International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in

Vol.3., Issue.6., 2015
(Nov.-Dec.,)

RESEARCH ARTICLE

ISSN: 2321-7758

PYRAMIDICAL PRINCIPAL COMPONENT WITH LAPLACIAN APPROACH FOR IMAGE FUSION

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ABSTRACT

The process of combining multiple input images into a single composite image is called image fusion. Main aim is to create from the collection of input images a single output image which contains a better description of the scene than the one provided by any of the individual input images. The output image should be more useful for human visual perception or for machine perception. Pixel level image fusion using wavelets and principal component analysis has been implemented and demonstrated. For this, the two methods of the image fusion are combined namely Laplacian pyramid based image fusion and the PCA based image fusion. It has been concluded that image fusion using DCT with higher level of decomposition showed better performance in some metrics and in other metrics PCA showed better performance. Image fusion basically works or uses in all digital areas whether it is medical ,military areas, remote sensing as well as for general purposes where input images or similar images are not clear to vision; fused images help for high resolution of vision.

Keywords: Types & levels of image fusion, fusion algorithms: PCA & Laplacian pyramid based image fusion

I. INTRODUCTION

Image fusion is a technique to combine the registered image to increase the spatial resolution of acquired low detail multi-sensor images and preserving their spectral information. The problem that multi-sensor image fusion tries to solve is to merge the information content from several images taken from the same scene and provide a fused image that have the finest information. So fused image provide superior image than the original source images. Image fusion could be performed at three different levels: pixel level, feature level and decision level [1]. The simple fusion method take the average of the gray level source images pixel by pixel and produce some undesired effects gives poor performance. To overcome this problem, multi scale transforms such as wavelets, laplacian pyramids and gradient pyramid. Discrete wavelet transform (DWT) would provide directional information in decomposition levels and contain unique information at different resolutions Principal component analysis (PCA) is a mathematical tool which transforms a number of correlated variables into a number of uncorrelated variables. The PCA is used in image compression and image classification. The fused image is achieved by weighted average of source images. To implement the pixel level fusion, arithmetic operations are widely used in time

domain and frequency transformations are used in frequency domain. In many applications area of navigation guidance, object detection and recognition, medical diagnosis, satellite imaging for remote sensing, rob vision, military and civilian surveillance, etc.,

II. RELATED WORK

F. Laliberte [1] presents proposed method of registration and pixel level fusion techniques. All the images are of different features and different intensities, different resolution at different time and used global point mapping and search for control point matches of retinal images. In this fourteen pixel level fusion used to classified according qualitative and quantitative performance.

V.P.S Naidu [2] works on pixel level image fusion algorithms used wavelet and PCA techniques fused image can be avoided using wavelets with shift invariant property. It has been concluded that image fusion using wavelets with higher level of decomposition shows better performance in some metrics.

S. Vekkot [3] presents the combination of pixel level and region based with enhancement of edges and structure fusion. These techniques are applicable for pixel and energy based algorithms done by analysing the data of images.

A.Umamahesvari [4] gives review of techniques of fusion in RGB images, Gray Scale images by user interactive with DCT approach which is Discrete cosine transformation usually for the better efficiency in fused images.

N.Indhumani [5] presents work on different modals or techniques of image fusion and applying 2D-DWT algorithm on input images. Both SF and Wavelet-DWT is used for efficient output in fused image. Coefficients at lower approximations are used in laplacian algorithm. Where SF and Wavelet combined together they are working for high approximation. Finally DWT algorithm gives the desired results with desired new fused coefficients. In this paper performance parameters are MSE, PSNR, where hybrid modal gives better results than this techniques.

M.A Mohamed [6] give their research on implementation of techniques for multifocus images based on FPGA. This paper analyze the issues of image fusion in various methods like in averaging, PCA, Pyramids, DWT, DCT. Author represents the comparison of various methods it gives better assessment by using Field Programmable Gate Arrays.

H. R. Shahdser [7] presented PCA image fusion method i.e. pan sharpening method for the higher and efficient resolution adds spatial information to it with no spatial PCAs visual and statistical analyzes show that this algorithm improves the fused and merging quality and resolution in terms of RASE, ERGAS, SAM as compared to fusion methods IHS, Brovey, PCA, HPF, HPM.

Simrandeep Singh[8] Works on multifocus image fusion it means it is based focal length of the images by using Gaussian and Laplace pyramids. It gives much improved resolution of fused images generally Laplace works on low level band and high level band so it gives good results according to multi focus.

Nisha Gadara[9] presents the comparative study of three techniques which are PCA, DCT, DWT where according to results of comparison there is some drawbacks in PCA, DCT as compared to these two techniques DWT is the best technique for fused the images.

