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# Analyze the performance of feature based image fusion techniques with optimization methods

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## Abstract
***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. Input images could be multi sensor, multimodal, Multi-focus or multi temporal [4]. The proposed methods is shows better results compare than other existing techniques. The value of image quality are measured in the terms of like Information Entropy, and Standard Deviation.***

## Keywords
***Discrete wavelet transform (DWT), Feature extractions, Information entropy, Standard deviation, Fusion symmetry, Pixel level.***

## 1.Introduction
Image fusion combines information from multiple images of the same scene to get a composite image that is more suitable for human visual perception or further image-processing tasks [1-8]. Therefore, it is natural to further exploit their capabilities for more intelligent tasks, for example, analysis of visual scenes (images or videos) or speeches (audios), which is followed by logical inference and reasoning [9-14]. For we humans, such tasks are performed hundreds of times every day so easily from subconscious, sometimes even without any awareness [15-19]. In computer vision applications, one of the challenging problems is the combining of relevant information from various images of the same scene without introducing artifacts in the resultant image [20]. Since images are captured by the use of differentdevices which may have different sensors. Because of the different types of sensors used in image capturing devices and their principle of sensing and also, due to the limited depth of focus of optical lenses used in camera, it is possible to get several images of the same scene producing different information [3]. Most of fusion algorithms for multispectral and panchromatic image such as: principal component analysis, contrast pyramid decomposition, IHS method, Brovey method, PCA method, wavelet transformation, Gaussian-Laplace pyramid, and so on [10]. A more popular method that has been explored in recent years is by using multi-scale transforms. The usually used multi-scale transforms include various pyramids, discrete wavelet transform (DWT), complex wavelet, ridgelet, curvelet transform (CVT), and contour let. Note that most of the image fusion methods are based on the assumption that the source images are noise free. Therefore, these fusion algorithms can produce high-quality fused images if the assumption is satisfied [8].

Different feature vectors extracted from the same object can reflect characteristics of the object from different aspects, that is why improved reliability and enhanced capability is expected from feature level fusion, since redundant information and complementary information are provided at the same time[21-24]. There are mainly two schemes in feature level fusion, which are serial feature fusion and parallel feature fusion. Serial feature fusion combines two or more sets of feature vectors into one union-vector and then extracts the final features from the high-dimensional real feature space [9]. On the other hand, parallel feature fusion groups two sets of feature vectors to jointly create a complex feature space and then extract the final features from the high-dimensional complex feature space[25-28].

The rest of this paper is organized as follows in section II we discuss about the literature survey for the proposed work, in section III we discuss about the proposed methodology and architecture, in section IV presents our proposed method block architecture. In section V we discuss about the Experimental result analysis between proposed and existing techniques. And finally in section VI we conclude the paper and also define the future scope of this paper.

## 2.Literature review
Nirmala Paramanandham, Kishore Rajendiran presented the Fusion is a process of extraction of useful information acquired from several domains. The objective of image fusion is to extract the needed data from multiple images to generate a composite

image that contains an enhanced representation of the image than any individual source image. Image fusion can be applied to various images like multi-sensor, multi-modal, multi-temporal or multi-focus. The reason behind going for image fusion is to reduce bandwidth, time consumption, increase in spatial information and reduction in power consumption [1].

Lianhai Wang, Junping Du, Suguo Zhu, Dan Fan and JangMyung Lee propose a fusion method based on the discrete wavelet frame transform and regional characteristics. First, the transform coefficients are obtained for the two source images using the discrete wavelet frame transform. The average image is acquired after averaging the transform coefficients, which can roughly represent the features of these two source images [2-3].

## 3.Proposed methodology

In this section we discuss about the proposed methodology and architecture for the image fusion techniques, for the experimental results we select the input image like multi-focus image set, and multi-modal image dataset etc. there are two different methods for the comparative performance analysis one is DFM methods and the other one is our proposed methods.

Step feature extraction:

a. input the host image and reference image
b. apply separately Wavelet transform function for feature extraction F(x)=I(x,y) is host image F1(x)=I1(x1,y1) is reference image M(F)= F(x) ×G(x) The convolution is perform in host image through transform function here M (F) stored the texture feature matrix of host image.

Then a feature vector is constructed using $\mu_{mn}$and$\sigma_{mn}$ as feature components:

f= [μ00 $\sigma_{00}$ $\mu_{01}$ $\sigma_{01}$ …. $\mu_{mn}\sigma_{mn}$] (1)

We obtain a numerical vector of 60 dimensions for 10 orientations and 6 scales changes. This moment feature value stored in M (F) matrix.

