International Journal on Future Revolution in Computer Science & Communication Engineering
Volume: 5 Issue: 5
ISSN: 2454-4248
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A Review on Multi-Focus Image Fusion

Bindu[1], Dr. Meenu Manchanda[2], Dr. Sandeep Tayal[3], Dr. Ankit Bansal[4]
M. Tech Scholar[1] – V. C. E, Department of ECE, Rohtak, Haryana, India
Associate Professor[2]– V. C. E, Department of ECE, Rohtak, Haryana, India
Associate Professor3– V. C. E, Department of ECE, Rohtak, Haryana, India
Associate Professor[4]– V. C. E, Department of EE, Rohtak, Haryana, India
bindurani831@gmail.com[1], meenumanchanda73@gmail.com[2]

Abstract – Image fusion is a process to collect the information of the images of the same scene from the different images with a focus on different objects. The Multi-focus image performs a vital role in image process and visual applications. The multi-focus image fusion could be a technique seeks to provide an effective activity level measurement to produce the clarity of source images. It finds application in various fields such as remote sensing, optical microscopy**,** medical diagnostics, forensic and defense departments. This paper presents totally different multi-focus image fusion techniques in spatial and frequency domain.

Key Words – *Image fusion, multi-focus image techniques, transform domain, spatial domain.*

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I. INTRODUCTION

Image fusion has become a very significant area in the field of image analysis and computer vision. Image fusion could be a method of gathering complementary information from two or more than two images from multiple sources such as multi-sensor, multi-focus, or multi-spectral images. This resultant a lot of is more precise and reliable than any unfocused input image from different sources. Scenarios in which it is not possible to capture images with all the objects in focus wherein the images are partly focused and partly defocused, a fully focused image can be obtained from the source images by the process of multi-focus image fusion. Applications of multi-focus image fusion include medical imaging, remote sensing, and robotics. The advantages of image fusion includes, enhanced spatial information, greater accuracy in target detection and recognition, and condensed workload and better system reliability.

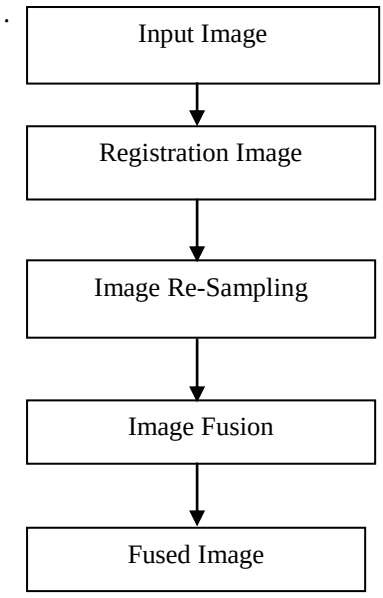

Figure 1Image Fusion Processing Steps

The multi-focus fused image so becomes a lot of comfortable for human visual perception and computer processing tasks.

II. MULTI FOCUS IMAGE FUSION

This technique gathering the number of source images to obtain a single focused image and vital use of such multi focused image fusion is to get a resultant image with enhance quality and it has more information than any others .relatively more information than any of the single source images. To point of depth of field there is limitation regarding optical. It is impossible to get a correct picture that has sharp focused images. These images are then fused to get a picture which has depth field is good according our requirements. It has three level of image fusion

- Pixel
- Decision
- Feature Levels

Here three level of image fusion the pixel level is the lowest one it has also advantages and disadvantages. Pixel level has advantages is that it locate error in unwanted noise easily and disadvantages of this methods is blurring artifacts. To overcome such kind of problems including in registration and noise sensitivity, region methods used. Extractions of features are done by feature level of image fusion. Here are such features of images like contrast, shape, size are combined. Descriptors are considered in decision level in all three levels pixel level gives more stability. Multi-focus image fusion is very interesting task in the field of digital image processing and as a result, has "all-in-focus" image. The actual fusion process can be performed at different levels. Here we describe all three levels separately.

Pixel Level

Pixel level method is the very simple and highly popular method. It is a low level of fusion in the phase of image pre-processing which shown in figure 1. It gives more clear images.

 ISSN: 2454-4248
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Feature Level

It deals with the features of the image. In this level of technique after feature extraction we get an enhanced fused image.

Region-Based

In this method image's pixel blocks are considered. It is the highest level technique. According to many papers considering regions it is multi focused measurements and representation.

III. LITERATURE SURVEY

Aiyue Chen et al: In this paper, to overcome the shortage of wavelet transform the NSCT techniques and other related methods correctly combines NSCT transform, frequency representation, which not showing the main characteristics and overcome the problem the coefficients of low frequency is not spares. In this it gives the excellent results of fusion accordingly modification degree, texture of image and alternative information.

Yong Yang et al: In this paper, it describes the proposed method for detecting the multi focused image fusion. The advantages of the proposed method include: (1) NSC Transform is accurate for image fusion because of excellent results gives in multimodal and shift invariance (2) using this proposed method it gives better result like guide to decision making in process of image fusion and also decrees complexity of processing of image fusion and also improves the reliability (3) in this proposed meted no artifacts and blurring effect etc gives enhanced result of fusion.

Kangjian He et al: In this paper, it describes the proposed method for IV and IF images. SF PCNN proposed method is used. Maximum level fusion rule and background regions are used in this proposed method. Pre-pixel average weighted method is used for low frequency coefficients and for high frequency coefficients SF PCNN is used.

