

**Image Fusion Methodology Using Hybrid Pyramidal DWT-Lp Approach**Er.Kulvir Singh¹, Er. Neeraj Julka²¹Department of Electronics & Communication, Asra College of Engg. & Technology²Department of Electronics & Communication, Asra College of Engg. & Technology

Abstract — Image fusion is described as the process of combining two or more images to form a more informative resultant image than any of the images used as input image. Image fusion is done to obtain a more enhanced and informative and more quality image from two or more images that are taken from different perspectives, different sensor, different modal and different temporal. The application areas of image fusion include both military and domestic purposes and even medical purposes. Several techniques have been designed till date for efficient fusion like Principal Component Analysis, Discrete Wavelet based fusion etc. This paper presents a hybrid technique for image fusion and the results of the applied hybrid technique are analyzed and verified using the MATLAB software.

Keywords- Image Fusion, DWT, LP, PCA, DWT

I. INTRODUCTION

Image processing is a wide area of research for scholars. It offers choice of numbers of fields and area in which research work can be carried out. Image fusion is one such field in the area of image processing in which various researches are being carried out to obtain better results. Image fusion is the method of getting a more informative and high quality image from two or more images. The images that are fused are more likely to be taken of same perspective and same sensors but these could be of different detectors, different modal, various focal and various temporal. In the process of image fusion, the information of all the images to be fused is considered and then fusion is done such that the resultant image will be more informative and qualitative. The need of image fusion is to obtain resultant image of high spatial and high spectral information. The algorithms that are developed for image fusion are input dependent. The process of image fusion finds its use in various control and exploration operations for domestic and non-civil goals. Applications of image fusion include areas like satellite imaging; rob vision, object revelation and recognizance. Image fusion can also be employed in medical diagnosis and treatments. This is done by merging or overlaying different images of patient to obtain more accurate information. The technique of image fusion is used for determining the situation by combining the information from various sensors. Various algorithms have been designed for image fusion that includes Laplacian Pyramid, principal component analysis, Discrete Wavelet Fusion etc. The techniques developed for image fusion should have high accuracy, high reliability & dimensionality.

II. IMAGE FUSION TECHNIQUES

Image fusion is referred to as the process of obtaining a superior image from the input images by extracting certain features of the input images. Basic objective of fusion is obtaining more informative and better quality image than the input images. Image fusion techniques are classified into following two categories:

1. Spatial Domain fusion

- 1.1. PCA
- 1.2. Averaging method
- 1.3. IHS method
- 1.4. High pass filtering

2. Frequency domain fusion**2.1 Pyramid based Decomposition based Fusion:**

- 2.1.1 FSD pyramid
- 2.1.2 Laplacian Pyramid
- 2.1.3 Ratio-of-low-pass pyramid
- 2.1.4 Gradient Pyramid
- 2.1.5 Morphological Pyramid

2.2 Discrete Wavelet Transform based Fusion

- 2.2.1 Haar wavelet transform Method
- 2.2.2 Daubechies wavelet transforms method.

- 1. Spatial Domain Fusion:** In these techniques, fusion is done by directly changing the image pixels. The values of the pixels of both the images are done such that a better and enhanced image is obtained as a result. Types of spatial domain fusion techniques are described below:

- 1.1. Principal Component Analysis (PCA):** Principal component analysis is a technique of image fusion in which the compound input set is transformed into new data set known as principal components. The data set with the maximum variance is referred to as the first principal component (PC1). The second principal component should lie within the space of the first principal component. The third principal component should then lie within the space of the second component and so on. The basis vectors of PCA preferably Fast Fourier Transform, Discrete Cosine Transform etc are not determinate and these basis vectors rely on the data set. Principal component Analysis technique excavates the intrinsic structure of data in an indifferent way and so it is considered as the most easiest and useful technique applied for image fusion

$$C = \text{Conv}(I_1, I_2) \dots\dots\dots I_1, I_2 \text{ are images}$$

$$[V \ D] = \text{eig}(C) \dots\dots\dots V \ D \text{ are vectors}$$

$$P_1 = V(1) / \sum v, \quad P_2 = V(2) / \sum v, \quad P_1 \text{ and } P_2 \text{ are weight values}$$

