applies to image pervasive fusion, with the better results than traditional methods of calculation (that is, the use of precise, fixed and unchanging algorithm to express and solve the problem), can integrated with their respective advantages, compose intelligent fusion system, expand their original function. Therefore, it is a pervasive image fusion method with huge potential, the main intelligent methods as follows:

NEURAL NETWORK

In recent years, neural network theory is a cutting-edge research field in artificial intelligence, suitable for non-linear modelling, with self-learning, self-organization, adaptive capacity, and higher accuracy, have good generality and flexibility for different object modelling, but the structure is complicated, not suitable as the steady-state model of optimization method for complex systems.

FUZZY THEORY

In recent years, fuzzy theory has begun to apply to the field of data fusion, because fuzzy theory provides an effective methods to express uncertainty and inaccuracy of in-formation, thus can establish the corresponding mathematical model to a lot of uncertainty data in data fusion issues; Meanwhile, fuzzy set theory can deal with knowledge digitally, with a way similar to the thinking of people to construct knowledge, therefore, it has a advantage of computing with clear and easy to understand.

ROUGH SET THEORY

Rough set theory has not only provided new scientific logic and research methods for the information science and cognitive science, but also provided an effective treatment technology to intelligent information processing. Rough set theory has abilities of analyzing, reasoning for incomplete data, and finding the intrinsic relationship between the data extracting useful features and simplifying the information processing, so the using of rough set theory on the image fusion is a subject worth exploring.

IMAGE FUSION CATEGORIES

Image fusion can be grouped into following categories:

Pixel Level

In pixel level fusion the source images are fused pixel-by-pixel followed by the information/feature extraction.

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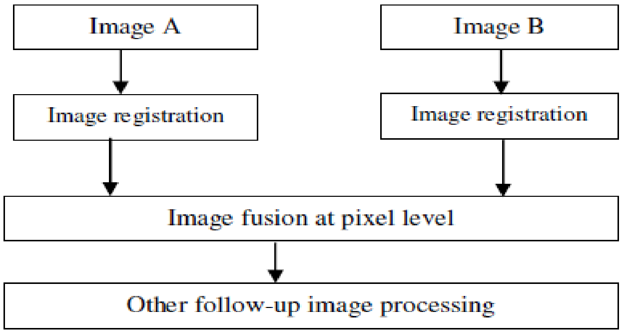


Figure 1: Pixel level fusion

Feature Level

In feature level fusion the information is extracted from each image source separately then fused based on features from input images.

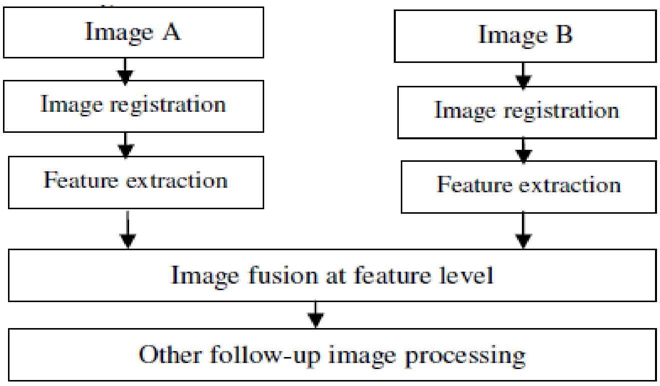


Figure 2: Feature level fusion

II MULTI-FOCUS IMAGE FUSION

The Researchers have proposed various methods for the fusion of multi-focus images. Literatures also describe many algorithms and tools for the same. Based on this literature study, the process of image fusion can be categorized into - frequency (transform) domain and spatial domain methods. Frequency domain methods involve an image undergoing multiple levels of resolutions, followed by various manipulations on the transformed images whereas spatial domain methods work directly on the pixel values. Both these methods can employ either of the three fusion methods namely pixel level, feature level and decision level.

2.1 Frequency domain methods

Frequency domain methods initially decompose the input images into multi-scale coefficients. Thereafter, various fusion rules are employed for the selection or manipulation of these coefficients that are then synthesized via inverse transforms to form the fused image. The essential characteristic of the frequency domain methods is to avoid blocking effects in the images.