Deepali Sale [10] presents wavelet family with haar orthogonal in this paper Laplace technique used using high level and low level bands where filters do their work for removing distortion at the edges with spatial frequency where Shift variant gives not good results instead of this using shift invariant algorithm for the better results of fused images.

III. PROBLEM FORMULATION

The conventional image embedding technique is watermarking which applies DCT to the host image. The problem appeared in this technique is that the size of the host image should be greater than the signature image, thereby reducing the signal to noise ratio and degrades the system performance.

IV. PROPOSED WORK

For better results, proposed technique introduced image fusion with hybrid technique. In this the two method of the image fusion are combined namely Laplacian pyramid based image fusion and the PCA based image fusion. Image Fusion is a process of

combining the relevant information from a set of images of the same scene into a single image and the resultant fused image will be more informative and complete than any of the input images. Many method of image fusion have been proposed earlier but were not as efficient as required. By studying the pervious technique, it was found that if the two techniques of the image fusion are combined, the resultant image will be better than applying the single technique on the image. The advantage of using PCA is that the MS bands are somewhat correlated. The PCA transform can convert the correlated MS bands into a set of uncorrelated components, say PC1, PC2, PC3… The first principle component (PC1) also resembles the PAN image. In this the two images are selected and on that images the Laplacian pyramid is applied using DCT, it will divide image into the pyramids and after that the PCA is applied on the images, as the result the image fused is more informative. This hybrid method is considered to be better and efficient than the previous methods of image fusion.

V. IMAGE FUSION ALGORITHMS

In this section the details of wavelets and PCA algorithm and their use in image fusion are described.

A. **Wavelet Transform**

Wavelet theory is an extension of Fourier theory and it is introduced as an alternative to the short time Fourier transform. In Fourier theory the signal is decomposed into sines and cosines but in wavelets the signal is projected on a set of wavelet functions. Fourier transform would provide good resolution in frequency domain but wavelet would provide good resolution in frequency domain as well as time domain. Wavelet transforms are linear transforms whose basis functions are called wavelets. The wavelets used in image fusion can be classified into many categories such as orthogonal, bi-orthogonal etc. Although these wavelets share some common properties, each wavelet has a unique image decompression and reconstruction characteristics that lead different fusion results. The Discrete Wavelet Transform (DWT) of image signals produces a non-redundant image representation, which provides better spatial and spectral localization of image information, compared with other multi scale representations. Recently, Discrete Wavelet Transform has attracted more and more interest in image processing. The DWT can be interpreted as signal decomposition in a set of independent, spatially oriented frequency channels. The signal S is passed through two complementary filters and emerges as two signals, approximation and Details. This is called decomposition or analysis. The components can be assembled back into the original signal without loss of information. This process is called reconstruction or synthesis. The mathematical manipulation.

B. **Discrete Cosine Transform Techniques**

The simplest method is to take the average of the source images. However, this often leads to undesirable side effects including reduced contrast. Many other techniques including pyramid based image fusion and wavelet transform based image fusion have been introduced to solve this problem. We present an image fusion technique based on average measure defined in the DCT domain. An improved version of direct DCT image fusion is obtained from the DCT representation of the fused image by taking the average of all the DCT representations of all the input images. Actually, this image fusion technique is called the DCT + average; modified or "improved" DCT technique. I can be found that, there is a contrast reduction in the fused images obtained by the modified DCT technique.

C. **Discrete Wavelet Transform Techniques**

The two-dimensional discrete wavelet transform is becoming one of the standard tools for images fusion. The DWT is computed by successive low pass and high pass filtering of the digital image or images. This is called the Mallat algorithm or Mallat-tree decomposition. Its significance is in the manner it connects the continuous time multiresolution to discrete-time filters. The principle of image fusion using wavelets is to merge the wavelet decompositions of the two original images using fusion methods applied to approximations coefficients and details coefficients.

D. Laplacian Pyramid Fusion

An image pyramid fusion consists of a set of low pass or band pass copies of an image, each copy

representing pattern information of a different scale. At every level of fusion using pyramid transform, the pyramid would be half the size of the pyramid in the preceding level and the higher levels will concentrate upon the lower spatial frequencies. The basic idea is to construct the pyramid transform of the fused image from the pyramid transforms of the source images and then the fused image is obtained by taking inverse pyramid transform. Typically, every pyramid transform consists of three major phases:

- Decomposition
- Formation of the initial image for recomposition.
- Recomposition

