An Improved Image Fusion Technique based on Texture Feature Optimization using Wavelet Transform and Particle of Swarm Optimization (POS)

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ABSTRACT
Image fusion technique applied in various field of medical science for diagnose of serious medical disease. The brain stroke detection in head is very difficult task because the tissues of head are important factor. Now the detection process used high intensity multimedia camera for gathering brain stroke image for analysis of stroke. In this paper proposed a feature optimisation technique for brain stroke detection. The proposed technique based on wavelet transforms function and particle of swarm optimisation technique. The proposed algorithm performs better in compression of pervious method such as WT and IWT transform method.

Keyword
Image fusion, feature optimization, POS

1. INTRODUCTION
The term image fusion usually implies the integration of images acquired by multiple sensors with the intention of providing a better perspective of a scene that contains more content. For merging remotely sensed images, particularly one multi-spectral image and one panchromatic image, fusion algorithms should aim to integrate information from images of different spectral and spatial resolution [1,2], leading to obtain a single image that includes the best features of each one. The applicability of image fusion are increases due to diversity of image used in different field such as medical science, military surveillance. Fusion process area are increase in the field of video processing [8, 9]. In last decade the process of image fusion are improved due to certain reason such method involved in transform function based and some method also used in heuristic function. The method of image fusion are divided into two section one is pixel based and another one is feature based. in current decade the feature based image fusion process are very efficient method[6,7].A dual-tree complex transforms function used for the extraction of feature for image fusion process. The process of dual-tree complex transforms function used as feature segmentation process. Other fusion methods are based on saliency measurement, local gradient and edge fusion. Pixel based algorithms concentrate on increasing image contrast whereas region based algorithms provide edge enhancement and feature extraction. Fusion can be performed on pixel, feature or decision level [15]. One such method is very important such as PCA technique. Basically PCA is pattern recognition technique used for similarity measure for image fusion. Indexing, automatic audio-visual speech recognition, biometric audiovisual speech synchrony, multi-sensor management for information fusion, face recognition, multimodal human computer interaction, audio-visual biometric, multi-sensor fusion etc [20]. For the process of feature optimization and feature selection used some heuristic function such as Genetic algorithm, ant colony optimization and particle of swarm optimization. The process of optimization request particle of swarm optimization technique is better in all technique and method of feature optimization [18]. In this paper we proposed a feature based image fusion technique. The proposed technique based on feature optimization technique using optimization algorithm. The above section discuss introduction of image fusion. In section II we describe Gabor wavelet transform. In section III discuss particle of swarm (POS). In section IV discuss proposed methodology for image fusion. In section V discuss Experimental result and finally conclude in section VI

2. FEATURE EXTRACTION
Feature extraction is important phase in image fusion technique. In feature extraction process raw image converted into frequency domain and process of sampling using wavelet transform function. Wavelet transform function gives the texture value of extracted feature in the form of horizontal, vertical and diagonal transform vector. Combined all these texture value and create feature matrix. For the extraction of feature used integer wavelet transform function value. Integer wavelet transform function is a family of wavelet transform function. The value of transform always produces the value of filter is whole number [14]. The wavelet transform function process in following derivative of equation.

$$\forall n: D^{i+1}(n) = A^{i}(2n+1) - \left[\sum_{k} pkA^{i}\left(2(n-k)\right) + \frac{1}{2}\right] \dots\dots\dots\dots (a)$$

$$0 \le i < j, 0 \le n < 2^{-(i+1)}N$$

$$-2 \le k \le 1$$

$$\forall n: A^{i}(2n) = A^{i}(2n) + \left[\sum_{k} ukAD^{i+1}(n-k) + \frac{1}{2}\right] \dots\dots\dots\dots (b)$$

$$0 \le i < j, 0 \le n < 2^{-(i+1)}N$$

$$0 \le k \le 1$$

where[x] represents the integer part of x,j is the number of scales,$A^{i+1}(n)$ and $D^{i+1}(n)$ denote, respectively, the approximation and the detail of the original signal calculated at the scales (i+1), 0≤ I <j[15]. The integer part of transform function gives the better encoding technique. The encoded transform value creates the number of packet and the randomly assigned packet in give dimension for search space

