International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 08 | Aug -2017 www.irjet.net p-ISSN: 2395-0072

# IMAGE FUSION EHANCEMENT USING DT-CWT TECHNIQUE

**[1]Lata Kushwaha , [2]Dr. Vandana Vikas Thakare**

*[1]M.E Student, Department of ECE, MITS, Gwalior, India*
*[2]Professor,Department of ECE, MITS, Gwalior, India*

---

**Abstract -** The image fusion has been proposed for the better perception which is based on the different algorithm. The input image passes through low pass and high pass filters to eliminate the noise. The input is then decomposed to find the wavelet coefficient followed by the application of fusion techniques DT-CWT, DWT and without wavelet(ordinary fusion algorithm) The experimentation proves the fact that DT-CWT yields the quality output as compared with the DWT and ordinary fusion algorithm.

***Key Words***: Perception, Dual tree complex wavelet transform, low pass, high pass wavelet coefficient, DWT

## 1.INTRODUCTION

Image fusion is phenomenon obtained by attaching the relevant information of given set of images altogether by camera at different angles of a scene or object etc into a single image to get better perceptual and quality. To remove the low quality information of an perceptual image obtained from multiple source and images image fusion is done. [3] The credibility of humans on technology is upgraded day by day vastly for their daily activities or work. The purpose of image fusion is to reduce the errors and noise from image of a scene or thing. The demanding areas are robotics, microscopic imaging and remote sensing. Image fusion is the popular area of the technical research which is being upgraded as the research is inspired by industrial demand. We have drawn the inspiration from the existing work and their short-comings in fusion. These shortcomings have initiated the new research with the aim of improvement. The earlier research work was based on destructive and real world prototype. But the modern simulation tools like Matlab, Labveiw, Abacus etc have replaced the costly and time consuming testing and prototype methods.[1] . In this process the way of reconstructing individual sets of data into one system is image registration.[2]

Established algorithm provides the supremacy of the proposed work whose coefficient provides a linear relationship. The possibilities of parametric adjustments and algorithmic variations Only shows that there result can direct the research im-practicular direction. In Proposed are DT-CWT for its correctness and measuring the performance parameters is compared with two methods which are discreet wavelet transform DWT using mean, min and max methods and basic fusion algorithm without using wavelet. Comparison of algorithm is done by changing decomposition levels between(1-6). Quantitative analysis is done for seeing best result.

### 1.1 Luminace Review

X.H. Zhanga and et.al have proposed modified visibility threshold equation and proposed a method for estimating just noticeable difference. They also explained DC tune model for luminance adaption adjustment and contrast masking with new innovations using human visual system. They concluded that JND estimation in this paper provides the better distortion measurement and visual signal compression. Authors work for the luminance adaption, contrast masking and influence of spatial frequency. An approximate parabola curve in the 0- 255 range of gray levels is obtained by the visibility threshold of HVS in digital images. for luminance and provides base threshold for JND. This gives better visual distortion measurement and visual signal compression.[6]

Paul Hill and et.al have proposed the wavelet transform for image fusion using contrast and luminance models.[8] In this DT-DWT algorithm is used with JND equation along with model 1 equation for luminance graph and contrast masking equation for masking intensity. Notice-ability Index along with perceptual fused coefficient.[13] are used for modification of the coefficient .

*JND threshold equation is*

$$t_{JND}(\lambda,\theta,i,j) = \alpha_l(\lambda,\theta,i,j)\,\alpha_c(\lambda,\theta,i,j)$$

Luminance adaption model

$$\alpha_l = \begin{cases} 17\left(1 - \frac{\bar{I}}{127}\right) + 3, & if\ \bar{I} \le 127 \\ \frac{3}{128}(\bar{I} - 127) + 3, & otherwise \end{cases}$$

Contrast masking equation

$$\alpha_c(\lambda,\theta,i,j) = \alpha_{c\ intra}(\lambda,\theta,i,j)\,\alpha_{c\ inter}(\lambda,\theta,i,j)$$

Notice ability Index given by

$$NI^I(\lambda,\theta,i,j) = \frac{|V^I_{\lambda,\theta,i,j}|}{t^I_{JND}(\lambda,\theta,i,j)}$$

Where I∈ {0,1} is the index of the images to be fused.

