**Abstract**

*Feature based image fusion is new area of research in the field of image fusion. The image fusion used lower content of image feature. The texture features are very important component of image. The processing and extraction of texture feature used various transform function such as wavelet transform function, Gabor transform function and many more signal based transform function. In the process of image fusion involve two and more image for the process of fusion. The fused image still image pervious quality as well as new feature and area of improved by new and adopted reference image. In this dissertation proposed a new image fusion technique. The feature selection and feature optimization used particle of swarm optimization technique. The particle of swarm optimization technique selects the optimal texture feature of both image original image and reference image. The original and reference image find the optimal feature sub set for the estimation of feature correlation. For the better fusion process used fuzzy inference rule. For the quality measurement of our proposed algorithm used some parameter such as IE, SD, FS and FF. The proposed algorithm simulated in MATLAB 7.14.0 software. Our experimental result shows better performance instead of PWT transform method of image fusion. Our proposed method increased the value of IS and SD. The improved value of SD shows that the proposed method is very efficient for the process of image fusion.*
1. Introduction

Computers have been widely used in our daily lives, since they can handle data and computation more efficiently and more accurately than humans. 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. For we humans, such tasks are performed hundreds of times every day so easily from subconscious, sometimes even without any awareness. 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. Since images are captured by the use of different devices 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. Image registration is the process of systematically placing separate images in a common frame of reference so that the information they contain can be optimally integrated or compared. This is becoming the central tool for image analysis, understanding, and visualization in both medical and scientific applications. There are many image fusion methods that can be used to produce high-resolution multispectral images from a high-resolution panchromatic image and low-resolution multispectral images. Starting from the physical principle of image formation, Neural network and fuzzy theory is the two main methods of intelligence, the image fusion system based on these two methods of can simulate intelligent human behavior, do not need a lot of background knowledge of research subjects and precise mathematical model, But find the law to resolve complex and uncertainty issues on the basis of input and output data of objects. From these characteristics and the advantages, it can be seen that the use of the approach combined by neural networks and fuzzy theory can better complete the multi-sensor image pervasive fusion. 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.

1.1 Wavelet Based Fusion

Wavelet based pixel-level image fusion schemes increase the information content of fused images by selecting the most significant features from input images and transferring them into the composite image. This process takes place in the multi resolution pyramid domain reached by the process of multi resolution analysis. Information fusion is achieved by creating a new, fused pyramid representation that contains all the significant information from the multi resolution pyramids of the input images. Input images, for the sake of simplicity only two, A and B, are first decomposed into multi resolution pyramids using a series of multi resolution QMF Analysis filter banks. Then, a new pyramid array is initialized containing no information, i.e. it is filled with zeros. The pyramid fusion algorithm then considers, in a systematic way, individual or groups of pixels from the multi resolution pyramid representations of the input images, and forms values for the corresponding pixels of the new pyramid. The coefficients of the new pyramid are formed either by transferring the input coefficient values directly or as arithmetic combinations of the corresponding coefficients from the input pyramids. Criteria for the selection and/or fusion of input pyramid coefficients are determined in the design of the feature selection process which is incorporated into the pyramid fusion algorithm.
2. Literature Survey

We study various research paper and journal and know about image fusion method with also wavelet based image fusion and other method. All methodology and process are not described here. But some related work in the field of image compression in concern of wavelet, pixel based, neural network, fuzzy neural network and genetic algorithm. Discuss by their respective title with reference number.

2.1 Pixel-Level Image Fusion Scheme Based On Steerable Pyramid Wavelet Transform Using Absolute Maximum Selection Fusion Rule

In this paper, author proposed a pixel-level image fusion scheme using multi resolution steerable pyramid wavelet transform. Wavelet coefficients at different decomposition levels are fused using absolute maximum fusion rule. Two important properties shift invariance and self-reversibility of steerable pyramid wavelet transform are advantageous for image fusion because they are capable to preserve edge information and hence reducing the distortion in the fused image. Experimental results show that the proposed method improves fusion quality by reducing loss of relevant information present in individual images. For quantitative evaluation, we have used fusion metrics as fusion factor, fusion symmetry, entropy and standard deviation. We proposed a pixel level image fusion scheme using steerable pyramid wavelet transform. In the proposed method, two main steps have to be followed: one, the source images are decomposed into low pass and high pass sub-bands of different scale using steerable pyramid, and secondly, low pass sub band is divided into a set of oriented band pass sub-bands and a low pass sub-band.