3. PARTICLE OF SWARM OPTIMIZATION
Particle of swarm optimization designed for the process of optimization. The basic principle of particle of swarm

optimization is dynamic population and bird fork property. By virtue of bird fork algorithm of particle of swarm optimization work. In the process of feature optimization of image fusion [20]. In the process of fusion used two different set of optimization. All feature value of image treat as particle. In amalgamation, the particle's feature value, Pid and its near value of particle, Pgd is a velocity value of optimization feature space. The random values rand1 and rand2 are used for the local and global value selection of particle, that is, to make the optimal solution. The values of c1 and c2 manage the value of velocity of Pid and Pgd in deciding the particle's next movement velocity. At that each iteration change the velocity of swarm and create new feature subset for selection of feature. The derivation of equation in (c) and (d) []

$$v_{id=W\times V_{id}+C1\times rand\times\left(P_{id-x_{id}}\right)+C_2\times rand2\times(P_{gd-X_{id}})} c \ldots\ldots (c)$$

$$X_{id=X_{id}+V_{id}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (d)$$

where w denotes the value of feature matrix; pid is the position of particle value, pgd is the position of global value best fitness value, c1 and c2 are constants and are known as acceleration coefficients; d denotes the dimension of the problem space; rand1, rand2 are random values in the range of (0, 1).

4. PROPOSED METHODOLOGY

In this section discuss the proposed algorithm for image fusion. The proposed algorithm based on feature selection and feature optimization technique. The process of proposed algorithm work in two modes in first mode performs feature extraction technique and in second phase performs feature optimization process. The feature optimization process is done by IWT transform function. The extracted feature generates feature matrix for the processing of feature optimization. The process of feature optimization and selection is done by particle of swarm optimization. Particle of swarm optimization is dynamic population based searching technique. After the process of optimization the feature selection process is performed and finally the value of feature of both image are maximized the image fusion are performed.

Steps perform for proposed algorithm in detail.

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

Then a feature vector is constructed using v1, v2, v3 as feature components:

f= [v1, v2, v3……..vn]……..(1)

We obtain a numerical vector of lower band of integer wavelet transform function. The all feature matrix is calculated as

N (F) =F1(x) ×W(x)

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

Then a feature vector is constructed of feature components:

f= [v1, v2, v3…….vn] ……..(2)

2. We obtain a numerical vector feature value of lower band of integer wavelet transform function. The all feature matrix is calculated.
3. Both the feature matrix convent into feature vector and pass through particle of swarm optimization.
4. Step two used here particle of swarm optimization for feature optimization.
   Mapping the feature matrix in number of particle and determine the velocity of particle that Xi∈ R^{d} here d is dimension of data.

$$v_{id=W\times V_{id}+C1\times rand\times\left(P_{id-x_{id}}\right)+C_2\times rand2\times(P_{gd-X_{id}})} \ldots (4)$$

$$X_{id=X_{id}+V_{id}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

5. Process of particle of swarm optimization optimised feature matrix of both image.
6. Searching process are done in both image
7. Searching take place for best feature
8. Select best feature
9. fusion process is done
10. Calculate MSER value of fusion image.