Perceptual fused coefficient

$$V^3 = \begin{cases} V^0 \frac{t\bar{f}_{ND}}{t^0_{fND}} & NI^0 > NI^1 \quad \text{AND} \quad OTHERWISE \\ V^1 \frac{t\bar{f}_{ND}}{t^1_{fND}} & \end{cases}$$

Author have concluded that a fused image
Not only contains most perceptually important content from the input images but also present its detail information with its original perceptual importance.

### 1.2 Image Fusion Review

Sweta K. Shah and Prof. D. U. Shah have proposed two categories of image fusion namely spatial fusion and transform fusion. Authors proposed PCA of spatial and DWT, SWT of transform domain techniques. They implemented the performance metrics without reference image to evaluate the performance of image algorithm. The spatial domain fusion directly deals with pixels of input image and in transform domain image is first transformed into frequency domain. Authors have proposed that spatial domain have blurring problem. Transform domain provide a high quality spectral content. Drawback of DWT is overcome by the SWT(Stationary Wavelet Transform). SWT is better technique than PCA and DWT.[16]

Chaveli Ramesh and T. Ranjith have proposed the concept of fusion symmetry algorithm. Fusion symmetry is the measure that find the relative distance of the fused image with respect to input image. If value of fusion symmetry is less than fused image gets whole information of two input images. Authors have proposed an algorithm named LFT which is obtained by transform domain. Output of this is compared with other methods namely Average and Laplacian Pyramid. Lifting wavelet theory is same as the DWT except that the number of samples at each stage is same as initial set. Author shows that when one of the two sensors is inferior it gives fusion factor and fusion symmetry. .[7]

## 2. PROPOSED WORK

### Decomposition

Decomposition is the way of seperating image into pieces without decrease in information of main images. In terms of image fusion it is the way of dividing a given image into texture and important components which represents the information of source images. Important components controls the geometric structure and smooth path of source image. Texture is controlled by texture. On increasing decompositon level loss of information is happened that's why it plays an important part in fusion. And fusion quality decreases so that obtained image is not clear as compared to that in lowest decomposition level. Decomposition depth depends on spatial level of object with its location and on the filter used in process of image fusion.

### Optimization

Optimization is the phenomenon of making something as perfect as possible. It can be defined in many ways. In terms of technology optimization allows researchers to search for optimal solutions to image fusion. It can also be defined as the way of finding alternative with the highest obtained performance under the given constraint, by increasing desired factors and minimizing undesired ones. For this DT-CWT algorithm is compared with other two algorithms DWT and without wavelet algorithm.

### Wavelet Transform

Wavelet is the process of dividing of signal with short duration finite energy function that starts with zero and ends at zero. Mathematically wavelet is defined as

$$\varphi_{a,b}(t) = \frac{1}{\sqrt{|a|}} \varphi \frac{(t-b)}{a}$$

Wavelet transform are differentiated in two types named continual and discrete. A transform is called continual wavelet transform if scale and location changes easily and vice-versa is called discrete wavelet transform. Wavelet transform has superior time and frequency qualities. Wavelet transform can be discriminated by father wavelet function utilized in DWT for LPF and mother wavelet function utilized in DWT for HPF.

### Procedure

Read the two source images and resize both to same size. Apply algorithm to decompose source image into low and high pass sub images. On each level we get four sub images 1 LP and 3 HP. Now apply wavelet coefficient rule to find fused coefficient. Apply reconstruction algorithm for construction fused image from fused LP and HP coefficient. At last fused image is obtained.

