

Image fusion using Iterative Block Level Principal Component Averaging (IBLPCA)

Er.PrabhDeep Kaur

Computer Science and Engineering

Global Institute Of Management and Emerging Technologies Amritsar

Prabhdeep.kaur24@yahoo.com

Abstract-The key objective of vision fusion would be to merging information from two or more images of exactly the same scene in order to deliver only the useful information. This paper has offered a novel image fusion technique which has integrated the PCA based approach to enhance the results further. The proposed technique is designed and implemented in MATLAB using image processing toolbox. Different images has also been used for experimental purpose.

KEYWORDS: Image fusion, PCA, DCT, DWT

I. INTRODUCTION

Image fusion is an essential subject in vision processing. Image fusion is a process of combining the relevant information from a couple of pictures in to a single image where in fact the resulting merged picture may well be more helpful and complete than some of the input pictures. Picture fusion means the combining of two in to a single picture that has the maximum information content without producing details which are nonexistent in a given picture. Caused by vision fusion is a new vision that retains the most desirable information and characteristics of input vision. Several situations in vision processing require high spatial and high spectral resolve in a single vision. In remote sensing and in astronomy, multi sensor merging can be used to reach high spatial and spectral resolution by merging visions from two sensors among that has high spatial resolution and the other one high spectral resolution. The key utilization of vision fusion is merging the grey level high resolution panchromatic vision and the colored low resolution multispectral image. [4]

When using the vision merging technique, some general requirements should be considered

- The fusion procedure shouldn't discard any information within the source pictures.
- The fusion procedure shouldn't introduce any artifacts or inconsistencies that may distract or mislead a human observer or any subsequent vision processing steps.
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- The fusion procedure should be consistent, strong and have, as much as possible, the capacity to tolerate imperfections such as noise or miss registrations.



Figure 1:- (a) Input image focused on the foreground (clock region) (b) Input image focused on the background (books region) (c) Fused image [5]

II. IMAGE FUSION TECHNIQUES

In the Image Fusion method the required data from the given supply photographs is merged together to make a composite image whose quality is more advanced than the given feedback images. Picture combination methods could be categorized in to two groups' i.e.

- Spatial domain fusion method
- Transform domain fusion [7]

There are different methods that have been developed to perform image fusion. Some known image fusion methods are described below:-

- (1) Intensity-hue-saturation (IHS) transform based fusion
- (2) Principal component analysis (PCA) based fusion
- (3) Multi scale transform based fusion:- (a) High-pass filtering method
- (b) Pyramid method :- (i) Gaussian pyramid
- (ii) Laplacian Pyramid
- (iii) Gradient pyramid
- (iv) Morphological pyramid
- (c) Wavelet transforms: - (i) discrete wavelet transforms (DWT)
- (ii) Stationary wavelet transforms
- (iii) Multi-wavelet transforms
- (d) Curvelet transforms [12]

2.1 Principal Component Analyses (PCA)

PCA is just a mathematical instrument for change of correlated factors in to uncorrelated factors. For picture classification and picture pressure PCA is used comprehensively. There's involvement of mathematical formula for change of factors which can be called key components. It computes a tight and optimum explanation of the info set. [7] Principal Component Analysis is a method, which reduces the multidimensional data sets into lower dimensions for analysis. This method determines the weights for each source. Image using the eigenvector corresponding to the largest eigen value of the covariance matrix of each source image. [11]

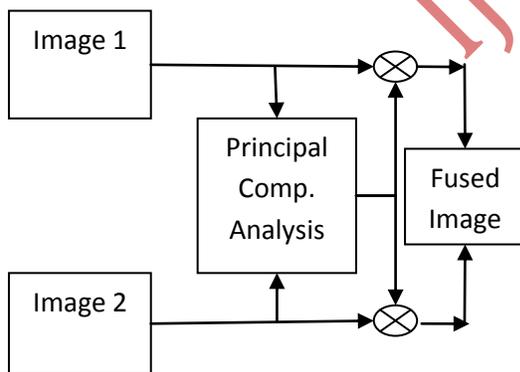


Figure 2:- Image Fusion Process using PCA [2]

