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A Review on Multi-Focus Digital Image Pair Fusion Using Multi-Scale Image Wavelet Decomposition

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ABSTRACT

The successful fusion of images acquired from different modalities or instruments is of great importance in many applications such as medical imaging microscopic imaging remote sensing computer vision and robotics. Optical imaging cameras suffer from the problem of limited depth-of-field of optical lenses, so it is difficult to get an image with all objects in focus. One way to overcome this problem is by using multi-focus image fusion technique, in which several images with different focus points are combined to form a single image with all objects fully focused. So, it is crucial to effectively extract the image information of the original images and reasonably combine them into the final fusion image. Image fusion is a process of combining relevant information from two or more images into a single informative image. The term image fusion refers to integration of information from different images of same object. The resulting fused output will be more clear and informative than the inputs. This paper proposes an efficient image fusion method based on different Multi-scale image wavelet decomposition techniques. Also quality assessment of fused images analyzes which overcome by our proposed method with better outcomes.

Keywords: Image Fusion, Wavelet Decomposition Techniques, Quality Assessment, Multi Focus Images

I. INTRODUCTION

Image fusion is the process of combining relevant information from two or more images into a single image. Image fusion is also a process of combining two or more images to enhance the relevant information content. Image fusion techniques are important as it improves the performance of object recognition systems by integrating many sources of satellite, ground based imaging systems with other related data sets such as medical imaging , microscopic imaging ,remote sensing computer vision and robotics. Image fusion is the technology that can take advantage of complementary information and redundancy information from different image sensors at the same time or at different times for the same scene by using some certain fusion rules, and then the fused images are more accurate and more complete than the single image and more suitable for human visual perception and processing. paper presents different image fusion algorithms and different parameters considered to measure the performance of image fusion algorithms. This paper is organized in as follows:

Optica imaging cameras suffer from the problem of finite depth of field, which cannot make objects at various distances (from the sensor) all in focus. Therefore, if one object in the scene is in focus, then the other objects at different distances from the camera will be out of focus and, thus blurred. One way to overcome this problem is by using multi-focus image fusion technique, in which several images with different focus points are combined to form a single image with all objects fully focused. This paper proposes an efficient image fusion method based on different Multiscale image wavelet decomposition techniques. Also quality assessment of fused images analyses.

II. LITERATURE SURVEY

This section describe a various techniques proposed by different researchers.

Chang-Hwan Son and Xiao-Ping Zhang[1] *Layer-Based Approach for Image Pair Fusion*, proposed new method for decomposing the image pairs into two layers, i.e., the base layer and the detail layer, is proposed for image pair fusion. a local contrast-preserving conversion method is first proposed to create a new base layer of the infrared image, which can have visual appearance similar to another base layer, such as the denoised noisy image. Then, a new way of designing three types of detail layers from the given noisy and infrared images is presented. To estimate the noise-free and unknown detail layer from the three designed detail layers.

Bin Yang and Shutao Li [2], *Multifocus Image Fusion and Restoration with Sparse Representation*, implement a sparse representation-based multifocus image fusion method. 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. Furthermore, the proposed fusion scheme can simultaneously resolve the image restoration and fusion problem by changing the approximate criterion in the sparse representation algorithm.

Mamta Sharma [3], *A Review: Image Fusion Techniques and Applications*, proposed image fusion for high resolution on panchromatic and multispectral images or real world images for better vision. Various methods of image fusion and some techniques of image fusion such as IHS, PCA, DWT, Laplacian pyramids, Gradient Pyramids, DCT, SF. Several digital image fusion algorithms have been developed in a number of applications.

Heng Chu and Weile Zhu [4], *Fusion of IKONOS Satellite Imagery Using IHS Transform and Local Variation*, proposed remote sensing image fusion algorithm based on IHS transform and local variation and its modified approach with low computational complexity. Visual effect and quantity evaluation results show that the proposed simple algorithm outperforms the conventional image fusion methods in the spectral domain with the spatial quality similar to that of the undecimated wavelet transform-based scheme. The proposed modified method can obtain the similar spatial resolution of the merged image with the IHS-based fusion algorithm and the better spectral quality in the green vegetation areas.