- 1.2. Average Method:** In this method the resultant image is formed keeping all the regions of the input images into focus. The pixel values are greater of the focused area of input images. The average value is obtained by summation of all the pixel values of the input images and then dividing the sum by the number of input images. This obtained average value is then assigned to the closely similar pixel of the resultant image.

$$I_f(x, y) = [I_1(x, y) + I_2(x, y)] \div 2$$

Where I_1 and I_2 are the images

- 1.3. IHS method:** IHS method of image fusion is the most commonly employed technique for obtaining a sharpened resultant image. In this technique, three features namely intensity, hue and saturation of color are extracted and controlled for obtaining a better quality output image. Any of the three features of the resultant image are replaced and this is done by using IHS transform technique. This is mainly employed on low spatial resolution pictures to obtain image with greater spatial resolution.

- 1.4. High Pass filtering:** A high pass filter is employed in this technique for obtaining a high quality resultant image by refining the multi colored picture of high resolution. This method is useful as it preserves the apparitional info that is incorporated in the lesser frequency data of the High Resolution Multispectral Image.

- 2. Frequency domain Fusion:** In this type of image fusion, decomposition of multiscalar coefficients of the images selected as input is done at first and then certain rules are implied. The coefficients of the fused image are chosen on the basis of the employed rules.

- 2.1. Pyramid based Decomposition Method:** It is considered as advantageous technique for image fusion as it is easier to tally and the filtering done using pyramid method is swifter than the filtering done through FFT. The format of the info provided by the pyramid method is also easily accessible

- 2.2. Discrete wavelet based Fusion:** Discrete wavelet transform is applied to split the input images into sup parts on the basis of band coefficients. The fusion is then done by fusing these coefficients using technique of maximum selection. Output image is obtained by applying Inverse DWT on the fused coefficients.

$$f(t) = \sum_k a_{j_0}(k) \phi_{j_0 k}(t) + \sum_k \sum_{j=j_0}^j d_j(k) \phi_{j,k}(t)$$

III. PROPOSED WORK:

The major problem in image fusion is the selection of technique that will perform image fusion, as there are various methods available so there is a need to find the best method that will fuse the image without any loss of edges or data. The images obtained after fusion should be highly spatial and should have high resolution.

In this fusion methods, two techniques of wavelet fusion and LP i.e. Laplacian Pyramid are combined and a new hybrid approach is proposed for image fusion. The images are first applied the technique of wavelet fusion and then the fused images with these techniques undergo fusion using LP technique. The problem of high shift invariance is resolved using this hybrid approach. The images obtained are of high spatial and high spectral resolution.

This hybrid technique of image fusion is considered to be better than the previously used techniques. The results obtained are better, efficient than the conventional techniques.

IV. BLOCK DIAGRAM:

In this proposed work a hybrid approach for image fusion is proposed. Wavelet fusion technique and the laplacian pyramid are the two techniques that are applied on the image. By combining the two techniques the quality of the image is not degraded and the resultant image obtained is more informative. In image fusion two images are selected that are fused, On the selected images firstly the Wavelet fusion is applied, after applying wavelet fusion technique, now the laplacian pyramid is applied on the all layers of the images, finally the fused image is obtained that is more informative than the original images .

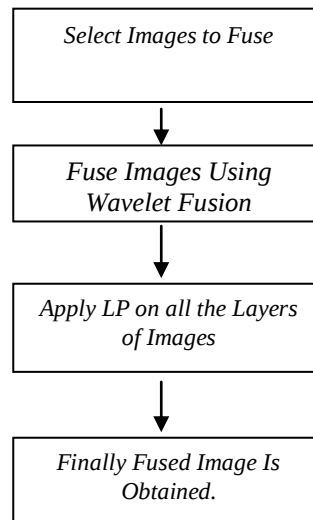


Fig 3. Process of applying proposed technique for obtaining a final fused image.

Steps to be followed for obtaining a fused image using proposed technique:

1. The first step would be selecting two images that are to be fused.
2. The selected images will be fused using wavelet fusion technique.
3. The layers of the images will be separated and then, Laplacian pyramid technique is applied on the separated layers.
4. A final fused image is obtained, after applying the hybrid technique proposed in the paper.

