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Multifocus Image Fusion Based on NSCT and Focused Area Detection

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ABSTRACT: Image fusion is the process that combines information in multiple images of the same scene. These images may be captured from different sensors, acquired at different times, or having different spatial and spectral characteristics. The object of the image fusion is to retain the most desirable characteristics of each image. The low-frequency sub-band coefficients are fused by the sum-modified-Laplacian-based local visual contrast, whereas the high-frequency sub-band coefficients are fused by the local Log-Gabor energy. The initial fused image is subsequently reconstructed based on the inverse NSCT with the fused coefficients. Second, after analyzing the similarity between the previous fused image and the source images, the initial focus area detection map is obtained, which is used for achieving the decision map obtained by employing a mathematical morphology post processing technique. Finally, based on the decision map, the final fused image is obtained by selecting the pixels in the focus areas and retaining the pixels in the focus region boundary as their corresponding pixels in the initial fused image.

KEYWORDS: Image fusion, NSCT, Sensor, Multi focus and Multiple Image.

I. INTRODUCTION

In applications of digital cameras, optical microscopes or other equipment, because of the limited depth-of-focus of optical lens, it is often impossible to acquire an image that contains all relevant focused objects. Therefore, in the scene, some objects are in focus, but other objects at different distances from the imaging equipment will be out of focus and, thus, blurred. However, in reality, people tend to obtain a clear image of all targets. Fusion methods in the spatial domain are directly on pixel gray level or color space from the source images for fusion operation, so the spatial domain fusion methods are also known as single-scale fusion method. For transform domain based methods, each source image is first decomposed into a sequence of images through a particular mathematical transformation. Then, the fused coefficients are obtained through some fusion rules for combination. Finally, the fusion image is obtained by means of a mathematical inverse transform. Thus, the transform domain fusion methods are also known as Multi-scale fusion methods. The simplest spatial-based method is to take the average of the input images pixel by pixel. However, along with its simplicity, this method leads to several undesirable side effects, such as reduced contrast. To improve the quality of the fused image, some researchers have proposed to fuse input images by dividing them into uniform-sized blocks and having those blocks to take the place of single pixels. For the block-based methods, the blocks are combined according to a clarity index, which evaluates whether the blocks are clear or not. To overcome the limitations of Wavelet Transform, Curvelet transform is put forward which consists of special filtering process and multi-scale Ridgelet Transform. This includes realization, sub-band division, smoothing block, normalization and so on. The quality of the image at the edges is improved by removing the noise using Nonsubsampled Counterlet Transform. The construction proposed in this is based on pyramid and directional filters. The NSCT is fully shifting invariant, Multiscale, and multidirectional. To allow helicopter pilots navigate under poor visibility conditions (such as fog or heavy rain) helicopters are equipped with several imaging sensors, which can be viewed by the pilot in a helmet mounted display. A typical sensor suite includes both a low-light-television (LLTV) sensor and a thermal imaging forward-looking-infrared (FLIR) sensor. In the current configuration, the pilot can choose one of the two sensors to watch in his display. A possible improvement is combining both imaging sources into a single fused image which contains the relevant image information of both imaging devices[3].Due to the limited depth-of-focus of optical lenses (especially such with long focal lengths) it is often not possible to get an image which contains all relevant objects

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'infocus'. One possibility to overcome this problem is to take several pictures with different focus points and combine them together into a single frame which finally contains the focused regions of all input images. Remote sensing is a typical application for image fusion. Modern spectral scanners gather up to several hundred of spectral bands which can be both visualized and processed individually, or which can be fused into a single image, depending on the image analysis task.

II. RELATED WORK

Various image fusion techniques have been proposed to meet the requirements of different applications, such as concealed weapon detection, remote sensing, and medical imaging. Combining two or more images of the same scene usually produces a better application-wise visible image. The fusion of different images can reduce the uncertainty related to a single image. Furthermore, image fusion should include techniques that can implement the geometric alignment of several images acquired by different sensors. Such techniques are called a multi-sensor image fusion. The output fused images are usually efficiently used in many military and security applications, such as target detection, object tracking, weapon detection, night vision, etc. The Brovey Transform (BT), Intensity Hue Saturation (IHS) transforms, and Principal Component Analysis (PCA) provides the basis for many commonly used image fusion techniques. Some of these techniques improve the spatial resolution while distorting the original chromaticity of the input images, which is a major drawback. Recently, great interest has arisen on the new transform techniques that utilize the multi-resolution analysis, such as Wavelet Transform (WT). The multi-resolution decomposition schemes decompose the input image into different scales or levels of frequencies. Wavelet based image fusion techniques are implemented by replacing the detail components (high frequency coefficients) from a colored input image with the details components from another gray-scale input image. However, the Wavelet based fusion techniques are not optimal in capturing two-dimensional singularities from the input images. The two-dimensional wavelets, which are obtained by a tensor-product of one-dimensional wavelets, are good in detecting the discontinuities at edge points. However, the 2-D Wavelets exhibit limited capabilities in detecting the smoothness along the contours. Moreover, the singularity in some objects is due to the discontinuity points located at the edges. These points are located along smooth curves rendering smooth boundaries of objects. Do and Vetterli introduced the new two- dimensional Contour let transform. This transform is more suitable for constructing a multi-resolution and multi-directional expansions using non- separable Pyramid Directional Filter Banks (PDFB) with small redundancy factor.