Zelang Miao, Wenzhong Shi, Alim Samat, Gianni Lisini, and Paolo Gamba [5], Information Fusion for Urban Road Extraction From VHR Optical Satellite Images, This paper presents a novel method exploiting fusion at the information level for urban road extraction from very high resolution (VHR) optical satellite images. Given a satellite image, we explore spectral and shape features computed at the pixel level, and use them to select road segments using two different methods (i.e., expectation maximization clustering and linearness filtering).A road centerline extraction method, which is relying on the outlier robust regression, is subsequently applied to extract accurate centerlines from road segments. After that, three different sets of information fusion rules are applied to jointly exploit results from these methods, which offer ways to address their own limitations. Two VHR optical satellite images are used to validate the proposed method.

Shashidhar Sonnad [6], A Survey on Fusion of Multispectral and Panchromatic Images for High Spatial and Spectral Information, furnish a survey on various image fusion algorithms of MS and PAN images such as, Brovey transform, Intensity- Hue-Saturation(IHS) transform, Principal Component Analysis (PCA), High pass Filtering, Wavelet transform, Integration of different transform methods with IHS , fusion method based of PCA and feature product of Wavelet transform, Fourier transform, General Intensity-Hue-Saturation (GIHS) transform, Optimal Filter design, modified Wavelet Averaging Merging method and modified Bi-cubic Interpolation method in non Sub sampled Contour let transform, improved IHS and PCA merges based on Wavelet decomposition, etc. the different satellite images used to test the particular methods and different quantitative performance measurement techniques. One should understand while applying image fusion technique is that, no specific image fusion technique is superior compared to others, the best technique is chosen depending upon the application.

Ni-Bin Chang, Kaixu Bai, Sanaz Imen, Chi-Farn Chen, and Wei Gao, Multisensor Satellite Image Fusion and Networking for All-Weather Environmental Monitoring, provides thorough review of contemporary and classic image fusion methods and presents a summary of their phenomenological applications, with challenges and perspectives, for environmental system analysis. Cross-mission satellite image fusion, networking, and missing value pixel reconstruction for environmental monitoring are described, and their complex integration is illustrated with a case study of Lake Nicaragua that elucidates the state-of-the-art remote sensing technologies for advancing water quality management.

Sheng Zheng, Wen-zhong Shi, Jian Liu, and Jinwen Tian, Remote Sensing Image Fusion Using Multiscale Mapped LS-SVM, This paper presents an MS Pan sharpening method using the proposed multiscale mapped least-squares support vector machine (LS-SVM). Under the LS-SVM framework, the salient features underlying the image are represented by support values, and the support value transform (SVT) is developed for image information extraction. The low-resolution MS bands are resampled to the fine scale of the Pan image and sharpened by injecting the detailed features extracted from the high-resolution Pan image. The support value analysis is implemented by using a series of multiscale support value filters that are deduced from the mapped LS-SVM with multiscale Gaussian radial basis function kernels. Experiments are carried out on very high resolution Quick Bird MS + Pan Data. Fusion simulations on spatially degraded data, whose origin MS bands are available for reference, show that the proposed MS Pan-sharpening method performs comparable to the state-of-the-art in terms of the pertained quantitative quality evaluation indexes, such as the Spectral Angle Mapper, relative dimensionless global error in synthesis (ERGAS), modulation transfer- function-based tool and quality index (Q4), etc. The SVT is an effective tool for remote sensing image fusion.

Yashaswini V A, P. Bhuvaneswari, B. Aravind, Multi Model Image Registration and Fusion using Fast Discrete Contour let Transform, proposes Transform Domain Fusion Rule (TDFR) via high pass modulation using Local Magnitude Ratio (LMR) in Fast Discrete Contour let Transform (FDCT) domain. Contour let transform method uses low resolution multispectral image and Cartosat-1 Panchromatic (PAN) of spatial resolution 2.5m is used as high resolution panchromatic image. This both images are up sampled in order to resize the image and registered using mutual information to parameterize and solve the correspondence problem in feature-based registration. This fusion rule generates as high resolution multispectral image at 2.5m spatial resolution with the help of Inverse Fast Discrete Contour let Transform increases the contrast of an image and thus gives sharper visual appearance. Different techniques are compared with this method such as Wavelet, Principal component analysis (PCA) and Curve let also tabulated.