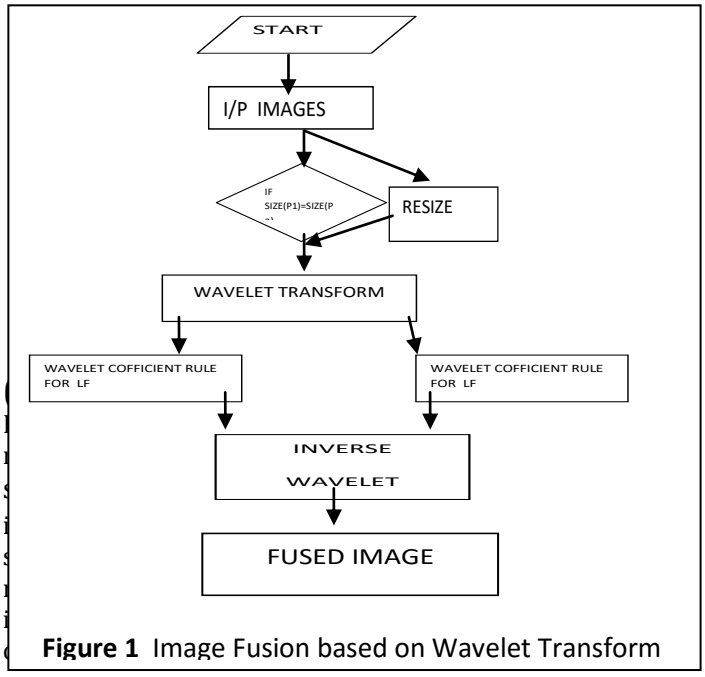



**Figure 1** Image Fusion based on Wavelet Transform

- Low pass filters in the two trees must differ by half a sample period.
- Reconstruction filters are used for inverse.
- In this all filters form the same orthonormal set.
- Both trees have the same frequency response.

## Methodology and model:

The figure below shows the basic idea of the proposed algorithm of image fusion. Each image is passed to the low pass and high pass filter to produce four components (LL,LH,HL,HH) for the actual , horizontal, vertical, and detail components. Then the fusion rules are applied to these components of the two images and then taking the inverse wavelet to generate the fused image.

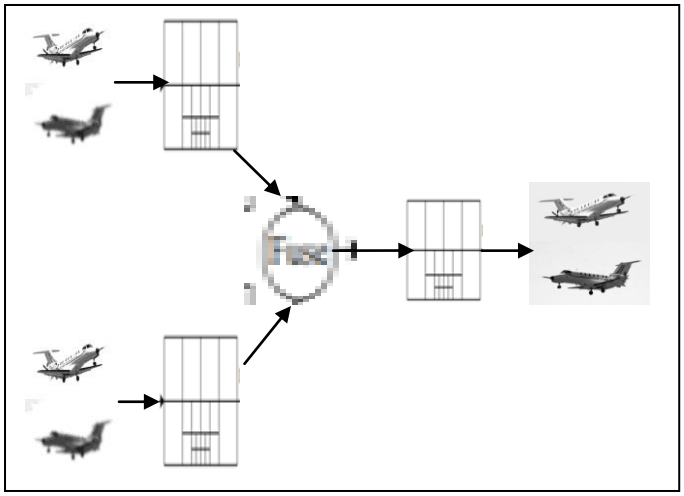


**Figure2.** Fusion of two images using DT-CWT

## Flowchart

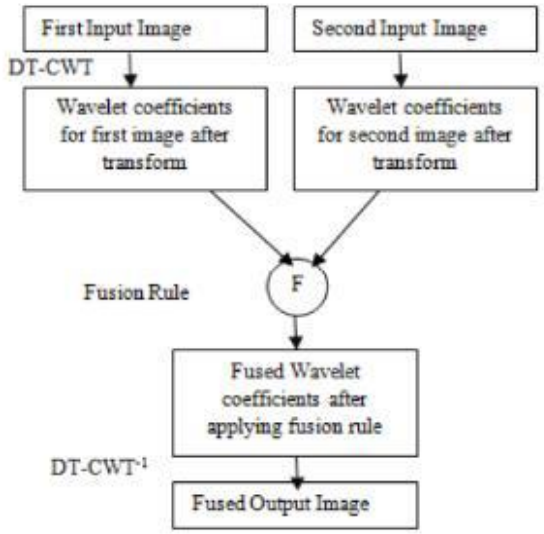



**Figure3** . Flow diagram of DT-CWT

## b). DWT:

DWT is one type of wavelet transform which is of discrete type. In other words it is the transform which converts discrete time signal to a discrete wavelet representation. DWT is time variant and uses one filter. It is performed at pixel level. The process can be shown as a bank of filters. It offers a precise way for image fusion by decomposing a image into low frequency band and high frequency band at different levels also reconstructed at these levels. It is due to following reasons:

- Inherent multi-resolution in nature
- Wavelet coding scheme
- Applications were scalability and tolerable degradation are improved.[10]

## Methodology

The figure below shows the basic idea of the DWT algorithm of image fusion. DWT is applied to source images and obtained wavelet coefficient. Each image is passed to the low pass and high pass filter to produce four components Then apply the fusion rules on it. After that inverse of algorithm is taken to get output image.