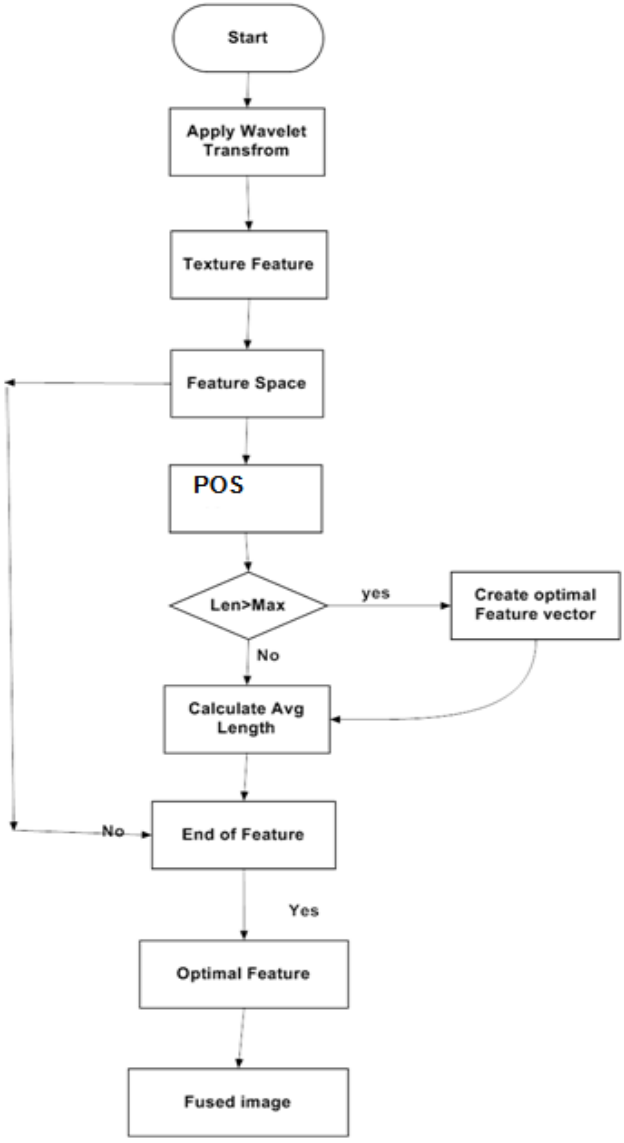

Figure 1: proposed model for feature based image fusion.

5. EXPERIMENTAL RESULT ANALYSIS

In this section discuss the experimental result analysis of proposed algorithm and pervious algorithm. The pervious and proposed algorithm implement in mat lab 7.8.0. For the input image used medical image database such as CT and MRI image of head. For the calculation of parameter used some standard formula such as PSNR, MSER and IQI[14].

Evaluation parameter

Equation of root mean square (RMSE)

$$E1 = \sqrt{\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\big(I1(i,j) - F(i,j)\big)2 \dots\dots\dots\dots\dots (1)}$$

$$E2 = \sqrt{\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}(I2(i,j) - F(i,j))^2 \dots\dots\dots\dots\dots (2)}$$

$$RMSE = \frac{(E1 + E2)}{2}$$

If the value of RMSE is low show that better image fusion technique

The peak to signal noise ratio estimated a

$$PSNR = 20\log 10\left|\frac{L^2}{MSE}\right| \dots\dots\dots\dots\dots\dots (3)$$

Here L is a level of gray scale image and MSE is mean square error rate.

Image quality index

$$IQI = \frac{M_{ab}}{m_{a\,m_b}}\frac{2xy}{x^2+y^2}\frac{2m_{am_b}}{m_a^2 m_b^2} \dots\dots\dots\dots\dots\dots\dots (4)$$

Image quality index measure the similarity of both image fused image and original image. If both images are equal value of this is 1.

Figure 2: shows that two input image of abdomen in same mode of initial and final area of stroke and fused both stroke with WT technique

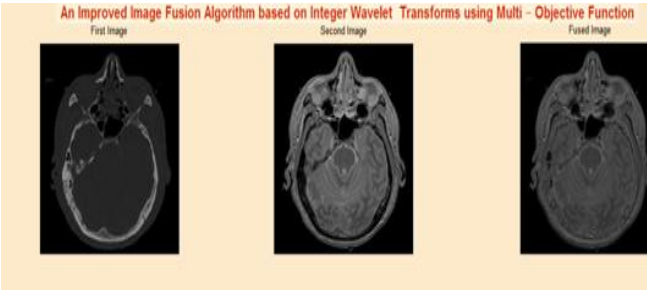

Figure 3: shows that two input image of brain in same mode of initial and final area of stroke and fused both stroke with IWT technique

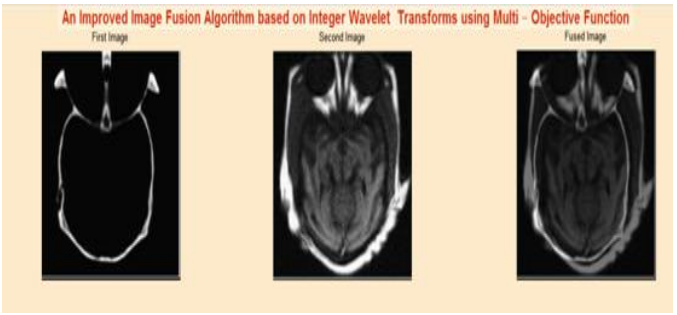

Figure 4: shows that two input image of brain in same mode of initial and final area of stroke and fused both stroke with HBT technique