The suitability of the proposed method is tested on multi focus and medical images. For this, we have presented two pair of images and their fusion results. The results are also tested on two different conditions; when images are free from any noise and other when they are corrupted with zero mean white Gaussian noise. From experiments, we observed that the proposed method performs better in all of the cases. The performance is evaluated on the basis of qualitative and
quantitative criteria. The main reasons to use steerable pyramid wavelet transform in image fusion are its shift invariance and rotation invariance nature. Further results show that the proposed method produces better results and applicable because steerable wavelet transform retain individual image information like edges, lines, curves, boundaries in the fused image.

2.2 Multispectral And Panchromatic Image Fusion Based On Genetic Algorithm And Data Assimilation

The framework of fusion based on data assimilation and genetic algorithm for multispectral and panchromatic image was presented. In the framework, Weights of indices of the various attributes were determined according to their important degree in the following processing; the objective function was composed of weights sum of various evaluation indices of image, then the objective function was optimized using genetic algorithm to obtain suitable images. Finally, the experiment about the fusions of panchromatic and multispectral image (Spot5, Quick Bird), prove the validity of this framework.

In this paper, the fusion framework based on data as simulation and genetic algorithm for Multispectral image and panchromatic image was presented. Data assimilation can combine the advantage of model operator and observe operator. Our proposed method can integrate the advantages of DWT and HIS, construct object function according to successive application to satisfy the aim of adaptively adjustment of fusion parameters. Standard deviation and average gradient are chosen as object function. In general, the higher the value, the better the texture information. And two experiments (Spot, Quick bird) validate this framework. The experiment results show that our proposed fusion framework is feasible.

2.3 A Comparative Analysis Of Image Fusion Methods

In this paper presents a comprehensive framework, the general image fusion (GIF) method, which makes it possible to categorize, compare, and evaluate the existing image fusion methods. Using the GIF method, it is shown that the pixel values of the high-resolution mutli spectral images are determined by the corresponding pixel values of the low-resolution panchromatic image, the approximation of the high-resolution panchromatic image at the low-resolution level. Many of the existing image fusion methods, including, but not limited to, intensity hue saturation, Brovey transform, principal component analysis, high-pass filtering, high-pass modulation, algorithm-based wavelet transform, and multi resolution analysis-based intensity modulation (MRAIM), are evaluated and found to be particular cases of the GIF method. The performance of each image fusion method is theoretically analyzed based on how the corresponding low-resolution panchromatic image is computed and how the modulation coefficients are set. This paper proposes a framework, the GIF method. Under different assumptions on how the LRPI is computed and how the modulation coefficients are set, many existing image fusion methods, including, but not limited to, IHS, BT, HPF, HPM, PCA, ATW, and MRAIM, are shown to be particular cases of the GIF method. The performance of each method is determined by two factors: how the LRPI is computed and how the modulation coefficients are defined. If the LRPI is approximated from the LRMIs, it usually has a weak correlation with the HRPI, leading to color distortion in the fused image. If the LRPI is a low-pass filtered HRPI, it usually shows less spectral distortion. If the modulation coefficient is set as a constant value, the reflectance differences between the panchromatic bands and the multispectral bands are not taken into consideration, and the fused images bias the color of the pixel toward the gray. Methods in which the modulation coefficients are set following the GIF method can preserve the ratios between the respective bands, give more emphasis to slight
signature variations, and maintain the radio-metric integrity of the data while increasing spatial resolution.