2.2 Discrete Cosine Transform

It's seen that all the picture fusion methods are extremely complex and consumes long which are tough to be used on real-time applications. The fusion strategies which are used in DCT domain are extremely effective when the feedback

photographs are numbered and merged photographs are restored in JPEG standard .For using the JPEG development, an image (in color or gray scales) is divided in two blocks of 8x8 pixels firstly. The Discrete Cosine Transform (DCT) is a while later used on each block leading to the technology of 64 coefficients that are quantized to decrease their magnitude. The coefficients are then changed into a one-dimensional variety in a crisscross fashion prior to entropy encoding. The compression is obtained in two measures; the initial through quantization and the next through the entropy development process. For reducing the problems undergone in the fusion of real time programs and enhancing the quality of merged picture, DCT fusion strategy is applied. [7]

2.3 Discrete Wavelet Transform (DWT)

In discrete wavelet change (DWT) decomposition, the filters are particularly developed to ensure that successive layers of the chart just contain details which are not presently accessible at the preceding levels. [1] Wavelet transforms are multi-resolution image decomposition tool that provide a variety of channels representing the image feature by different frequency sub bands at multi-scale. It is a famous technique in analyzing signals. When decomposition is performed, the approximation and detail component can be separated 2-D Discrete Wavelet Transformation (DWT) converts the image from the spatial domain to frequency domain. [10]

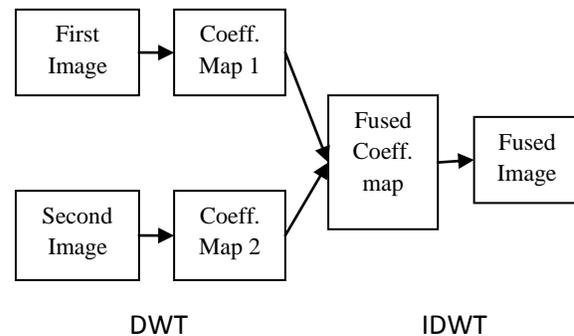


Figure 4:- Image Fusion process Using DWT [2]

III. LITERATURE SURVEY

Cao et al. (2010) [1] has proposed that multi focus vision fusion handles a stack of imagery that have been acquired with an alternative focus point to get an vision with all the current objects in the scene full focused. Multi focus noisy vision fusion algorithm utilizing the contour let transform has been proposed. Guofeng Shao (2013) [9] Conventional methods of multi-focus image fusion have high computation

and cause blocking effect or artificial effect easily. An effective multi-focus image fusion scheme based on the lifting scheme of wavelets is proposed in this paper. Haghighat et al. (2010) [6] has studied that the aim of vision fusion would be to merge information from many images of the exact view to be able to deliver only the useful information. The discrete cosine transform based types of vision fusion are considerably better and time-saving in real-time systems using discrete cosine transform based values of unmoving image or video. K Sharmila, S Rajkumar (2013) [13] Medical image fusion is the process of deriving imperative information from multimodality medical images. This derived information can be used for various purposes like, diagnosing diseases, detecting the tumor, surgery treatment and so on. This type of information cannot be obtained using single modality image. Therefore, the drawbacks of single modality medical image has paved the way for the process of combining different modality images such as Computed Tomography (CT), MRI, Positron Emission Tomography (PET), and Single Photon Emission Computed Tomography (SPECT) into a single image. Qingping Li, Junping Du (2013) [8] centered on the situation, a region-based multi-focus picture combination system was planned based on the regional spatial frequency (LSF). Firstly, calculate LSF for each pixel of resource pictures, and a segmentation of the common picture was presented to section the source images. From the segmented picture, a distributed area illustration is purchased to label the source images. The identification of essential functions in distributed area illustration, area spatial frequency (RSF), has been used to guide the combination process. Rong Fan, Qiufen Yang and Guanqun Liu (2014) [3] planned the nonlinear measured multiband combination algorithm which introduced the nonlinear measured value. The simulation effect suggests that the calculated number of the improved image combination algorithm is somewhat decreased, and the real-time efficiency has been improved significantly. Varshney, P.K. (2011) [13] investigated the situation of fusion of remote sensing images, e.g., multispectral image fusion, based on MRF models and incorporates the contextual constraints via MRF models to the fusion model. Fusion algorithms underneath the maximum a posteriori criterion are developed to search for solutions. Y Phamila, R.Amutha [12] presented a simple and efficient multi-focus image fusion scheme explicitly designed for wireless visual sensor systems equipped with resource constrained, battery powered image sensors employed in surveillance, hazardous environment like battlefields etc. Here the fusion of multi-focus images has been based on higher valued Alternating Current (AC) coefficients calculated in Discrete Cosine Transform (DCT) domain. The proposed method overcomes the computation and energy limitation of low power devices and is investigated in terms of image quality and

