ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 5, May 2017

A Critical Review on Image Fusion Techniques

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ABSTRACT: Image fusion is the popular area of the technical research. The technology is being upgraded as the research is inspired by industrial demand. This paper deeply investigates the recent enhancement in the image. The pressing demand is from medical image fusion, remote sensing and ETM. This work covers the brief review of the research work going at the global level. This paper covers IHS, PCA, wavelet transform image fusion and pair wise spatial frequency matching.

KEYWORDS: Image Fusion; DWT;DT-CWT; PCA; DCT.

I. INTRODUCTION

'Image fusion' term itself is self-explanatory. The dual image combination into one image. Sometimes the images obtained from multiple sources lack the quality and information. This problem can be resolved by fusing the images. The resultant image has more spatial and spectral details. The image has better characteristics. The demanding areas are robotics, microscopic imaging and remote sensing. The latest trends in the discrete wavelet transform method of image fusion and principle component analysis are preferred techniques. This work also investigates morphological techniques and combination of DWT with PCA.

II. LITERATURE REVIEW

Richa Srivastava and Ashish Khare have worked on threshold image fusion. They have used Dual Tree Complex Wavelet Transform (DT-CWT) method. Authors have also proposed a threshold based fusion rule to avoid noisy coefficient selection during fusion. This paper proposes that the quantative as well as standard like edge strength fusion factors, sharpness and gradient. The proposed fusion method is tested for multi-focus, medical and remote sensing images. This shows that the proposed method is effective for different applications.[1]

In this paper Sneha J. Sonawane and K.N.Pawar have proposed different techniques and aspects of image fusion for medical image processing to remove the problem of not getting an image that contain all relavant information in focus. They have reduced the storage cost by cutting the storage to a single fused image instead of multiple image. They have proposed medical image fusion for driving useful knowledge medical image data structure. Multichannel image analysis is the co registered assesment of all single possibility images that represent the same. Authors have provided the fusion classification and techniques in the field of medical and compare the earlier methods that suffers from noise, artifacts and spectral degradation. Depending on the methods to be used this paper provides various results.[2]

Kulvir Singh and Neeraj Julka have proposed a new hybrid technique along with a Laplacian Pyramid approach. For solving the matter of edge preservation and for fusing images this hybrid technique is used. This hybrid technique works in following steps: Authors have selected two images that are fused by using wavelet fusion. Again they selected two images for fusion one that obtained in first step and second one that have to be fused. They apply wavelet and LP on the layers separately on both the images. And finally get the fused image. Laplacian pyramid approach is used with wavelet fusion for retaining the standard of fusion image. This paper proved that in terms of quality and edge preservation planned technique is better than standard technique. The techniques developed for fusion should have high accuracy, dimension and duplicability.[3]

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In this paper Gagandeep kaur and Anand Kumar Mittal have proposed a new hybrid technique and comparison of results of two image using it. They also proposed comparison of new hybrid algorithm with older. Discrete cosine transform and variance combination with hybrid discrete wavelet transform. These techniques provides good results in terms of Pseudo signal to noise ratio and mean square error. [4]

Kede ma et al. has worked on the untouched area of perceptual quality assessment as used for multi-solarization image fusion. The authors have designed multi-solarization fusion data-list. They analyzed valued difference between the different multi-solarization image fusion. Findings given by authors are unsuccessful in finding multi-solarization fusion assessment. No multi-solarization image fusion was designed for good qualities for test images. For predicting the pick out characteristics of multi-solarization image fusion images earlier quality models are unable to test images. To remove earlier drawback authors have designed a new image quality assessment(IQA) algorithm for multi-solarization image fusion images which is based on two sources one is structural similarity approach and other is a novel measure approach. After this authors have provided the proposed model by automatically turning the parameter of multi-solarization image fusion for dynamic scenes the proposed model is generalized. In this paper to demonstrate the potential values of proposed image quality assessment model the authors have used an automatic parameter tuning of multi-solarization image fusion model as an example.[5]