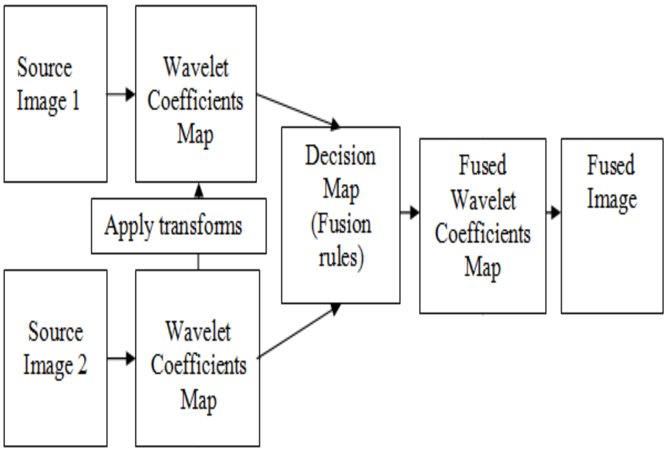


Fig.3. Frequency domain image fusion process

2.2 Spatial Domain Methods

Spatial domain fusion method work directly on the source images, weighted average is one of the simplest spatial domain methods, which doesn't need any transformation or decomposition on the original images.

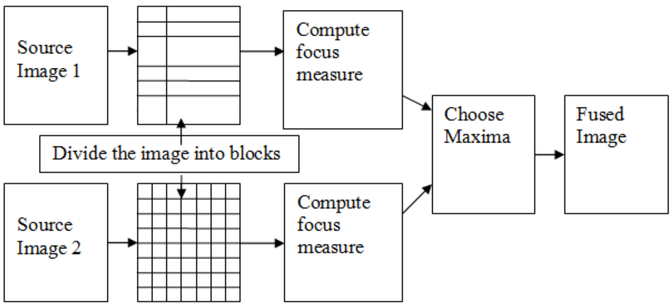


Fig.4. Spatial domain image fusion process

This method is advantageous because, it is simple and fit for real-time processing. The spatial domain is further improved by computing the degree of focus for each pixel or block using various focus measures. Figure-4 illustrates the spatial domain image fusion process.

Note: Guided Image Filtering Theory Guided filters have been successfully employed in many image processing applications, especially in image fusion. Some image fusion methods with guided filters have obtained positive results. A guided filter is applied to optimize the fusion weight map in these existing methods.

III. LITERATURE SURVEY

Pixel-level image fusion scheme based on steerable pyramid wavelet transform using absolute maximum selection fusion rule

The author's conclusion when the images are free of any noise and others, they are contaminated with zero mean white Gaussian noise. From experiments, we have seen that the proposed method performs better in all respects.

Performance is evaluated on the basis of qualitative and quantitative criteria. The main reason for using steady pyramid wavelet transforms in image fusion is its shift inversion and rotation inversion nature.

Optimization of Image Fusion Using Genetic Algorithms and Discrete Wavelet Transform

Here author concludes that a pair of "original" solutions is selected for reproduction from the previous selection pool. A new solution is created by producing "child" solutions using crossover and / or mutations. New candidate solutions are selected and the process continues until a new population of suitable size solutions is produced. The given technique is more accurate and improves the aspect of loss of information which is the fault of many other techniques. When incorporating efficiency from the Extraction Extraction technology and PLGA_IF from DWT_IF, the results improve the accuracy of the fused image, which can be beneficial for weather forecasts.

Multispectral and panchromatic image fusion Based on Genetic Algorithm and Data Assimilation

Here author concludes that most fusion algorithms for multispectral and punch chromatic images such as: major component analysis, contrast pyramid decomposition, IHS method, brow method, PCA method, waveform, Gaussian-Laplace pyramid, and so on, their Fusion rules cannot be adjusted favourably according to the purpose of the fusion image. In order to solve this problem, assimilation assimilation has been introduced in the meteorological area. This means that observational data and numerical simulation data are more integrated in nature to achieve analysis results. Fusion based on data assimilation and genetic algorithm was introduced for multispectral and pancreatic image.