Performance table:

Table 1: shows that value of fused image and reference image of abdomen (Fig.2)

METHOD	MSER	PSNR	IQI
WT	11.64	17.94	.95
IWT	23.55	26.59	0.93
IWT-POS	23.75	30.59	0.94

Table 2: shows that value of fused image and reference image of brain. (Fig.3)

METHOD	MSER	PSNR	IQI
WT	4.44	13.7	.96
IWT	18.34	21.62	.94
IWT-POS	18.54	25.62	.93

Table 3: shows that value of fused image and reference image of brain (Fig.4)

METHOD	MSER	PSNR	IQI
WT	4.0	12.6	.96
IWT	18	21.0	.94
IWT-POS	18	25.4	.93

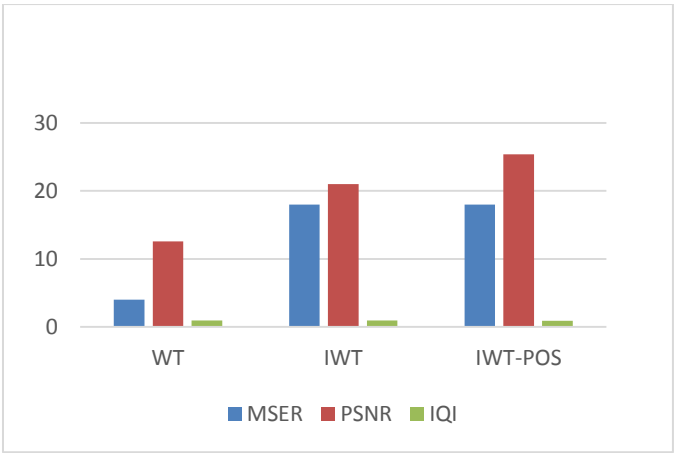

Figure 5: shows that comparative result analysis of all three Parameter for two different images of abdomen (Fig 2), here our hybrid method IWT-POS shows the better result in the form of such as MSER, PSNR and IQI

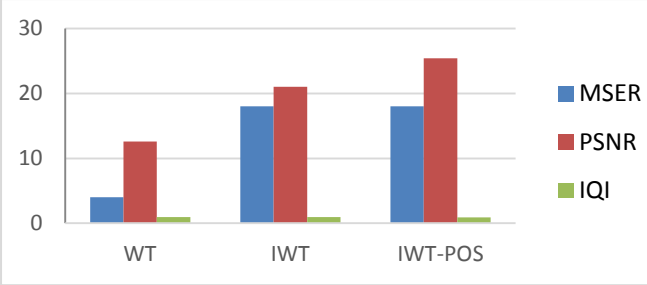

Figure 6: shows that comparative result analysis of image of brain (Fig 3), here our hybrid method IWT-POS shows the better result in the form of such as MSER, PSNR and IQI

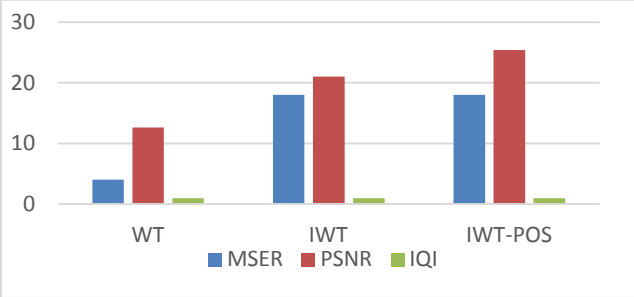

Figure 7: shows that comparative result analysis of image of brain.(Fig.4), here our hybrid method IWT-POS shows the better result in the form of such as MSER, PSNR and IQI.

6. CONCLUSION AND FUTURE WORK

In this paper proposed an optimized feature based image fusion technique. The proposed method used wavelet based feature extraction technique, wavelet provide lossless feature extraction. The extracted feature used new born optimization algorithm particle of swarm optimization. Our experimental result shows that better performance in compression of pervious image fusion technique. The proposed image fusion technique improved the value of PSNR and value of image quality index value. In future further explored this method and increase the value of PSNR and image quality index.