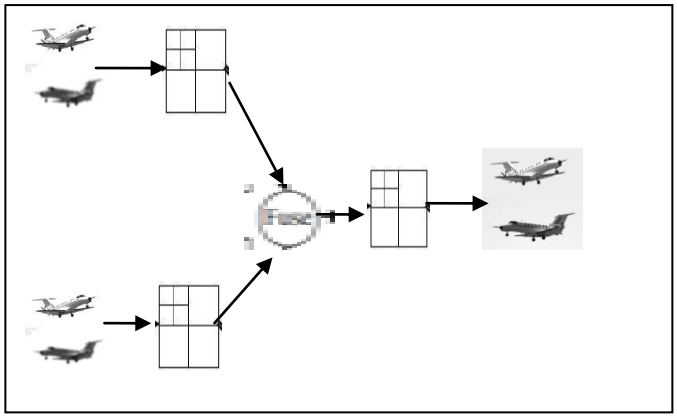


**Figure4.** Flow diagram of DWT ALGORITHM

Model shows the proposed technique pseudo code
Input images are applied. Apply the input images into 1 filter stage for eliminating the noise Applying the inputs to low pass filter and high pass filter for decomposing the inputs to four components (LL,LH,HL,HH). Get the approximate value of the wavelets coefficients. Applying the fusion rules on it. Now Inverse the applied fused wavelet to produce the fused image on combing coefficient.

## 2). Without Wavelet Algorithm

This algorithm is the process of getting an output image with all regions in focus. The value of the pixel P (l, m) of each image is taken and added. This sum is then divided by 2

to obtain the average. The average value is assigned to the corresponding pixel of the output image which is given in equation (1). This is repeated for all pixel values.

$$K(l,m) = \frac{\{X(l,m) + Y(l,m)\}}{2}$$

Where X (l , m) and Y ( l, m) are two input images. In this maximum mode and minimum mode case is also defined. [11]

**Flow chart of DWT**

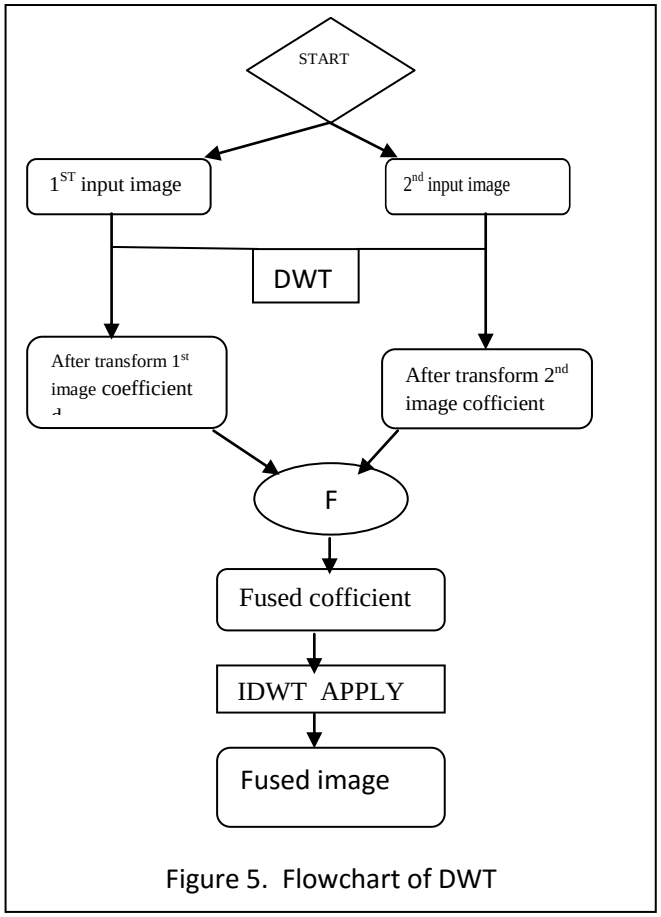



Figure 5. Flowchart of DWT

**d). Metrics**

Metric is the mathematical analysis of an algorithm to show the performance and comparison among other algorithms. In terms of image processing it is the mathematical comparison of algorithms to choose the best result of image fusion. There are many methods to do this. PSNR and MSE very commonly used. These are independent to each other. If PSNR increases and MSE decreases then obtained image is of better quality.[15]

