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Improved DWT for Multi-Focus Image Fusion

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Abstract: ***Image fusion plays an important role in day-to-day applications. An image is corrupted by noise blurring and can have the poor visual quality. Image fusion is used to enhance the quality of a degraded image. It is one of the important task and pre-processing step in digital image processing. With the rapid development of the medical image technology, medical image fusion becomes increasingly important in medical analysis and diagnosis. Digital Image fusion may be categorized into two broad domains which are Spatial Domain and Transform Domain. The main techniques for image fusion are average method, principle component analysis, Brovey transform, artificial neural networks, pyramid method, wavelet transform for gray-scale images. Earlier proposed method suffers from the noise, artifacts and spectral degradation. The average method leads to the undesirable side effects such as reduced contrast. The weighted wavelet-based method for fusion of PET and CT images has been proposed , However, this method confronted with the problem of selecting the parameters of weight , that is to say this method depended on the weights given by the user. Therefore, different weights will lead to different fused results. A pyramid method used for image fusion suffers from blocking artifacts and creates undesired edges. Single wavelet also gives no proper results***

Keywords: Image Segmentation, SVM Classifier, Texture Features, Statistical Features

1. Introduction

Image fusion can be broadly defined as the process of combining multiple input images or some of their features into a single image without the introduction of distortion or loss of information. The fusion of images is often required for images which are acquired from different instrument modalities or capture techniques of the same scene or objects. Image fusion is the process by which two or more images are combined into a single image retaining the important features from each of the original images. Several approaches to image fusion can be distinguished, depending on whether the images are fused. The purpose of image fusion is to combine information from several different source images to one image which becomes reliable and much easier to be comprehended by people.

The objective of image fusion is to combine complementary as well as redundant information from multiple images to create a fused output image. Therefore, the new image generated should contain a more accurate description of the scene than any of the individual sources image and is more suitable for human visual and machine perception or further image processing and analysis tasks.

2. Related Works

A lot of research has been done in the field of image fusion but yet the area of image fusion, especially for the medical images remains to be a hot area of research. Stress has been laid to summarize the concept of different authors who has worked in this field.

Wen Cao et.al.(2003) proposed a Remote-sensing image fusion method based on PCAT and WF'T in their paper title "A Remote Sensing Image Fusion Method Based on PCA Transform and wavelet packet transform". [1]

D.C. He et.al.(2004) [ ] proposed a new and original method of fusion in their paper titled "A new technique for multi-resolution image fusion", which is capable of (1) Combining a high resolution image with a low resolution image with or without any spectral relationship existing between these two images; [2]

Petrovic and Xydeas (2004) [ ] described A novel approach to multiresolution signal-level image fusion in their paper entitled "Gradient-based multi resolution image fusion" for accurately transferring visual information from any number of input image signals, into a single fused image without loss of information or the introduction of distortion. [3]

J. Zeng et.al.(2006) [ ] presented a review on some of the recent image fusion algorithms and associated assessment techniques in their paper titled "Review of Image Fusion Algorithms for Unconstrained Outdoor Scenes". [4]

Miao and Wang (2006) [ ] elaborated a new novel image fusion algorithm based on contourlet transform entitled in their paper "A Novel Image Fusion Method Using Contourlet Transform". The principal of contourlet and its good performance in expressing the singularity of two or higher dimensional are studied. [5]

Dawei and fang (2007) [ ] presented the basis conceptions of image fusion are given in their paperr titled "A New Improved Hierarchical Model of Image Fusion". The hierarchical model of image fusion is supplemented. Some preprocessing segments, such as the re-sampling of image, spatial and temporal registration, are introduced to the improved model. Some other pending solving questions in image fusion are given.[6]

Vekkot and Shukla (2009) [ ] introduced a novel architecture with a hybrid algorithm which applies pixel based maximum selection rule to low frequency approximations and filter mask based fusion to high frequency details of wavelet decomposition in their paper entitled "Novel Architecture for Wavelet based Image Fusion". [7]

S. Rajkumar and S. Kavitha (2010) [ ] proposed a multimodality medical image fusion system using different fusion techniques in their paper entitled " Redundancy

Discrete Wavelet Transform and Contourlet Transform for Multimodality Medical Image Fusion with Quantitative Analysis" and the resultant is analysed with quantitative measures. [8]

S. Das and M. K. Kundu (2011) [ ] composed an efficient novel multimodality Medical Image Fusion (MIF) method based on a novel combined Activity Level Measurement (ALM) and Contourlet Transform (CNT) for spatially registered, multi-sensor, multi-resolution medical images in their paper entitled " Fusion of Multimodality Medical Images Using Combined Activity Level Measurement and Contourlet Transform". [9]

Sabari Banu (2011) [ ] presented the survey of existing fusion schemes and a novel approach of medical image fusion using Discrete Wavelet Transform (DWT) in his paper entitled "Medical Image Fusion by the analysis of Pixel Level Multi-sensor Using Discrete Wavelet Transform". [10]

3. Algorithm

Existing methods suffers from the noise, artifacts and spectral degradation. The average method leads to the undesirable side effects such as reduced contrast. The weighted wavelet-based method for fusion of PET and CT images has been proposed , However, this method confronted with the problem of selecting the parameters of weight , that is to say this method depended on the weights given by the user. Therefore, different weights will lead to different fused results. Pyramid methods used for image fusion suffers from blocking artifacts and creates undesired edges and hence contour also uses the pyramid method, So single method have no proper results. To make it refine we need to add two methods that may overcome the problem of each other.

Implementation Steps:

- Load images
- Load the two original images: two aero-plane
- Images A1 and A2.
  Load A1;
  Load A2;
- Perform decompositions at different levels.
- Merge the two images from wavelet decompositions at level 5 using db2 by taking two different fusion methods: fusion by taking the mean for both approximations and details.
- XFUSmean=wfusimg(X1,X2,'db2',5,'mean','mean')
- Restore images from their decompositions
- Save image after fusion.

4. Results

Pairs of Fig 1, 2 and 3, 4 are the images at different resolution. However, the fig. in 3 and 6 shows the results of the wavelet based image fusion algorithm.

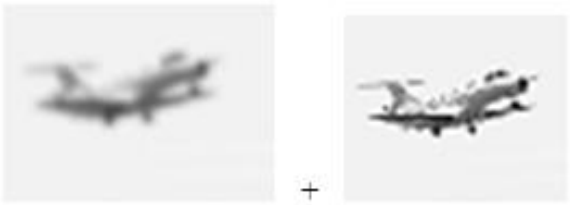

Fig. 1 + Fig. 2

Fig. 3

Fig. 4 + Fig. 5

Fig. 6

5. Conclusion

Multi-sensor image fusion seeks to combine information from different images to obtain more inferences than can be derived from a single sensor. It is widely recognized as an efficient tool for improving overall performance in image based application. The spectral quality of the images is preserved better than using the other approaches. The reason that we can find more spatial detail from the fused composite images is that many mixed pixels in the original composite image are decomposed into many different categories in a fused image with the improvement of the spatial resolution. The work done in this paper forms the basis for further research in wavelet based fusion and other methods which integrate the fusion algorithms in a single image. The novel hybrid architecture presented here gives promising results in all test cases and can be further extended to all types of images by using different averaging, high-pass and low-pass filter masks.

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Author Profile

Shivika Grover is pursuing her M.Tech. in ECE from Kurukshetra University, Haryana. Her field of interest is in Image processing and fusion and efforts estimation.