III. METHODOLOGY

Description of the Proposed Work

1. To study about image fusion and its different techniques.
2. To develop an algorithm which will fused the relevant information of two images.
3. To simulate the designed model.
4. To verify the developed logic operation for various images.
5. To analysis the system performance parameter.

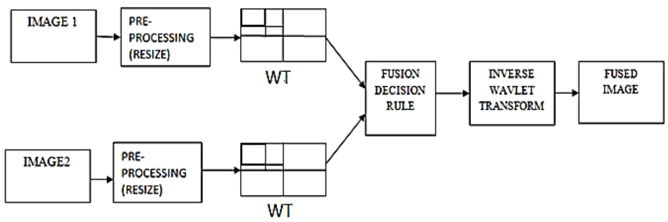

Figure 1. Block diagram of a generic image fusion approach

Transformation coefficient is first performed on each source images, and then a fusion decision map is generated based on a set of fusion rules. The fused transformed coefficient map can be constructed from the wavelet coefficients of the source images according to the fusion decision map. Finally the fused image is obtained by performing the inverse wavelet transform. From the above diagram, we can see that the fusion rules are playing a very important role during the fusion process.

- *Image Decomposition*

In Wavelet transform signal is decomposed, with higher frequency and lower frequency band. Two main types of transform discrete and continuous wavelet transform. In discrete wavelet transform of two dimensional images involves sub–sampling and recursive sampling. At each level we obtain three images as HH(containing diagonal information in high frequency),LH(containing horizontal information in high frequency) and HL(containing vertical information in high frequency).These decomposition produces one approximation image known as LL(low frequency information). At each level of decomposition, the image is split into high frequency and low frequency components; the low frequency components can be further decomposed until the desired resolution is reached. When multiple levels of decomposition are applied, the process is referred to as multi-resolution decomposition. The conventional WT can be applied using either a decimated or an un-decimated algorithm. In the decimated algorithm, the signal is down sampled after each level of transformation. In the case of a two-dimensional image, down-sampling is performed by keeping one out of every two rows and columns, making the transformed image one quarter of the original size and half the original resolution. The decimated algorithm can be represented visually as a pyramid, where the spatial resolution becomes coarser as the image becomes smaller. The decimated algorithm is shift-variant, which means that it is sensitive to shifts of the input image.

- *Fusion Rule (Maximum frequency)*

The wavelet transform coefficients obtained from the input images need to be combined to form a new set of coefficients to be used for backward transform. There are various fusion rules to form the fused wavelet coefficients matrix using the coefficients of the input images. In this proposed work, taking the largest absolute values of the corresponding wavelet coefficients among input images is chosen as the basic fusion rule also the maximum frequency used in fusion rule.

- *Inverse DWT*

Final fused image is reconstructed by inverse wavelet transform from the modified coefficients, In the undecimated algorithm, the signal is up sampled after each level of transformation. In the case of a two-dimensional image, which down samples the approximation coefficients and detail coefficients at each decomposition level, the undecimated wavelet transform (UWT) does not incorporate the down sampling operations. Thus, the approximation coefficients and detail coefficients at each level are the same length as the original signal. The UWT up samples the coefficients of the low pass and high pass filters at each level, the resolution of the UWT coefficients decreases with increasing levels of decomposition.

IV.CONCLUSION

A new multi-focus image fusion technique was proposed. Image fusion techniques are important as it improves the performance of object recognition systems. This project proposes an image fusion method based on different Multi-scale image wavelet decomposition techniques. The process of image fusion combines the input images and extracts useful information giving the resultant image. By using new proposed method we can got more accurate result than other method, Image fusion has so many contrast advantages basically it should enhance the image with all the perspectives of image.

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