Image fusion is the combination of two or more different images to form a new image by using a certain algorithm. The combination of sensory data from multiple sensors can provide more reliable and accurate information. It forms a rapidly developing area of research in remote sensing and computer vision. Most of fusion approaches were based on combining the multiscale decompositions (MSD's) of the source images. MSD-based fusion schemes provide much better performance than the simple methods studied previously. Due to joint information representation at the spatial-spectral domain, the wavelet transform becomes the most popular approximation in image fusion. However, wavelet will not "see" the smoothness along the contours and separable wavelets can capture only limited directional information. Contourlet transform was recently pioneered by Minh N. Do and Martin Vetterli .It is a "true" two-dimensional transform that can capture the intrinsic geometrical structure, which is key in visual information. Compared with wavelet, contourlet provides different and flexible number of directions at each scale. It has been successfully employed in image enhancement, denoising and fusion. Unfortunately, due to down samplers and up samplers presented in both the Laplacian pyramid and the directional filter banks (DFB), the foremost contourlet transform is not shift-invariant, which causes pseudo- Gibbs phenomena around singularities.

III. EXISTING SYSTEM

The importance of image fusion in current image processing systems is increasing, primarily because of the increased number and variety of image acquisition techniques. The purpose of image fusion is to combine different images from several sensors or the same sensor at different times to create a new image that will be more accurate and comprehensive and, thus, more suitable for a human operator or other image processing tasks.
Currently, image fusion technology has been widely used in digital imaging, remote sensing, biomedical imaging, computer vision, and so on. The MST-based image fusion method can significantly enhance the visual effect, but in the focus area of the source image, clarity of the fused image will have different degrees of loss. That is because, in the

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process of Multi-scale decomposition and reconstruction, improper selection of fusion rules often causes the loss of useful information in the source image..

IV. PROPOSED SYSTEM

Proposed image fusion technique is based on Non Sub-sampled Contour let Transform method (NSCT), which is a shift-invariant version of the contou rlet transform. The NSCT is built upon iterated non-subsampled filter banks to obtain a shift-invariant directional multi resolution image representation. The contour let transform employs Laplacian pyramids for Multiscale decomposition, and directional filter banks (DFB) for directional decomposition. To achieve the shift-invariance, the non-subsampled contour let transform is built upon non-subsampled pyramids and non-subsampled DFB.

NSCT decomposition is to compute the multi scale and different direction components of the discrete images. It involves the two stages such as non sub sampled pyramid(NSP) and non sub sampled directional filter bank(NSDFB) to extract the texture, contours and detailed coefficients. NSP decomposes the image into low and high frequency subbands at each decomposition level and it produces n+1 sub images if decomposition level is n. NSDFB extracts the detailed coefficients from direction decomposition of high frequency subbands obtained from NSP. It generates m power of 2 direction sub images if number of stages be m.

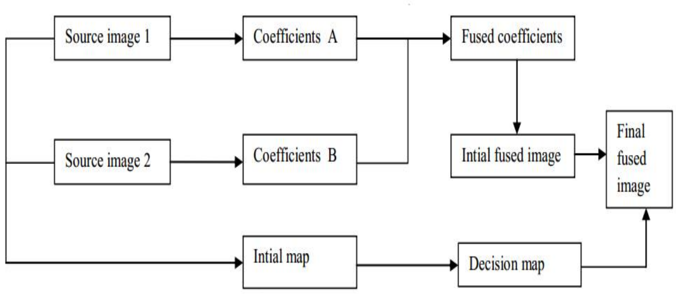
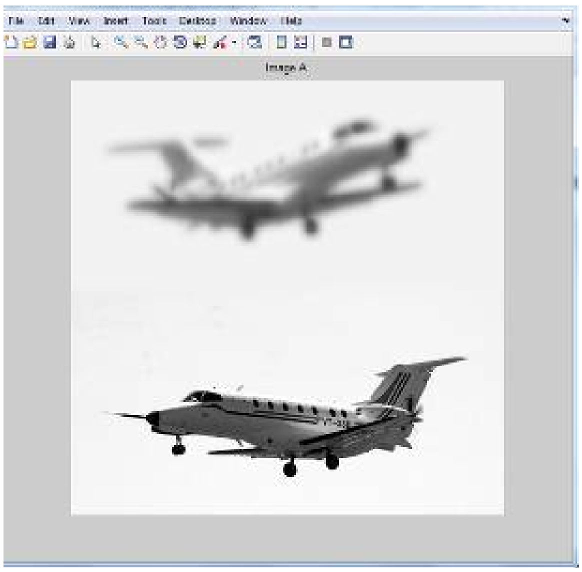


Fig 1. Schematic diagram of the proposed image fusion algorithm

V. SIMULATION RESULTS



(a)