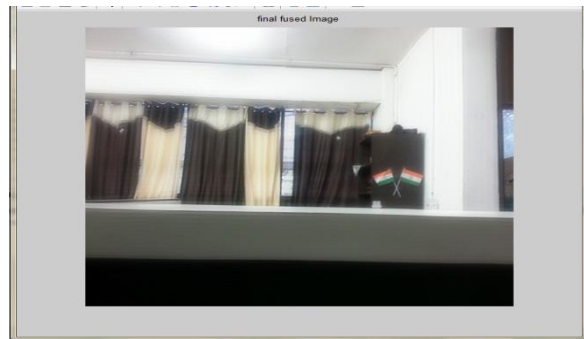
V. RESULTS & DISCUSSIONS:

Two blurred input images are selected and a output image is obtained after fusing both the input images. The resultant image is of better quality, with better spectral resolution and it can be observed from the images below.



(a) Input Image 1

(b) Input Image 2



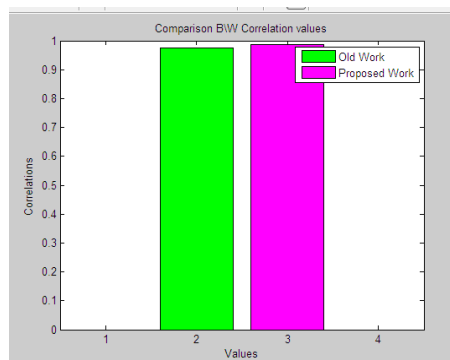
(c) Resultant image obtained after fusion

The graphs showing comparison between the wavelet technique and the proposed technique for fusion are illustrated below:

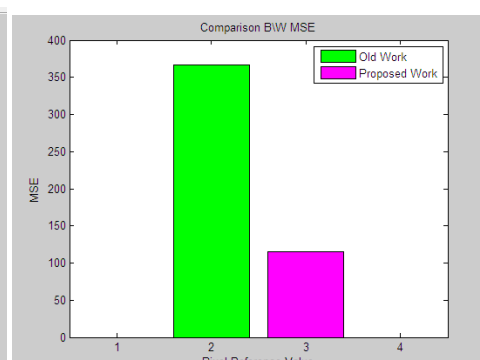
Table 1, showing the comparison between the old approach and proposed approach

Sr no	Parameters	Old Approach	Proposed Approach
1	Correlation	0.9821	0.9903
2	MSE	1197.64	338.5302
3	BER	0.0576	0.0438
4	PSNR	17.3475	22.8348

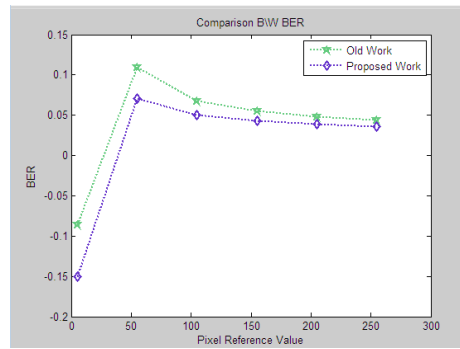
Below are the graphical comparison of the techniques:-



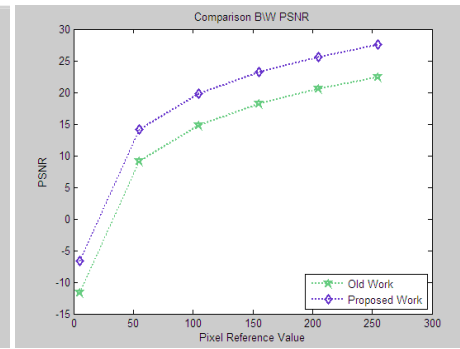
(a) Comparison graph of the correlation value



(b) Comparison graph of Mean square Error



(c) Comparison graph of BER



(d) Comparison graph of PSNR values

VI. CONCLUSION:

This proposed hybrid approach solves the problem of edge preservation and fused the images more specifically. Since, the second approach used with wavelet fusion technique is Laplacian Pyramid, this technique analyses each particular of the image and hence helps in retaining the quality of fused image. The Laplacian Pyramid technique checks each pixel of the images and hence easily observes any change in the information of the image. The proposed technique has proved to be better than the conventional techniques in terms of edge preservation and is better in the terms of quality.