computation energy. Yong Yang (2010) [14] a novel discrete wavelet transform (DWT) based method for medical picture mix is presented. Firstly, the medical photos to be merged are decomposed by the DWT. Secondly, by considering the features of individual aesthetic program (HVS) and the bodily meaning of the wavelet coefficients. Eventually, the merged picture is constructed by the inverse DWT (IDWT) with all the mixed coefficients.

IV. PROPOSED ALGORITHM

Step1:- First input image (two images) is given.

Step2:- If both the input images are colored images then conversion is done, if both the images are grey in color then apply the proposed hybrid fusion approach (IBLPCA & DCT) then we get the resultant image and hen parameters are evaluated.

Step3:- When images are colored images then in conversion process proposed hybrid fusion approach (IBLPCA & DCT) is applied on Hue, Saturation & Intensity. (Because the HSI definition of saturation is a measure of a color's purity/grayness. Purer colors have a saturation value closer to 1, while grayer colors have a saturation value closer to 0.)

Step4:- When images are converted to Hue, Saturation & Intensity for the resultant image we have to convert the image HSI to RGB.

Step5:- After the conversion of HSI to RGB we will get the resultant image which will be fused image.

Step6:- When we get the fused image then we will evaluate the parameters

1. Peak Signal to Noise Ratio (PSNR).
2. Mean Square Error (MSE).
3. Root mean square error

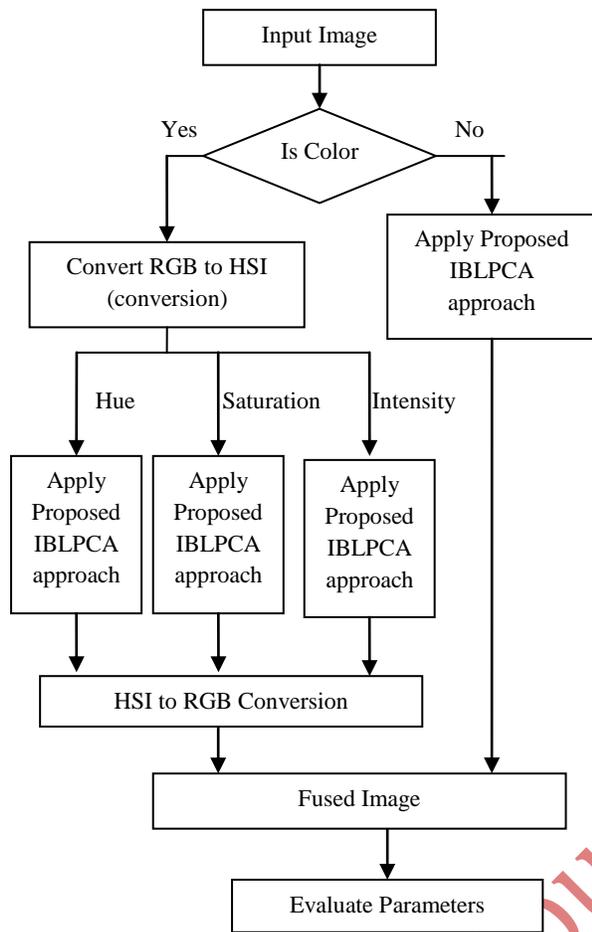


Figure 5:- Flow chart of proposed methodology

V.EXPERIMENT RESULTS

In the experiments, the proposed approach has been implemented to test a wide variety of different images. The algorithm has been implemented in MATLAB.