## PSNR

It is the ratio between the original and a compressed *image*. Ratio of maximum possible power of a signal and the power of corrupting noise that affects the fidelity of representation. Used to quantify the nature of remaking of project codes.

$$\text{PSNR} = 20log \frac{255\sqrt{3}}{\sum_{m=1}^{m}\sum_{n=1}^{n}(A_{ij}-B_{ij})^2}$$

The higher PSNR better image

## MSE

The *MSE* is a measure of the quality of an estimator which has always non-negative values closer to zero are better.

$$\text{MSE} = \frac{1}{mn}\sum_{m=1}^{m}\sum_{n=1}^{n}(A_{ij} - B_{ij})^2$$

Where A= Perfect image
B= Fused image i, j are pixel row and column index
m, n number of row and column
The lower MSE means better performance.

## e) SIMULATION

The matlab R2011a is used to simulate the fusion process in two ways. The batch processing has been implemented and graphical user interface is also used which is as under:

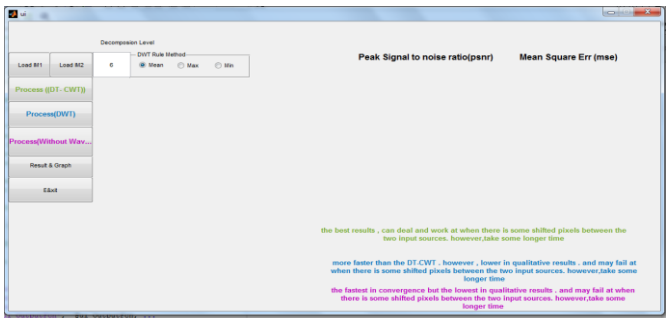


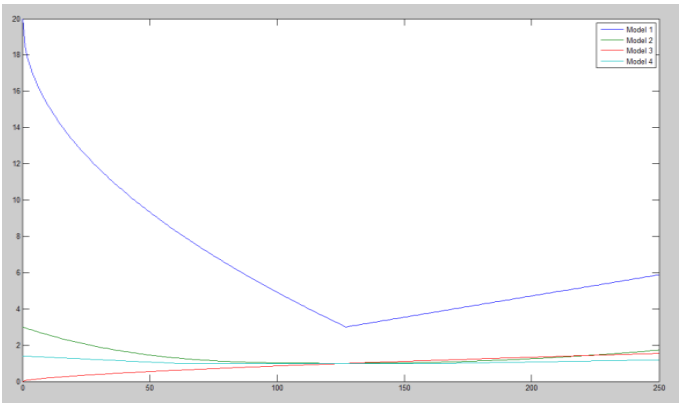

Figure 6. GUI For Image Fusion

GUI has two push buttons to load two input images IM1 and IM2 for the fusion purpose. The text box displays decomposition level, where as it is the important part of fusion. Some more push buttons are used in this GUI Which are described as follows. First button is used to display the DT-CWT process output by interfacing the code with it. Second button for second wavelet algorithm that is DWT. Third button is used for displaying ordinary fusion algorithm output. Fourth push button is used for showing graph between luminance intensity and just noticeable difference. Last push button is used to exit the program. Two labels are used to display PSNR and MSE. Other four to display the output of PSNR and MSE result with respect to each algorithm push button. Three conditions are also displayed on the screen first shows DT-CWT related algorithm, second for DWT and third without wavelet.

**(f) GRAPH**

Graph shown here is between JND and luminance intensity. This graph shows the variation of luminance brightness with

respect to different models namely model1, model 2, model 3 and model 4.




**Graph 1. Luminance intensity**

In this vertical axis's shows JND and horizontal axis's shows luminance intensity.