VII. FUTURE SCOPE:

Further enhancements in the fusion can be obtained for fusion by applying any optimization algorithm. Optimization algorithms have the ability of improving the quality of results. Employing optimization algorithm for image fusion might improve the quality of image formed after fusion and more informatics image will be formed.

VIII. REFERENCES:

- [1] Deepak Kumar Sahu,, "Different Image Fusion Techniques –A Critical Review" International Journal of Modern Engineering Research, Vol. 2, Issue. 5, pp-4298-4301, October 2012.
- [2] Gang Li,YiFeng Dong, "Improved Image Fusion Algorithm Based on Wavelet Transform in EFVS"DOI 10.1109/CS0.2014.42,2014.
- [3] A.Umaamaheshvari, "IMAGE FUSION TECHNIQUES "IJRRAS 4 (1), pp 69-74, July2010.
- [4] Haozheng Ren , "Research of multi-focus image fusion based on M-band multi-wavelet transformation" Advanced Computational Intelligence (IWACI), 2011 Fourth International Workshop on Pp 395 – 398 ,2010.
- [5] Dr.S.S.Bedi , "Image Fusion Techniques and Quality Assessment Parameters for Clinical Diagnosis: A Review "International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 2, pp 1153-1157, Feb 2013.
- [6] Yong Yang, "Medical Image Fusion via an Effective Wavelet-Based Approach" EURASIP Journal on Advances in Signal Processing,2010.
- [7] Xiaoyi Yang , "Research on fusion algorithm based on wavelet transformation in SAR image identification" Intelligent Control and Automation (WCICA), 2011 9th World Congress on Pp 419 – 424,2011.
- [8] Qiang Fu, "Multi-focus Image Fusion Algorithms Research Based on Curvelet Transform" Genetic and Evolutionary Computing,WGEC '09. 3rd International Conference onPp 442 – 446, 2009.
- [9] Wu Yiqi , "Multilevel and Multifocus Image Fusion Based on Multi-Wavelet Transformation" Computer Network and Multimedia Technology,. CNMT 2009. International Symposium on, pp 1-4 , 2009.
- [10] Yahao Yan , "Multi-focus image fusion algorithm based on NSCT", Cloud Computing and Intelligent Systems (CCIS), 2012 IEEE 2nd International Conference on Volume:01 , Pp 85 – 89, 2012.
- [11] R.Maruthi, "MULTI FOCUS IMAGE FUSION BASED ON THE INFORMATION LEVEL IN THE REGIONS OF THE IMAGES "Journal of Theoretical and Applied Information Technology, pp 80-85, 2007.

- [12] YAO Wan-qiang, "Multi-spectral image fusion method based on wavelet transformation" The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Vol. XXXVII. Part B7.pp 1261-1266, 2008.
- [13] J.Sapkal, "Image Fusion based on Wavelet Transform for Medical Application "International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue 5, , pp.624-627 624, 2012.
- [14] S. Zebhi , "IMAGE FUSION USING PCA IN CS DOMAIN" Signal & Image Processing : An International Journal (SIPIJ) Vol.3, No.4, pp 153-166, 2012.
- [15] N. INDHUMADH, "Enhanced Image Fusion Algorithm Using Laplacian Pyramid and Spatial frequency Based Wavelet Algorithm" International Journal of Soft Computing and Engineering (IJSCE) Volume-1, Issue-5, pp 298-303,2011.
- [16] Mirajkar Pradnya P, " IMAGE FUSION BASED ON STATIONARY WAVELET TRANSFORM" International Journal of Advanced Engineering Research and Studies,2013.
- [17] Anjali Malviya, "Image Fusion of Digital Images", International Journal of Recent Trends in Engineering, Vol 2, No. 3, pp 146-148, Nov 2009.
- [18] Vadher Jagruti, "Implementation of Discrete Wavelet Transform Based Image Fusion" ,Journal of Electronics and Communication Engineering Volume 9, Issue 2, Ver. VIII, Mar - Apr. 2014.