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A Study an Image Fusion for the pixel level and feature based Techniques

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ABSTRACT

Image fusion is an important technique for various image processing and computer vision applications such as feature extraction and target recognition. In the field of image fusion, pixel-level image and feature based image fusion is the basis for other image fusion methods and multi-resolution image fusion based on multi-scale decomposition is an important branch of image processing. In this paper we study various image fusion techniques for the quality improvement and comparative performance for the fused image.

Keywords:- Image Fusion, Fuzzy System, Neural Network, Discrete Wavelet Transform, Feature extraction, Multi-resolution.

INTRODUCTION

Image fusion is the process of enhancing the perception of a scene by combining information captured by different modality sensors. Image fusion reduces uncertainty and also minimizes redundancy in the output, thus maximizing relevant information from two or more images of a scene [1]. There are various methods available to implement image fusion. Basically, these methods can be categorized into two categories. The first category is the spatial domain-based methods, which directly fuse

the source images into the intensity values. The other category is the transformed domain-based methods, which fuse images with certain frequency or time–frequency transforms [8].Through image fusion, different images of the same scene can be combined into a single fused image. The fused image can provide more comprehensive information about the scene which is more useful for human and machine perception. For instance, the performance of feature extraction algorithms can be improved by fusing multi-spectral remote sensing images [5].

During the past two decades, many image fusion methods are developed [1–12]. According to the stage

at which image information is integrated, image fusion algorithms can be categorized into pixel, feature, and decision levels. The pixel-level fusion integrates visual information contained in source images into a single fused image based on the original pixel information.

In the past decades, pixel-level image fusion has attracted a great deal of re-search attention. Generally, these algorithms can be categorized into spatial domain fusion and transform domain fusion [6]. The spatial domain techniques fuse source images using local spatial features, such as gradient, spatial frequency, and local standard derivation [1]. For the transform domain methods, source images are projected onto localized bases which are usually designed to represent the sharpness and edges of an image [6].

In image fusion rules, the low frequency coefficients obtained after the coefficient transform are calculated using a conventional averaging method. The high frequency coefficients obtained after the coefficient transform can then be fused using many methods, such as selecting the greatest absolute coefficient value, the weighted coefficient fusion rule based on a window, or selecting the coefficient based on a window when the coefficient absolute value is also greater [3].

Multi-focus image fusion is the process in which different images with different focus settings are fused to produce a new image with extended depth of field. Its purpose is to attempt to increase the apparent depth of field through the fusion of object within several different fields of focus. Hence it plays important roles in many different fields such as biomedical imaging and computer vision. Multi-focus image fusion is one of the main research fields of image fusion [11].

The rest of this paper is organized as follows in section II we discuss about the rich literature survey for the existing image fusion techniques. In section III we also describe the about image fusion comparative study in a table no. 1. And finally In section IV we conclude the about our paper which is based on the whole literature survey journey also discuss the future scope.

II RELATED WORK

In this section we discuss the about rich literature survey for the image fusion techniques based on the various research paper which are highly cited from various reputed organization such as IEEE transactions, Elsevier, Springer and other international journal research papers. In the next section we also discuss the survey in the tabular format.

[2] This letter developed a new robust and faster multiband image fusion method based on the resolution of a generalized SE. The application of the Woodbury formula allows any permutation in the frequency domain to be avoided and brings two benefits. The proposed algorithm can be embedded into a BCD or an ADMM to implement (hierarchical) Bayesian fusion models.

[7] This paper proposes a novel image fusion scheme using the signal sparse representation theory. Because image fusion depends on local information of source images, we conduct the sparse representation on overlapping patches instead of the whole image, where a small size of dictionary is needed. In addition, the simultaneous orthogonal matching pursuit technique is introduced to guarantee that different source images are sparsely decomposed into the same subset of dictionary bases, which is the key to image fusion.

[5] The proposed method is based on a two-scale decomposition of an image into a base layer containing large scale variations in intensity, and a detail layer capturing small scale details. A novel guided filtering-based weighted average technique is proposed to make full use of spatial consistency for fusion of the base and detail layers.