### (g). output

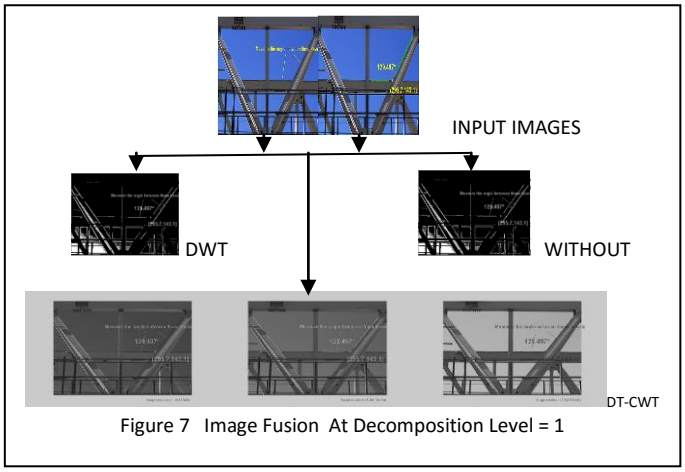



Figure 7 Image Fusion At Decomposition Level = 1

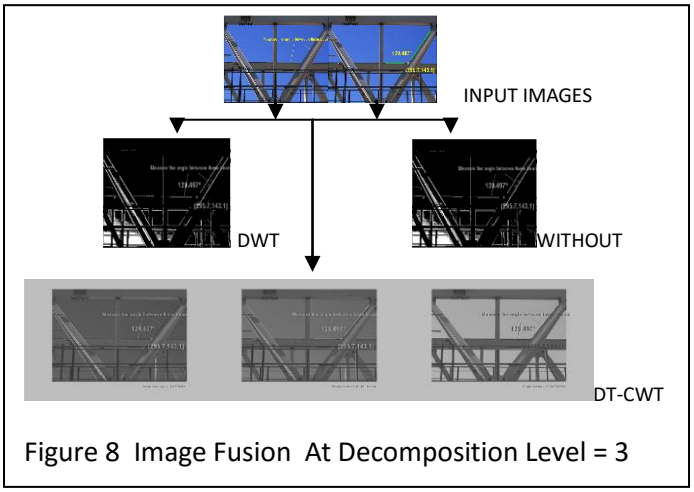



Figure 8 Image Fusion At Decomposition Level = 3

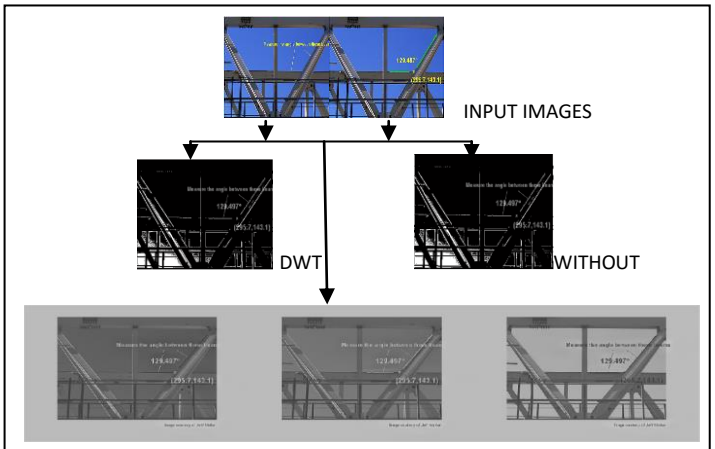



Figure 9 Image Fusion At Decomposition Level = 6

In this figure considered a sample at different decomposition level. The sample image1 has some data and other image 2 has some changes. As a result get good quality image but takes longer convergence time in second sample(Ex 2) both images are different and without defect. The output once again have good perception and images are fused with all details merged into one.

### (h). Table

#### I. Example 1

| | D=1 | | D=3 | | D=6 | |
|---|---|---|---|---|---|---|
| | PSNR | MSE | PSNR | MSE | PSNR | MSE |
| PROPOSED | 29.0807 | 80.986 | 27.2735 | 122.7808 | 26.9454 | 132.4166 |
| DWT | 2.9438 | 3.3273 | 2.9438 | 3.3273 | 2.9438 | 3.3273 |
| WITHOUT WAVELET | 2.9338 | 3.3274 | 2.9338 | 3.3274 | 2.9338 | 3.3274 |

Ex1, (tables) shows the result of proposed (DT-CWT), DWT and simulation without wavelet consistently. The PSNR is higher and MSE is lowest in all two tables of proposed as compared to other two algorithm. It proves that proposed algorithm yields better results over other algorithm performance.