Shuya Song et al: In this paper they described about the fusion of fused images requires that the fused image as accurately as possible can reflect the lesion, blood vessels and other information and method for registration and fusion of fused images based on NSCT and adaptive PCNN is proposed: The color fused image and the fluorescence contrast fused image were NSCT fused in every channel of R, G, B to get the high-frequency sub-bands and low-frequency sub-band of the 2pictures .and the fusion of the low-frequency sub-band with the regional energy which may effectively preserve the complementary info between the 2 sorts of bodily structure pictures. For the high-frequency a part of the 2 pictures, a simplified PCNN model is used for processing. Considering that the link strength parameter of the PCNN model has a great influence on the fusion result, the Laplacian energy as PCNN adaptive link strength, By comparing the number of ignition times to have coalesced, finally the NSCT inverse transformation outputs the fusion results.

G.Seshasai et al: In this paper presents a novel multi-focus image fusion method (novel hybrid) First, In this paper, it describes the proposed method in which maximum level fusion rule are used for low frequency coefficients and high frequency coefficient fused rule maximum level fusion rule which gives better result. In this meted there artifacts problem overcame.

Kurakula Sravya et al: In this paper they describe such kind of techniques regrinding transformation which gives the better image fusion algorithm like Discrete Wavelet Transform, the Discrete Curve let Transform, and NSC Transform. Basically it describes analysis based on multi resolution for checking the ability and for good identification ability to edge feature. Such proposed method gives better result by NSCT and also analyses a feature of image. In this paper they describe many project of fusion also discussed deep research regarding fusion of images.

IV. MULTI FOCUS IMAGE FUSION METHODS

Currently, many image fusion techniques have been used to fuse multi-focus images and image fusion images. Usually, such type of fusion techniques has two classes: spatial domain methods and transform domain methods. The first one is very simple fusion method that works on source images directly. In the second one firstly transforms the input images into frequency domain by using some fusion tools and then integrates them and get result. In Spatial domain, the information of image pixels is directly used without any pre-processing or post-processing. Intensity values of pixels from the input images are directly fused in this method. In the transform domain, the image is first transformed into the frequency domain. Here In the transform domain, by applying transform methods firstly get the images to take a final result have to select a set of coefficients among such set of coefficients and after that inverse transform also done.

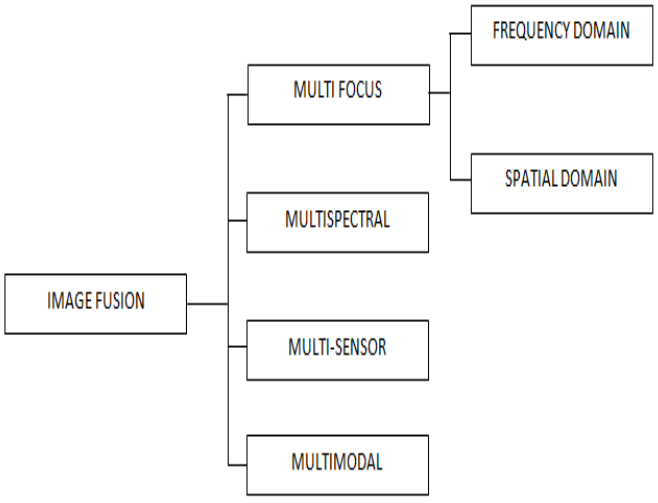

Figure 2 Image fusions and the fusion methods used in multi-focus image fusion

 ISSN: 2454-4248
90 –93

Frequency domain methods

Frequency domain methods at first divide the source images into coefficients of multi scale. It has many characteristics but important characteristic of the frequency domain methods is to avoid block effects in the images. However, the pyramid based method does not bring in any spatial orientation selectivity in the decomposition process. But disadvantage is block effect but there is many other family of the multi-resolution fusion techniques are there that also wavelet-based methods they apply the different proposed method.

Spatial Domain Methods

Such kind of methods work on input images which called source images. Here one is the simplest method which is the weighted average .because such method does not requirement for transformation and decomposition. So this method has many advantages so it is very simple and it is fit for a real time processing. This method has needed further imposition which is done by computing

V. COMPARISON

Name	Domain	Merits	Demerits
PCA	SPATIAL	This tool transforms the correlated variable into the uncorrelated variables	Degradation problem
DWT	TRANSFORM	Better signal to noise ratio	the fused image has a less spatial resolution
DWT+ PCA	TRANSFORM	The fused image had high spatial resolution with high-quality content of spectral	complex fusion algorithm
AVERAGE METHOD	SPATIAL	It has fast running speed this is advantage	Disadvantage is that objects are not seen clear.
SIMPLE MAXIMUM METHOD	SPATIAL	The advantage is that it results in highly focused image output got from the source image as compared to the average method.	the disadvantage is that the pixel level method is affected by the blurring effect which directly affects the image contrast

VI. CONCLUSION

Nowadays there has been nice progress in the field of image fusion and especially with in multi-focus image fusion. We know existing methods are not without defects, and there is a need for the improvement of the quality of fused images. This is due to the fact that multi-focus image fusion approaches do not depend greatly on the application domain or on the acquisition devices, their major focus being the quality of the images. In order to assess the standard of the fused image, speed and accuracy are the two important parameters. The accuracy is also dependent on bringing the source images to the common coordinate system (Image Registration) before the fusion process. Hence the choosing the correct image registration algorithm program is very important. Therefore researchers are directing their research towards achieving a better quality of fused image through speed and accuracy. In addition, researchers have also proposed combinational approaches employing more than one strategy to fuse the images. In this paper, the multi-focus fusion research methods have been broadly classified as frequency and spatial domain methods. Frequency domain methods have been further classified as wavelet and different variations of wavelets. Spatial domain methods are mostly based on focus measure evaluation. This survey presents a broad classification of the different methods that are being used in the field of multi-focus image fusion. This survey presents a comprehensive study to the researchers in the field of multi-focus image fusion research.

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