[8] In this paper, they have presented a multi-focus image fusion method based on sparse representation theory. The contributions of this paper can be concluded into two aspects. First, we explored the image sparse representation theory to resolve the image fusion problem, which can simultaneously conduct image fusion and restoration. Second, the "sliding window" technique is introduced to overcome the shift variance problem, which may increases the complexity but will not be a problem owing to the hardware's development.

[13] This paper presents an unsupervised distribution-free change detection approach for synthetic aperture radar (SAR) images based on an image fusion strategy and a novel fuzzy clustering algorithm. The image fusion technique is introduced to generate a difference image by using complementary information from a mean-ratio image and a log ratio image. Experiments on real SAR images show that the image fusion strategy integrates the advantages of the log-ratio operator and the mean-ratio operator and gains a better performance.

[6] In this paper, we compare various multi-resolution decomposition algorithms, especially the latest developed image decomposition methods, such as curvelet and contourlet, for image fusion. The investigations include the effect of decomposition

levels and filters on fusion performance. By comparing fusion results, they give the best candidates for multi-focus images, infrared–visible images, and medical images. The experimental results show that the shift-invariant property is of great importance for image fusion. In addition, we also conclude that short filter usually provides better fusion results than long filter, and the appropriate setting for the number of decomposition levels is four.

[11] This paper proposes a new method for multi-focus image fusion based on dual-channel pulse coupled neural networks (dual-channel PCNN). Compared with previous methods, our method does not decompose the input source images and need not employ more PCNNs or other algorithms such as DWT. This method employs the dual-channel PCNN to implement multi-focus image fusion. Two parallel source images are directly input into PCNN. Meanwhile focus measure is carried out for source images.

[3] In this study, they proposed a fusion method based on the discrete wavelet frame transform and regional features. The main characteristic of this method is that it performs better at preserving the regional features of images. In addition, it can retain the details of images, such as edges, and it may also inherit the source image information.

[1] In this paper, a simple and competent image fusion algorithm based on standard deviation in wavelet domain is proposed and compared with both transform domain as well as spatial domain techniques. The techniques are evaluated with various databases quantitatively and qualitatively.

[14] In this article, a novel multimodal Medical Image Fusion (MIF) method based on Non-subsampled Contourlet Transform (NSCT) and Pulse-Coupled Neural Network (PCNN) is presented. The proposed MIF scheme exploits the advantages of both the NSCT and PCNN to obtain better fusion results. The source medical images are first decomposed by NSCT. The low-frequency sub-bands (LFSs) are fused using the ‘max selection’ rule. For fusing the high-frequency sub-bands (HFSs) a PCNN model is utilized.

III. COMPARATIVE STUDY ANALYSIS

Table 1: Shows the comparative study of Image fusion Techniques to improve Quality of stored information, less power consumption and memory area issues.

Sr No.	Ref No.	Title	Author Name	Publication	Year	Proposed work
1	[2]	R-FUSE: Robust Fast Fusion of Multiband Images Based on Solving a Sylvester Equation	Qi Wei, Nicolas Dobigeon, Jean-Yves Tourneret, Jose Bioucas-Dias, Simon Godsill	IEEE	2016	This letter proposes a robust fast multiband image fusion method to merge a high-spatial low-spectral resolution image and a low-spatial high-spectral resolution image.
2	[1]	A Simple and Efficient Image Fusion algorithm based on Standard Deviation in Wavelet Domain	Nirmala Paramanandham, Kishore Rajendiran	IEEE	2016	A simple image fusion framework is developed based on the standard deviation, where consistency verification is used as a selection criterion in approximation band and maximum fusion rule to the detailed bands. Inverse discrete wavelet transform is applied to the selected coefficients to obtain the final fused image.
3	[5]	Image Fusion with Guided Filtering	Shutao Li, Xudong Kang, Jianwen Hu	IEEE	2013	The proposed method is based on a two-scale decomposition of an image into a base layer containing large scale variations in intensity, and a detail layer capturing small scale details.
4	[7]	Pixel-level image fusion with simultaneous orthogonal matching pursuit	Bin Yang, Shutao Li	Elsevier ltd.	2012	proposed a novel image fusion scheme using the signal sparse representation theory. Because image fusion depends on local information of source images, they conduct the sparse representation on overlapping patches instead of the whole