## 3. CONCLUSIONS

The proposed algorithm DT-CWT is compared with DWT and fusion without wavelet. Considered two samples. On the basis of the result obtained by fusion of samples get finer quality image but it more to yield the result. The perception

of the images is also supported by the quantitative metrics PSNR and MSE. This can be safely concluded the proposed algorithm when applied on the images helps in the better perception.

On increasing decomposition level PSNR of output images decreases and MSE of output image increases that proves that at low decomposition level obtained image is of good quality and perception.

## REFERENCES

[1]. Kulvir Singh and Neeraj Julka," A Review on Image Fusion Techniques and Proposal of New Hybrid Technique" International Research Journal of Engineering and Technology (IRJET) e- ISSN: 2395 -0056 Volume: 03 Issue: 03 | March-2016 .

[2]. Medha Balachandra Mule and Padmavathi N.B.," IJARCET Basic Medical Image Fusion Methods" International Journal of Advanced Research in Computer Engineering & Technology (IJARCET) Volume 4 Issue 3, March 2015.

[3]. Ms. Mukta V. Parvatikar and Prof. Gargi S. Phadke," Comparative Study of Different Image Fusion Techniques" International Journal of Scientific Engineering and Technology (ISSN : 2277-1581) Volume No.3 Issue No.4, pp : 375-379, 1April 2014.

[4].Deepak Kumar Sahu, M.P.Parsai,"Different Image Fusion Techniques–A Critical Review" International Journal of Modern Engineering Research (IJMER), www.ijmer.com Vol. 2, Issue. 5, Sep.-Oct. 2012 pp-4298- 4301 ISSN: 2249-6645.

[5]. Kusum Rani and Reecha Sharma," Study of Image Fusion using Discrete wavelet and Multiwavelet Transform" International Journal of Innovative Research in Computer and Communication Enginering *Vol. 1, Issue 4, June 2013.*

[6].X.H. Zhanga, W.S. Linb, P. Xue "Improved estimation for just-noticeable visual distortion" a School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore 639798, Singapore bInstitute for Infocomm , Research, Singapore 119613, Singapore Received 27 June 2003; received in revised form 6 December 2004.

[7]. Chaveli Ramesh and T. Ranjith," fusion performance measures and a lifting wavelet transform based algorithm for image fusion"Published in conference on Conference on 8-11 July 2002.

[8]. Paul Hill and et. al ," Perceptual Image Fusion using Wavelets" ieee transactions on image processing.

[9].Deepak Kumar Sahu and M.P.Parsai," Different Image Fusion Techniques –A Critical Review" International Journal of Modern Engineering Research (IJMER) Vol. 2, Issue 5, Sep.-Oct. 2012 pp-4298-4301 ISSN: 2249-6645.

[10]. Miss. Devyani P. Deshmukh and Prof. A. V. Malviya*2 ," Image Fusion an Application of Digital Image Processing using Wavelet Transform" International Journal of Scientific & Engineering Research, Volume 6, Issue 11, November-2015 1247 ISSN 2229-5518.

[11]. Bincy Bavachan and Dr.Prem Krishnan," A Survey on Image Fusion Techniques" ijrcct. ISSN(I) 2278-5841

[12]. Internet source.

[13].Andrew B. Watson," DCTUNE: A Technique For Visual Optimization of DCT Quantization Matrices For Individual Images" Watson, A. B. (1993). *Society for Information Display Digest of Technical PapersXXIV*, 946-949.

[14]. Zhenyu We and King N. Ngan," Spatio-Temporal Just Noticeable Distortion Profile for Grey Scale Image/Video in DCT Domain" ieee transactions on circuits and systems for video march 2009.

[15].M. Hossny and S. Nahavandi," image fusion algorithms and metrics duality index"2009.

[16]. [16]. Sweta K. Shah and Prof. D.U. Shah," Comparative Study of Image Fusion Techni-ques based on Spatial and Transform Domain" International Journal of Innovative Research in Science, Engineering and Technology *(An ISO 297: 2007 Certified Organization)* Vol. 3, Issue 3, March 2014, ISSN: 2319-8753.