**2.4 Medical Image Registration Using Genetic Algorithm**

This paper addresses the image registration problem applying genetic algorithms. The image registration’s objective is to define mapping that best match two set of points or images. In this work the point matching problem was addressed employing a method based on nearest-neighbor. The mapping was handled by affine transformations. This paper presents a genetic algorithm approach to the above stated problem of mis-registration. The genetic algorithm is an iterative process which repeatedly modifies a population of individual solutions. At each step, the genetic algorithm selects individual at random from the current population to be parents and uses them to produce the children for the next generation. In each generation, the fitness of every individual in the population is evaluated, multiple individuals are stochastically selected from the current population (based on their fitness), and modified (recombined and possibly randomly mutated) to form a new population. The new population is then used in the next iteration of the algorithm. Over successive generations population ‘evolves’ toward an optimal solution. The algorithm terminates when either a maximum number of generations has been produced, or a satisfactory fitness level has been reached for the population.

In this paper we have focused on genetic algorithm for medical image registration. Genetic algorithm is a evolutionary algorithm. There are other methods like simulated annealing, mutual information theory for image registration. Apart from this, there are other algorithms like graph algorithm and sequence algorithms. We can implement these algorithms and show the comparative study and get the most suitable for medical applications.

**2.5 Implementation and comparison of image fusion using discrete wavelet transform and principal component analysis**

In this paper author considers two fusion techniques Discrete Wavelet Transform (DWT) and Principal Component Analysis, fusion methods for these two techniques has been proposed and also the effectiveness is compared. In DWT the two images to be fused are decomposed at different levels and their approximation and detail co-efficient are calculated, a fusion scheme is used to combine these co-efficient and then Inverse of DWT is taken to reconstruct the image. In PCA the principal components of the two images are extracted and a fusion scheme is proposed to fuse these principal components to reconstruct the image. Finally comparison of these two techniques is performed on the basis of some evaluation criteria and the decision has drawn that which technique is better.

The principles of the merger have been around for many years, and the application of this technique is not limited to medical imaging. The military has used the fusion of infrared images from visible light to detect camouflaged targets. The daily weather report includes a satellite image merged with a geographic map. Fusion Software is like glue, bringing together images from multiple devices, including dual-mode scanners and PACS systems and now even planning systems for radiation therapy. The relationship between the software and hardware of the merger will become more intertwined in the future, and radiological practices only benefit from it. There are , of course, the limits of what is possible with any fusion methodology . The extreme differences between the imaging studies will always create problems. The use of (non-linear) deformable techniques introduces a degree of flexibility and expands the range of possibilities, but the fact is that the quality of the images fusion depends on the quality of the data being merged.
3. Proposed Methodology

In this section discuss the proposed methodology of feature based image fusion technique based on wavelet transform function and particle of swarm optimization, the feature of transform function passes through feature selection process. The feature selection process used particle of swarm optimization technique. The particle of swarm optimization select the optimal feature of given texture feature matrix. If the correlation coefficient factor estimate the value of correlation is zero then fusion process is done. The process of proposed model divide into two section first section deals with initially take host image and reference image passes through wavelet transform function for feature extraction after the feature extraction applied optimization task done by particle of swarm optimization. after the optimization of optimal feature of reference image and original image used rule of inference for the process of fusion.

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 \[ F_1(x) = I_1(x_1,y_1) \] is reference image

\[ M(F) = F(x) \times G(x) \]

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:

\[
\begin{bmatrix}
\mu_{00} & \sigma_{00} \\
\mu_{01} & \sigma_{01} \\
\vdots & \vdots \\
\mu_{mn} & \sigma_{mn}
\end{bmatrix}
\] …………………(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.

\[ N(F) = F_1(x) \times G(x) \]

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 \( \mu_{1mn} \) and \( \sigma_{1mn} \) as feature components:

\[
\begin{bmatrix}
\mu_{100} & \sigma_{100} \\
\mu_{101} & \sigma_{101} \\
\vdots & \vdots \\
\mu_{1mn} & \sigma_{1mn}
\end{bmatrix}
\] …………………(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 convert 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 SVM that is \( X \) is original data \( R \) is transform data such that \( X \in R^d \) where \( d \) is dimension of data.