Block diagram of proposed work

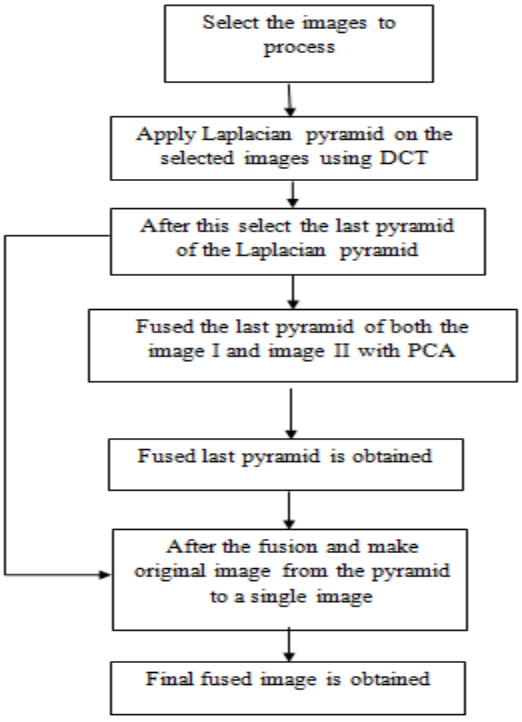

Fig 1: Block diagram of purposed work

VI. SIMULATION RESULTS:

Methodology:

Image fusion is the process of combining relevant information from two or more images into a single image. The resulting image will be more informative than any of the input images. Various method of image fusion have been proposed so far. In this approach a new method based on hybridization of the pervious method is proposed. The steps of the proposed method are explained as following:-

1) Initially select two images namely image I and image II from the given set of the data images, so that the fusion is applied on it .
2) After selecting the images apply Laplacain pyramid on both the images by using DCT, by applying Laplacian pyramid on the image the image is divided into pyramids
3) Now select the last pyramid Laplacain pyramid from both the images, after applying Laplacain pyramid method on both images, image I and image II.
4) After the selection of the last pyramid fused the last pyramid of the both the image, image I and image II with PCA (principal component analysis).
5) The last pyramid that is fused by the PCA is obtained
6) After the fusion is done, now take rest of the pyramid of the images and convert them into the single image. As they were converted into pyramid from the original image.
7) Finally after applying both Laplacain pyramid method and the PCA method the fused image is obtained, that is much informative than the original image. So this hybrid method is considered to be better than the previous methods.

VII. RESULTS

Fig 2: First image

Fig 3: Second image

Fig 4: Fused image

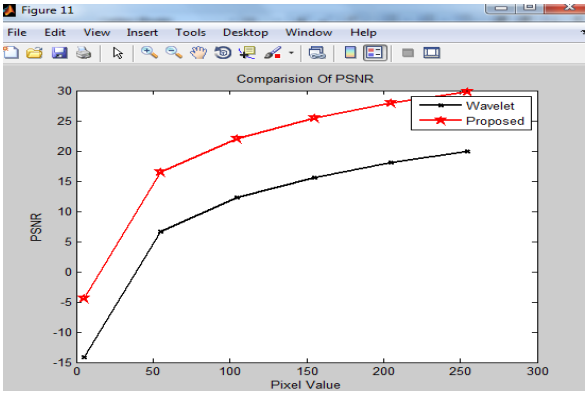

Fig 5: Comparison of wavelet & hybrid proposed

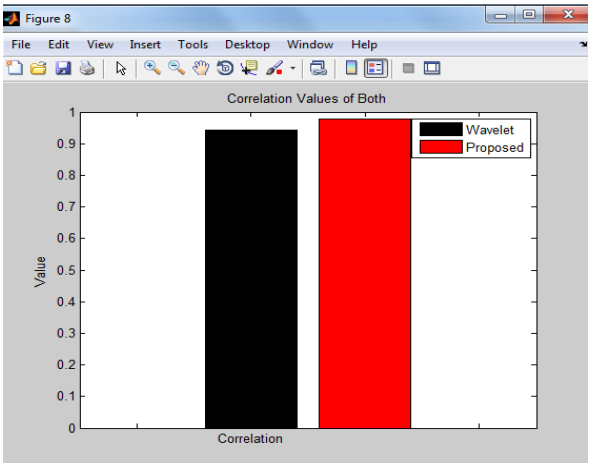

Fig 6: Correlation values of wavelet & proposed technique (hybrid)

VIII. CONCLUSION

By analysis of different techniques for different fusion methods, we can say that fused image using pixel-based technique has good contrast for maximum method result and have a lower contrast in case of average as well as minimum method for input images with different levels of contrast. As image fusion is done in order to get a new image that is more informative than the others .many techniques of image fusion have proposed but were not able to do fusion efficiently Using PCA with Laplacian Pyramid algorithm gives better and efficient results on fused Images.

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