						image, where a small size of dictionary is needed.
5	[12]	Digital three-dimensional image fusion processes for planning and evaluating orthodontics and orthognathic surgery. A systematic review	Joanneke M. Plooij,Thomas J. J. Maal, Piet Haers, Wilfred A. Borstlap,Anne Marie Kuijpers-Jagtman, Stefaan J. Berge	Elsevier ltd.	2011	From these articles it is concluded, that image fusion and especially the 3D virtual head are accurate and realistic tools for documentation, analysis, treatment planning and long term follow up. This may provide an accurate and realistic prediction model.
6	[4]	Study of Different Image fusion Algorithm	Kusum Rani1, Reecha Sharma	IJETAE	2013	This paper presents a review on some of the image fusion techniques (simple average, simple minimum, simple maximum, PCA, DWT). Comparison of all the techniques concludes the better approach for its future research.
7	[3]	New Region-based Image Fusion Scheme Using the Discrete Wavelet Frame Transform	Lianhai Wang, Junping Du, Suguo Zhu, Dan Fan and JangMyung Lee	IEEE	2016	They propose a fusion method based on the discrete wavelet frame transform and regional characteristics. First, the transform coefficients are obtained for the two source images using the discrete wavelet frame transform.
8	[6]	Performance comparison of different multi-resolution transforms for image fusion	Shutao Li, Bin Yang, Jianwen Hu	Elsevier ltd.	2011	compare various multi-resolution decomposition algorithms, especially the latest developed image decomposition methods, such as curvelet and contour let, for image fusion. The investigations include the effect of decomposition levels and filters on fusion performance.
9		MRI and PET image fusion by	Sabalan Daneshvar, Hassan Ghassemian	Elsevier ltd.	2010	In the proposed fused images the color

	[10]	combining IHS and retina-inspired models				information was least distorted, the spatial details were as clear as the original MRI, and the integration of color and spatial features was normal. The statistical analyses tools such as entropy, mutual information, discrepancy, and average gradient are demonstrated that the proposed algorithm did considerably increase spatial information content and reduce the color distortion compared to the counterpart fusion methods.
10	[8]	Multifocus Image Fusion and Restoration With Sparse Representation	Bin Yang and Shutao Li	IEEE	2010	In this paper, a sparse representation-based multi-focus image fusion method is proposed. In the method, first, the source image is represented with sparse coefficients using an over complete dictionary. Second, the coefficients are combined with the choose-max fusion rule. Finally, the fused image is reconstructed from the combined sparse coefficients and the dictionary.
11	[9]	Multi-focus image fusion for visual sensor networks in DCT domain	Mohammad Bagher, Akbari Haghighat, Ali Aghagolzadeh, Hadi Seyedarabi	Elsevier ltd.	2011	In this paper, an efficient approach for fusion of multi-focus images based on variance calculated in DCT domain is presented. Due to simplicity of our proposed method, it can be easily used in real-time applications. The experimental results verify the efficiency improvement of their

						method both in output quality and complexity reduction in comparison with several recent proposed techniques.
12	[13]	Change Detection in Synthetic Aperture Radar Images based on Image Fusion and Fuzzy Clustering	Maoguo Gong, Zhiqiang Zhou, Jingjing Ma	IEEE	2012	This paper presents an unsupervised distribution-free change detection approach for synthetic aperture radar (SAR) im-ages based on an image fusion strategy and a novel fuzzy clustering algorithm.

IV CONCLUSION

The image fusion technique is introduced to generate a difference image by using complementary information from a mean-ratio image and a log-ratio image. Image fusion techniques consider the several applications discussed include medical diagnosis, remote sensing, surveillance systems, biometric systems, and image quality assessment. During the past two decades, many image fusion methods are developed, in this paper we study various image fusion techniques for the spatial and transfer domain techniques in the various real life applications, In future we impalement the feature based image fusion for the purpose of above mentioned applications.

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