7. REFERENCES

[1] Shutao Li , Bin Yang, Jianwen Hu "Performance comparison of different multi-resolution transforms for image fusion" Information Fusion Vol- 12, 2011. Pp 74-84.

[2] V Jyothi ,B Rajesh Kumar ,P Krishna Rao , D V Rama Koti Reddy " image fusion using evolutionary algorithm (GA)" Int. J. Comp. Tech. Appl., Vol 2, 2011. Pp 322-326.

[3] Max Mignotte "A Label Field Fusion Bayesian Model and Its Penalized Maximum Rand Estimator for Image Segmentation" ieee transactions on image processing, ieee Vol- 19, 2010. Pp 1610-1624.

[4] Max Mignotte "A Multiresolution Markovian Fusion Model for the Color Visualization of Hyperspectral Images" ieee transactions on geoscience and remote sensing, VOL. 48, 2010. Pp 4236-4247."

[5] J. J. Lewis, R. J. OCallaghan, S. G. Nikolov, D. R. Bull, C. N. Canagarajah "Region-Based Image Fusion Using Complex Wavelets" IEEE 2007. Pp 234-241.

[6] Susmitha Vekkot,, Pancham Shukla "A Novel Architecture for Wavelet based Image Fusion" World Academy of Science, Engineering and Technology, 2009. Pp 372-377.

[7] Lei Zhang , WeishengDong , DavidZhang , GuangmingShi "Two-stage image denoising by principal component analysis with local pixel grouping" Pattern Recognition, Vol-43, 2010. Pp 1531-1549.

[8] Kalpana Seshadrinathan, Alan C. Bovik "unifying analysis of full reference image quality assessment" IEEE 2008. Pp 1200-1204.

[9] Ce Liu, Richard Szeliski, Sing Bing Kang, C. Lawrence Zitnick "Automatic Estimation and Removal of Noise from a Single Image" transactions on pattern analysis and machine intelligence, IEEE, VOL. 30, 2008. Pp 299-315.

[10] R. Redondo, F. Sroubek, S. Fischer, G. Cristobal "Multifocus image fusion using the log-Gabor transform and a Multisize Windows Technique" Information Fusion, Elsevier 2008. Pp 1-9.

[11] Styliani Ioannidou , Vassilia Karathanassi "Investigation of the Dual-Tree Complex and Shift-Invariant Discrete Wavelet Transforms on Quickbird Image Fusion" IEEE geoscience and remote sensing letters, VOL. 4, 2007. Pp 166-171.

[12] Nikolaos Mitianoudis, Tania Stathaki "Image Fusion schemes using ICA bases" Elsevier Science, 2007. Pp 1-38.

[13] Shutao Li, Bin Yang "Multifocus image fusion using region segmentation and spatial frequency" Image and Vision Computing, Vol-26, 2008. Pp 371-379.

[14]A. Bastys, J. Kranauskas, and R. Masiulis, "Iris Matching by Local Extremum Points of Multiscale Taylor Expansion," Advances in Biometrics: Lecture Notes in Computer Science 2009, pp 1070-1079.

[15]Suresh Chandra Satapathy, Anima Naik and K Parvathi" A teaching learning based optimization based on orthogonal design for solving global optimization problems" in Springer Open Journal, 2013.

[16] Image compression using Fast Fourier Transform by Parminder Kaur, Thapar Institute of Engineering and Technology, Patiala.

[17] J.M. Shapiro, Embedded image coding using zerotrees of wavelet coef_cients, IEEE Trans. Signal Processing, vol. 41, pp.3445-3462, Dec. 1993.

[18]J. Chen, M. Yang, Y. Zhang, and X. Shi, Ecg compression by optimized quantization of wavelet coefficients, ICIC 2006, LNCIS, vol. 345, Springer-Verlag Berlin Heidelberg, 2006, p. 809814.

[19] D. Karaboga, An idea based on honey bee swarm for numerical optimization, Tech. Report TR06, Erciyes University, Engineering Faculty, Computer Engineering Department, 2005.

[20] D. Karaboga and B. Akay, A survey: Algorithms simulating bee swarm intelligence, Artificial Intelligence Review 31 2009, no. 1, 68–55.