N (F) =F1(x) ×G(x)

The convolution is perform in host image through transform function here (F) stored the texture feature matrix of host image.

Then a feature vector is constructed using $\mu 1_{mn}$ and $\sigma_{1mn}$ as feature components:

f= [μ100 $\sigma 1_{00}$ $\mu_{011}$ $\sigma_{01}$ …. $\mu 1_{mn}$ $\sigma 1_{mn}$] (2)

We obtain a numerical vector of 60 dimensions for 10 orientations and 6 scales changes. This moment feature value stored in N (F) matrix.

1. Both the feature matrix convent into feature vector and pass through particle of swarm optimization
2. step two used here particle of swarm optimization for classification of pattern Transform data to the format of an DFM that is X is original data Ris transform data such that Xi∈ $R^d$ here d is dimension of data.

Conduct scaling on the data

$\alpha = \sum_{i=1}^{m}\sum_{j=1}^{n} sim(Xi, xj) \because m * k$

here α is scaling factor and m is total data point and k is total number of instant and sim find close point of data.

Consider the RBF kernel K(x; y)

H(x) = $\exp((-(\delta - c)2 / (r2)$

this is kernel equation of plane.

Use cross-validation to 2nd the best parameter C and

Use the best parameter C and to train the whole training set

Ro=$\alpha\frac{1}{p}\sum_{i=1}^{p} min\,(xi - yi)$

where Ro is learning parameter of kernel function.

Generate pattern of similar and dissimilar pattern of both image.

3. Estimate the correlation coefficient of both patterns using person's coefficient.

Estimate the feature correlation attribute as

$$\mathrm{Rel(a,b)} = \frac{\mathrm{cov(a,b)}}{\sqrt{\mathrm{var(a)}\times\mathrm{var(b)}}}$$

Here a and b the pattern of host image and reference image. The estimated correlation coefficient data check the total value of MSE

$$x(t) = w0 + \sum_{j=1}^{\text{total data}} wj \exp\left(\frac{-(\text{total}-xj)}{\sigma^2}\right)$$

Create the relative feature difference value

$$Rc = \sum_{k=1}^{r}\sum_{i=1}^{m}(hi - h)(eik - et)$$

if the relative pattern difference value is 0

4. fusion process is done
5. calculate Information entropy value of fused image
6. calculate Standard Deviation value of fused image
7. Calculate fusion Symmetry of fused image.
8. Calculate Fusion Factor of fused image.

## 4.Proposed method architecture

In this section we discuss about the proposed methodology and architecture for the image fusion techniques, for the experimental results we select the

input image like multi-focus image set, and multi-modal image dataset etc. there are two different methods for the comparative performance analysis one is DFM methods and the other one is our proposed methods.