Bhavana and Krishnappa have proposed multi-modality medical image fusion methodology. The authors have used discrete wavelet transform often computed tomography(CT), positron emission tomography and magnetic resonance imaging technique gives some information regarding the alignment which is incomplete and ambiguous. In this paper Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) images preprocessed along with exchanging the quality of the input (I\P) images which are degraded and non-readable due to various factors by using spatial filtering techniques likes Gaussian filters with different activity levels the enhanced image is then fused based on discrete wavelet transform. Proposed method has worked as follows. Firstly, Positron Emission Tomography and Magnetic Resonance Images are taken as input for preprocessing Positron Emission Tomography images firstly decomposed into removal of noise and enhancing the input images using Gaussian filter to sharpen the input images filtering used high or low pass region carries more automatically and spectral information. This region decomposed by applying four level discrete wavelet transform. After this authors have combine high frequency coefficient of Positron Emission Tomography and Magnetic Resonance Images using average method. Similarly by combining low frequency coefficients of Positron Emission Tomography and Magnetic Resonance Images obtained fuse results for the low activity region. To get better structural information fuzzy C means clustering used. For avoiding color distortion color patching is also done. Finally fused image is extracted and displayed with less color distortion and without losing any structural information. In this research authors have proposed a new fusion method for fusing Positron Emission Tomography and Magnetic Resonance Images brain images on discrete wavelet transform with less colour distortion and without losing any anatomical information.[6]

Ashishgoud Purushotham et al. have worked on the algorithm discrete wavelet transform and principal component analysis of image fusion. They concluded that image fusion using wavelets with higher level for decomposition showed better performance metrics and in other metrics principal component analysis showed. They proposed different performance metrics with and without reference image to evaluate the performance image fusion algorithm. Both principal component analysis and wavelet transform have done pixel level image fusion in principal component analysis. They proposed that discrete wavelet transform performs better than principal component analysis on the basis of higher mean and weak signal to noise ratio. Two methods work as follows: In discrete wavelet transform, first they took two images that they have to be fused. Then applied discrete wavelet transform and remove wavelet coefficient. On fusion according to its rules wavelet fused coefficient are removed and then inverse discrete wavelet transform is done. Finally get fused images. In principal component analysis this may take first the image that has to be fused. After that they are analyzed and then at multiplex some part of images and some of the principal component analysis are multiplied separated for few. At last in final step these are added we get the fused image.[7]

Mary Sincy and M.Mathura have proposed a method dual tree complex wavelet transform for a novel image fusion. In this paper authors have proposed fusion method base on 2D, DT-CWT is better than fusion methods based on real oriented 2D dual tree transform stationary wavelet transform and classical discrete transform. This technique works on following steps. First, take two images that have to be fused. Apply the DT-CWT algorithm on both images. After that fusion rule is applied. Fused wavelet coefficient after applying function. Take inverse of DT-CWT and after that they

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have obtained fused o/p image. In this paper they proposed attention towards the use of multi-resolution image fusion techniques. Obtained image fusion technique is capable of achieving improved directionality. They have showed that image quality mainly depends on directionality property of multi-resolution techniques fusion rules input images are registered.[8]

Nayera Nahvi and Deep Mittal have worked on medical image fusion using discrete wavelet transform. Authors have present a new algorithm to improve the quality of these fused images using DWT approach. Performance calculated on the basis of Pseudo signal to noise ratio, Mean square error and total processing time. This proposed the medical image fusion characteristics like imaging modalities to fusion algorithms and organs that are taken steps for image fusion in this paper first they take two images that have to be fused. Apply the wavelet decomposition of both images. They specified the different levels of decomposition on the output. After that perform discrete wavelet transform(DWT) and specify method of wavelet fusion, fuse wavelet coefficients and then perform inverse discrete wavelet transform we obtained final result. In this paper authors have results the wavelet transform as a powerful method for image fusion. Authors observed that maximum minimum fusion rule along with haor wavelet gives better results, so that values of Pseudo signal to noise ratio increases and mean square error decreases as the decomposition level increases.[9]