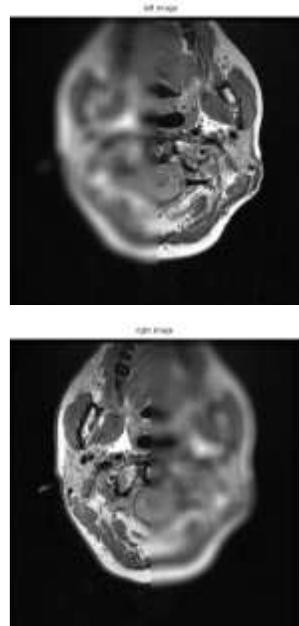


Figure 6:- Input images

Both the images contain noise. The picture is dark, hazy and blurred. The input images which requires carefully integration and sequential steps to acquire clarity to attain a noise free output image.

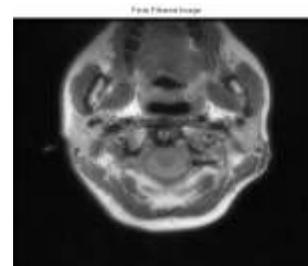


Figure 7:- Output image

The output image i.e fused image is obtained after applying the IBLPCA algorithm.



Figure 8:- Input images

Both the images contain noise. The picture is dark, hazy and blurred. The input images which requires carefully integration and sequential steps to acquire clarity to attain a noise free output image.



Figure 9:- Output images

The output image i.e fused image is obtained after applying the IBLPCA algorithm.

Performance Evaluation

This section contains the comparison among the proposed and the existing method.

A. Mean Square Error

Mean Square error is a risk function corresponding to the expected value of the squared error loss or quadratic loss.

Table 1:- MSE ANALYSIS

Image	IBLPCA method
Img 1	23
Img 2	38
Img 3	73

Img 4	66
Img 5	51
Img 6	53
Img 7	97
Img 8	30
Img 9	24

B. Peak Signal To Noise Ratio

It is the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

Table 2:- PSNR ANALYSIS

Image	IBLPCA method
Img 1	26.433
Img 2	24.796
Img 3	19.791
Img 4	22.996
Img 5	23.866
Img 6	20.181
Img 7	21.708
Img 8	25.559
Img 9	26.328

C. RMSE Analysis

Root-mean-square error (RMSE) is a frequently used measure of the differences between values (sample and population values) predicted by a model or an estimator and the values actually observed.

Table 3:- RMSE ANALYSIS

Image	IBLPCA method
Img 1	4.863
Img 2	6.216
Img 3	13.153
Img 4	8.139
Img 5	7.144
Img 6	12.408
Img 7	9.870
Img 8	5.544
Img 9	4.941

VI.CONCLUSION

The main objective of vision fusion is to merging information from multiple images of the same view in order to deliver only the useful information. The PCA based methods of vision fusion are more suitable and time-saving in real-time systems using PCA based standards of still images. In this dissertation an efficient approach for fusion of multi-focus images based on variance calculated in PCA

domain is considered. This study work propose a technique IBLPCA which illuminate normalization with adaptive histogram equalization to reduce the color artifacts which will be introduced due to the transform domain method. The fusion process may degrades the sharpness of the edges in the digital images so to overcome this problem edge preserving smoothing is integrated with proposed algorithm to improve the results further. To do the performance analysis various metrics has also been considered in this paper.

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