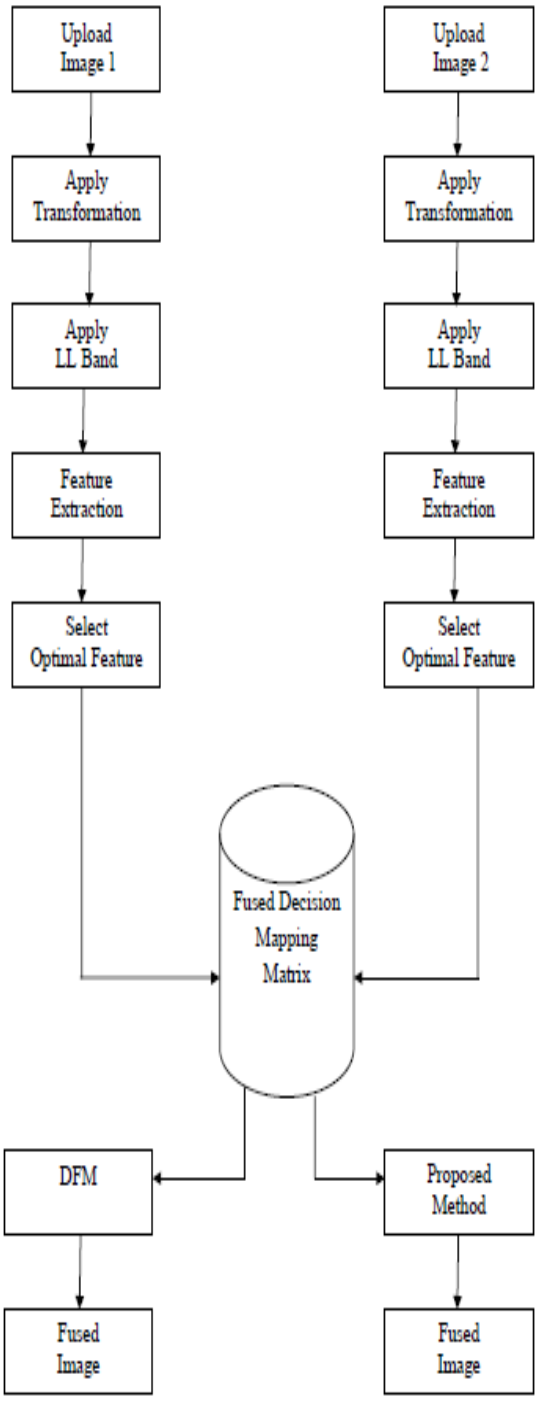


Figure 1 Proposed methodology architecture

## 5.Experimental result analysis

In this section we discuss the about the experimental process of image fusion is performed. To investigate the effectiveness of the proposed method for image fusion based on wavelet transform function and particle of swarm optimization. We used MATLAB software 7.14.0 and some reputed image used for experimental task such as the name given head image, head CT image, and table clock image.

Table 1 Shows that the comparative result analysis for the Clock image with using DFM and Proposed method and we find the value of Information Entropy and Standard Deviation.

Table 1 Comparative result analysis

| Image name | Name of method | Information Entropy | Standard Deviation |
|---|---|---|---|
| Multi-focus Clock Image set | DFM | 12.4821 | 16.8555 |
| | Proposed | 17.549 | 19.1211 |

Table 2 Shows that the comparative result analysis for the medical image with using DFM and Proposed method and we find the value of Information Entropy and Standard Deviation.

Table 2 Comparative result analysis for the medical image

| Image Name | Name of method | Information entropy | Standard deviation |
|---|---|---|---|
| Multimodal MRA medical Image set | DFM | 19.1231 | 21.1948 |
| | Proposed | 22.6307 | 23.9566 |

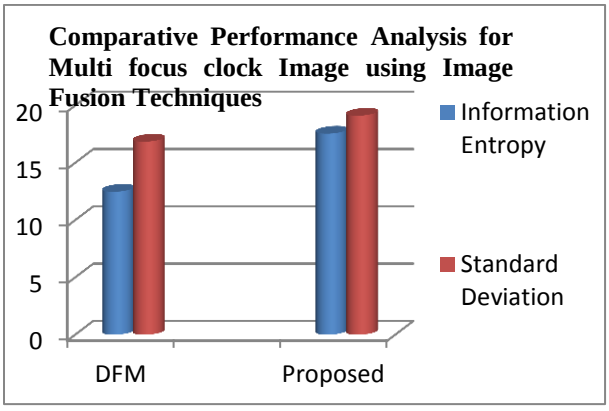


Figure 2 Comparative performance analysis of Image

Figure 2 Shows that the comparative performance analysis of Image fusion techniques for Multi-focus

clock image dataset, and we obtain the value of Information entropy and Standard deviation.

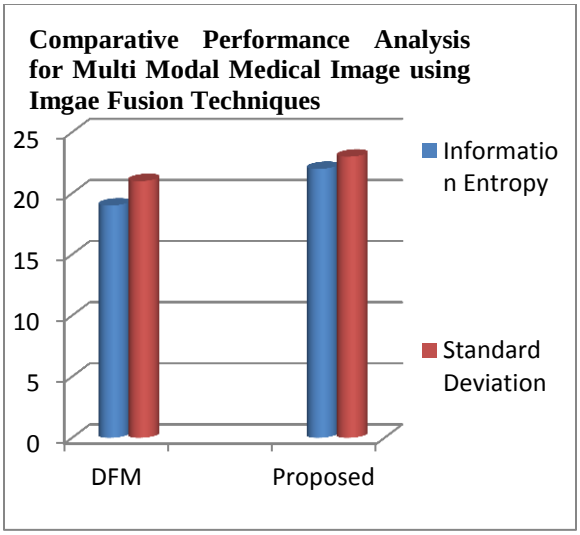


Figure 3 Comparative Performance analysis

Figure 3 Shows that the comparative performance analysis of Image fusion techniques for Multi-Modal Medical image dataset, and we obtain the value of Information entropy and Standard deviation.

## 6.Conclusion and future work

Image fusion is used in a in traffic control, law enforcement, home land security, medical diagnosis, robotics and remote sensing. In this paper we present the feature based image fusion techniques and our experimental results shows better results compare than other existing techniques, in future work we also used some metaherustic methods for the selection and transformation of an image.

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