Conduct scaling on the data

\[ \alpha = \sum_{i=1}^{m} \sum_{j=1}^{n} sim(Xi, xj) \] \( m \times k \) here \( \alpha \) 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 \( K(x; y) \)

\[ H(x) = exp(- (\delta - c) / (r2)) \] 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

\[ \alpha_0 = \alpha_0 \sum_{i=1}^{p} min (xi - yi) \] where \( \alpha_0 \) 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

\[ \text{Rel}(a, b) = \frac{\text{cov}(a, b)}{\sqrt{\text{var}(a) \times \text{var}(b)}} \]

Here a and b the pattern of host image and reference image.

The estimated correlation coefficient data check the total value of MSE

\[ x(t) = w_0 + \sum_{i=1}^{\text{total data}} w_j \exp\left(-\frac{(\text{total}-x_i)^2}{\sigma^2}\right) \]

Create the relative feature difference value

\[ \text{Rc} = \sum_{k=1}^{m} \sum_{i=1}^{n} (h_i - h)(e_{ik} - e_t) \]

If the relative pattern difference value is 0 then apply fuzzy inference rule for the selection of optimal feature and optimized feature using fuzzy inference rule.

In our algorithm, we use five state feature selection process of fusion for policy. The five state includes five parameters which are a, b, c, d and e. The algorithm calculates the fused status of being image from the parameters as shown below.

If (a=optimal feature) && (b=non-optimal feature) {
    Process = fused – a/(b-a)
} 
Else if (b=optimal feature and c= non-optimal feature) {
    Process = fused – b/(c-b)
} 
Else if (c=optimal feature and d=non-optimal feature) {
    Process = d – fused/(d-c)
} 
Else if (d=optimal feature and e=non-optimal feature) {
    Process = e – fused/(e-d)
} 
Else if (e=optimal feature and a=non-optimal feature) {
    Process = a – fused/(a-e)
} 
Else {
    Process = 0
}

Finally images are fused.

3.1 Description of Model

In this section describe the process of proposed model. The proposed model contain with wavelet transform function and particle of swarm optimization. The swarm optimization used for the feature optimization process. And finally apply fuzzy inference rule for the fusion process.

Step 1. Initially put the original image and reference image for the processing of feature extraction

Step 2. After processing of image discrete wavelet transform function are applied for the texture feature extraction

Step 3. After the texture feature extraction calculate the maximum value of feature using mean standard formula.

Step 4 the maximum value of feature set is global value of fitness constraints of particle of swarm optimization

Step 5. The particle of swarm optimization select the all feature as particle and measure value of difference and move according to feature direction for the processing of optimal

Step 6. The selection of optimal feature in both image estimate the correlation coefficient function of value R.
Step 7. If the value of R is 0 image are going on process of fuzzy inference rule.
Step 8. If value of R not equal to 0 the processing going to fuzzy base of feature.

3.2 Proposed Model

![Proposed Model Diagram]

Figure 3.2.1 proposed model of image fusion using fuzzy inference rule.

4. Experimental Result Process
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.
Naresh Kumar Saindane, Prof. Parmalik Kumar, Rajendra Kumar Patel: Optimize Set of Pixel Based on Wavelet Transform Function for Image Fusion Technique
fusion. The fuzzy inference rule provide the decision making facility for the process of image fusion.

The proposed algorithm simulated in MATLAB 7.8.0 software. And used some distorted image data from google web site. Our empirical result shows that better result in compression of pervious algorithm of image fusion. Goal of image quality assessment is to supply quality metrics that can predict perceived image quality automatically. While visual inspection has limitation due to human judgment, quantitative approach based on the evaluation of “distortion” in the resulting fused image is more desirable for mathematical modeling. The goals of the quantitative measures are normally used for the result of visual inspection due to the limitations of human eyes. In Mathematical modeling, quantitative measure is desirable. One can develop quantitative measure to predict perceived image quality. In this dissertation used PSNR, IQI and MSER for estimation of quality of image.

References