IV. PROPOSED METHOD

The main requirement of the fusion process is to identify the most significant features in the input images and to transfer them without loss of detail into the fused image.

1. **Take Image 1 using imread function**

2. **Take Image 2 using imread function**

3. **Combine those images**

(a) Take dimension of images using size (img)function

```
NormDim = align(p1, p2);
```

(b) Check if the maxDim == 2048, exit the program

4. **Initialize the step, threshold and block size(Proposed parameters)**

```
step = 1; T = 5; bsz = 17;
```

5. **Compute the modified laplacian gradients of the images**

```
Grads = zeros(p1, p2, num);
for kk = 1 : num
img = mImg( : , : , kk);
Grad = mlap(img, step, T, bsz);
```

6. **First, compute the modified Laplacian gradients(Proposed Technique)**

7. **Image Fusion initialize the fusion image**

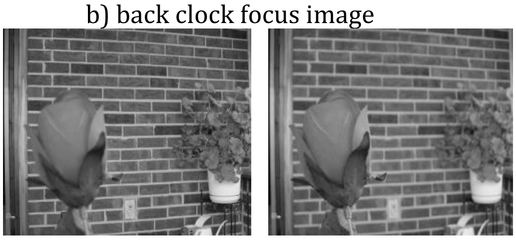
```
fimg = zeros(p1,p2);
```

8. **Extend images**

(a)Extend mImgs and Grads to maxDim(2 ^

(a) (b)

Figure1: a) front clock focus image
b) back clock focus image



(a) (b)

Figure 2: a) back flower focus image
b) front flower focus image

Image	SSIM	ESSIM
Clock	0.9834	0.9988
Pepsi	0.9834	0.9948
flower	0.9927	0.9995
OpenGL	0.9802	0.9919
lab	0.9906	0.9931
disk	0.9834	0.9983

Table 1: Image SSIM and ESSIM value

Image sets	Contrast pyramid	DWT	SIDWT	De's algorithm	QT Based	Proposed Method
Clock	0.9735	0.9751	0.9819	0.9778	0.9762	0.9834
Disk	0.9725	0.9755	0.9757	0.9725	0.9774	0.9834
Flower	0.9648	0.9669	0.9645	0.9607	0.9671	0.9927
Lab	0.9807	0.9818	0.9831	0.9813	0.9834	0.9906
Open GL	0.9556	0.9642	0.9662	0.9592	0.9608	0.9802
Pepsi	0.9852	0.9854	0.9822	0.9860	0.9862	0.9834

Table 2: - Gradient similarity metrics

Image sets	Contrast pyramid	DWT	SIDWT	De's algorithm	QT Based	Proposed Method
Clock	0.6880	0.6619	0.7003	0.7384	0.7373	0.9988
Disk	0.6849	0.6503	0.6822	0.7340	0.7383	0.9983
Flower	0.6444	0.6222	0.6583	0.6821	0.6962	0.9995
Lab	0.6910	0.6616	0.6839	0.7442	0.7470	0.9931
Open GL	0.6946	0.6784	0.7058	0.7289	0.7308	0.9919
Pepsi	0.7548	0.7293	0.7445	0.7847	0.7847	0.9948

Table 3: - Edge base similarity matrices

V. CONCLUSION

Authors Concluded, that a new multi-focus image fusion method with a guided filter. In the proposed algorithm, use of guided filters is used to first identify the main feature maps of the source images, and then the initial decision map is defined with mixed measurements combined with two efficient focus measurement descriptors. Experimental results show that the proposed fusion method can be competitive with some sophisticated methods or even better performance. Quadtree also offers a deplete strategy and a new weighted focus-measure, thus in an effective IV structure, areas focused from source images can be detected, effective and properly. And the detected areas can be extracted well from the source images and can be reconstituted to create the fusion image.

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