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Multi-Focus Image Fusion Based on NSCT and Focused Area Detection

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Abstract: ***To overcome the difficulties of sub band coefficients selection in multi-scale transform domain based image fusion and solve the problem of block effects suffered by spatial domain based image fusion, this paper presents a novel hybrid multi-focus image fusion method. Firstly, the source multi-focus images are decomposed using the non-sub sampled contour let transform (NSCT). The low frequency sub band coefficients are fused by the Sum-Modified-Laplacian (SML) based local visual contrast, while 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. Secondly, 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. Lastly, 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. Experimental results demonstrate that the proposed method is better than various existing transform-based fusion methods, including gradient pyramid transform, discrete wavelet transform, NSCT, and a spatial-based method, in terms of both subjective and objective evaluations.***

I. INTRODUCTION

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 create combine different images from several sensors or the same sensor at different times to 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. 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. A possible way to overcome this problem is to utilize multi-focus image fusion techniques, in which one can obtain one image with all of the objects in focus by way of it containing the best information from multiple original images. Image fusion methods are usually divided into spatial domain and transform domain fusion techniques. 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 .

II. EXISTING METHODOLOGY

The importance of image fusion in current image pro-cessing systems is increasing, primarily because of the increased number and variety of image acquisition techniques. The purpose of image fusion is to combine different image from several sensors or the same sensor at different times to create new image that will be more accurate and compreh sive 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, bio-medical imaging, computer vision, and so on.

III. PROPOSED METHODOLOGY

In this paper, a novel image fusion scheme that is based on NSCT and focused area detection is proposed for multi-focus image fusion. The potential advantages of the proposed method include:

A. NSCT is more suitable for image fusion because of superiorities such as multi-resolution, multi-direction, a shift-invariance.

B. 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.

IV. ADVANTAGES

A. Image Denoising

B. Image Enhancement

C. Medical Applications

V. APPLICATIONS

It helps in medical field to improve the clarity of image we use this method and we can easily find the disease and we can take measure to cure that immediately.

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VI. CONCLUSION

In this paper, a novel image fusion scheme that is based on NSCT and focused area detection is proposed for multi-focus image fusion. The potential advantages of the proposed 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. The experimental results on several groups of multi-focus images, regardless of whether there is noise or not, have shown the superior performance of the proposed fusion scheme. The NSCT algorithm is time-consuming and of high complexity, so the next step that will be studied is how to improve the speed of the algorithm.

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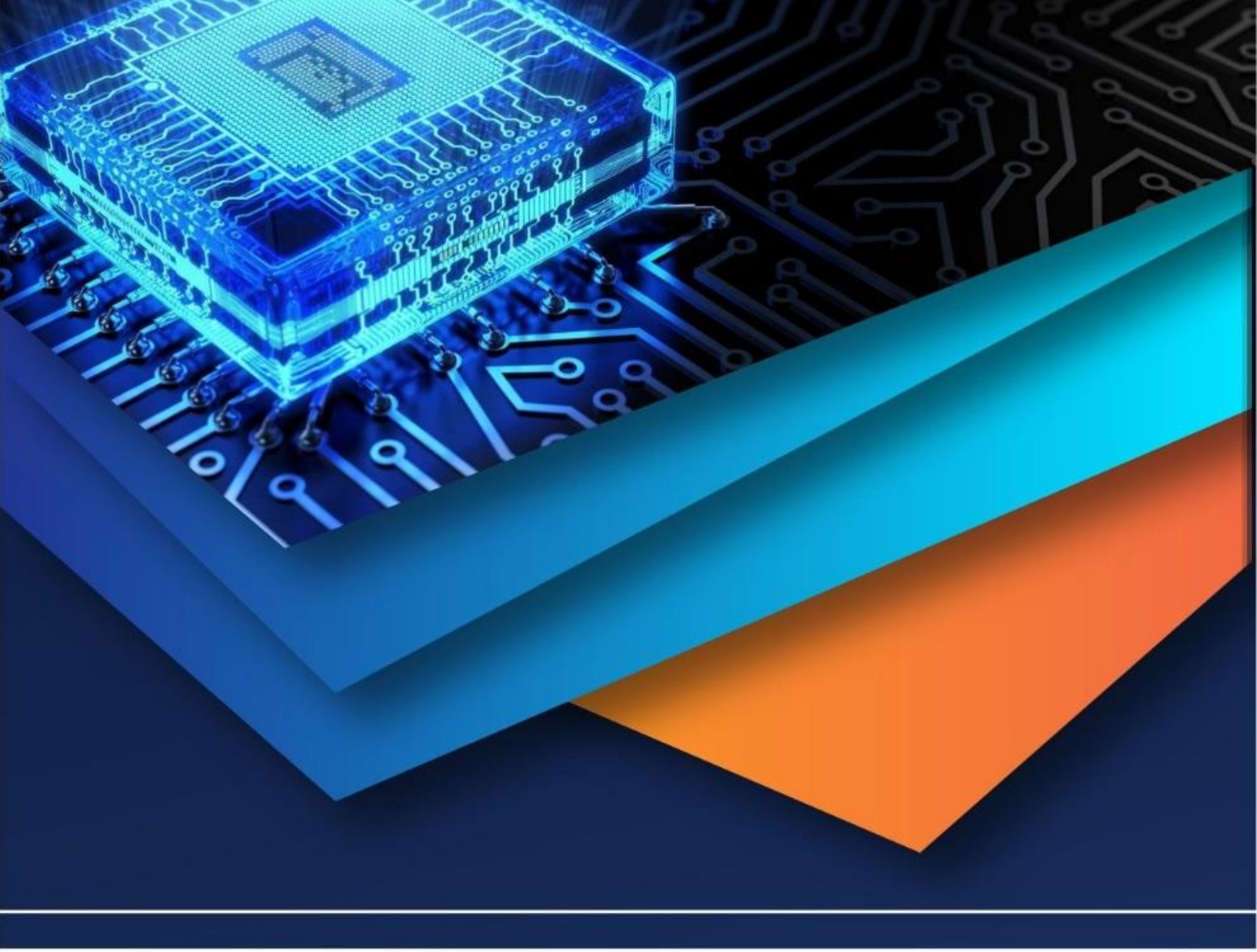

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