Kai Zeng et al. have worked on perception evaluation. Authors have used multi-solarization image fusion algorithms. In this research first authors have build a database that contains source input images with multiple exposure levels(>= 3) together with fuse images generated by both standard and new image fusion algorithms. In this research, image fusion is active in the last ten years and a valid number of image fusion and objective image quality assessment methods have been proposed. In this paper, authors have been allocated the evaluation and comparison of classical and standard multi exposure fusion(MEF) and relevant image quality assessment. In this research current work is that none of the traditional and standard objective of image quality assessment model developed for image fusion achieves good correlation with subjective opinion obtained result motivates the authors to design advance objective quality models for image fusion.[10]

Nisha Gawari and Dr. Lalitha.Y.S have worked on fusion techniques they have used principal Component Analysis, Discrete Cosine Transform and Discrete Wavelet Transform. Authors have discussed formulation process flow diagrams algorithms of given techniques. In this paper Discrete Wavelet Transform based two algorithms are proposed, these are maximum pixel replacement and pixel averaging approach. On the basis of their result they concluded that for applications principal Component Analysis, Discrete Cosine Transform technique is used whereas Discrete Wavelet Transform based technique provide good quality of fused images.[11]

Kusum Rani and Reecha Sharma have proposed a study of image fusion. They uses Discrete Wavelet Transform and multi-wavelet transform. In this paper Discrete Wavelet Transform is used for multi resolution, fusion and multi-wavelets are the extension of scalar wavelets. In this paper authors have compared Discrete Wavelet Transform and Discrete multi-wavelets Transform. A multi-wavelet system provides perfect reconstruction, good performance at the boundaries and a higher order of approximation. image fusion is done in following steps using 2D-DMWT first author take two separate images that have to be fused. Registration in levels are done. After pre-filtering apply the 2D-DMWT to the registered input images. They have appoint different weights to multi-wavelet coefficient using an activity level measurement. After that grouping is done and coefficient selection is done then consistence verification is done. At last inverse discrete multi-wavelets Transform is applied and post filter is used. After that we get fused image. In this paper authors have showed that qualitatively multi-wavelet transform give better performance than wavelet and this can be happen with proper selection of multi-wavelet transform.[12]

Mirajkar Pradnya P. and Sachin D. Ruikar have proposed an image fusion approach based on stationary wavelet transform. This method is firstly applied with the original image to get an edge image frequency measurement properties in level1 and level2 both. After that this result is compared with some other methods. 2D SWT Method is based on the idea of no decimation. In this paper author have calculated the performance results of used fusion method that provides good result. In addition to this that algorithm can be applied to other feature in noisy image source.[13]

M. Hossny and S. Nahavandi have proposed the duality between image fusion algorithm and quality metrics. The authors have proposed duality index as main function against which combination of fusion algorithms, metrics and their parameters are tested. The proposed duality index depends on performing fusion experiments. The authors have formulated the duality between image fusion algorithms and metrics. It can be realized and tested. proposed method has been runs to estimate comp ability indices of various combinations of fusion algorithms. The main objective of this

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Vol. 5, Issue 5, May 2017

method is to validate that fusion metric does not suite all fusion operations. In this paper author concludes that tuning image fusion algorithms and metrics requires a real valued main function that describes how it is compatible.[14]
M.Seetha et al. have proposed the performance analysis of image fusion. They have used image segmentation in this paper for evaluating the performance of fused image the authors have made measurement using tranquil based segmentation. Objective of this study is to segment the given spectral image into individual regions and calculate the quality of various image fusion techniques. Authors have proved that principal components analysis fusion techniques preserves more un-earthy information as compared with multiplicative and bravery image fusion techniques. In this research image fusion is done on three levels- pixel, feature and decision.[15]

III. CONCLUSION

The current review paper investigates the DWT, PCA and combination of DWT and PCA. It can be concluded safely that fusion algorithm selection is specific problem based. The spatial domain provides high quality resolution of the image in the spatial domain. The best solution is the combination of DWT and PCA techniques.

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