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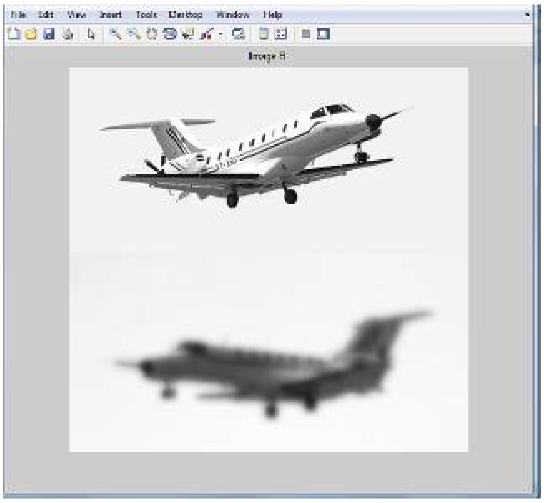

(b)

Fig 3: source images

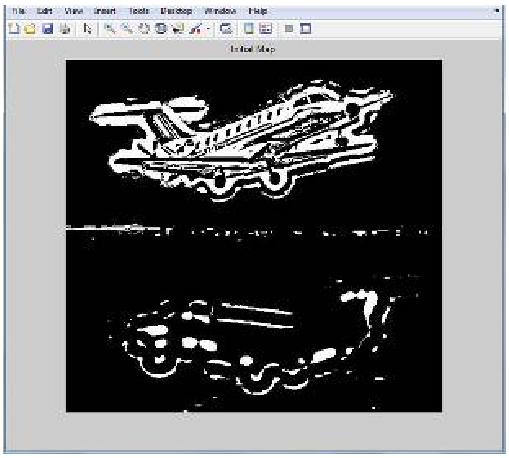

Fig 4; Initial Map

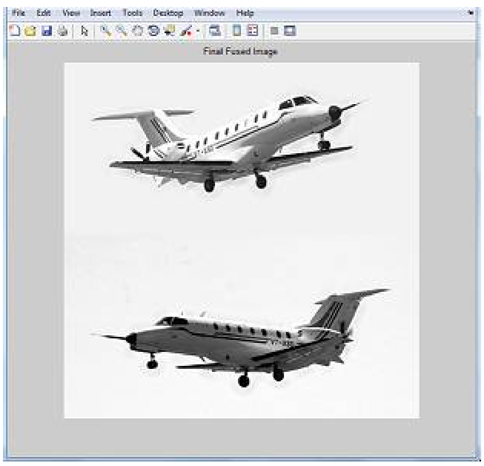

Fig 5: Final Fused Image

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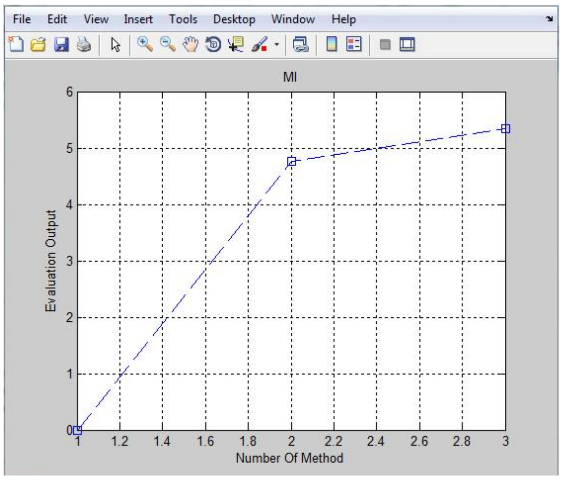

Fig 6: MI EVALUTION GRAPH

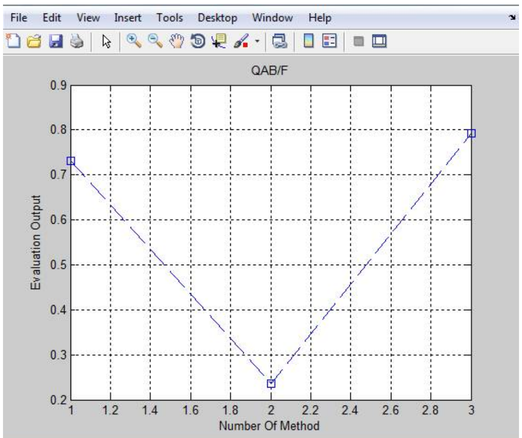

Fig 7: $Q^{AB/F}$ EVALUTION GRAPH

VI. CONCLUSION

NSCT was helped to represent an image with better contour edges in different directions. The pixel level fusion was performed to fuse relevant details from low and high frequency using Gabor and gradient filters. The potential advantages of the pro-posed method include: (1) NSCT is more suitable for image fusion because of superiorities such as multi-resolution, multi-direction, and shift-invariance; (2) using the detected focused areas as a fusion decision map to guide the fusion process not only reduces the complexity of the procedure but also increases the reliability and robustness of the fusion results; and (3) the proposed fusion scheme can prevent artifacts and erroneous results at the boundary of the focused areas that may be introduced by detection focused area based methods during the fusion process.

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