International Journal of Advanced Trends in Computer Applications
www.ijatca.com

Curvelet Image Fusion using Neural Network and SVM Algorithm

[1]Monika Kumari, [2]Mr. Sanjay Yadav
[1]M.Tech Student, HPTU
[2]Assistant Professor
Himachal Pradesh Technical University
[1] kumarimonika007@gmail.com, [2]sanjay12066@yahoo.com

Abstract: *This paper describes a novel image fusion process which is suitable for pan-sharpening of multispectral (MS) groups furthermore in view of multi-resolution analysis. The combination of high-spectral but low spatial resolution multispectral and low-spectral but high spatial resolution panchromatic satellite images are exceptionally helpful methods in different uses of remote sensing. A few studies demonstrated showed that wavelet-based image fusion strategy gives high quality of the spectral content of the fused image. In this paper we present another method based on the Curvelet transform utilizing Neural Network and SVM which represents edges better than wavelets and since edges play a vital role in image understanding and one great approach to enhance spatial resolution is to upgrade the edges then Curvelet-based image fusion method provides richer information in the spatial and spectral domains simultaneously. We will perform image fusion using Curvelet Transform with Neural Network and SVM Techniques. This new technique has reached an optimum fusion result.*

Keywords: *Edge detection, Fusion, Multiresolution analysis, Wavelet transform, Curvelet transform.*

I. INTRODUCTION

The process of including complementary and redundant information from different images into one composite image which includes a better description of the underlying scene is known as image fusion and these results in a fused image more useful for human visual and machine processing. Image fusion strategies are basically classified into pixel level and region level approaches.

Pixel level techniques: The set of pixels in the source image determine each pixel in the fused image. Basically pixel level techniques are classified into spatial domain and transform domain techniques.

Region level techniques: This technique involves the segmentation of the images into regions and then based upon the extracted region fusion is performed.

The process of image fusion combines two or more images. Different images contain different information is the main idea behind image fusion. Wavelet transforms is that in which the transformation should allow only changes in time extension but not shape. This is affected by choosing suitable basis functions that allow for these Changes in the time. Curvelet are an appropriate basis for representing images which is smooth apart from singularities along smooth curves *where the curves have bounded curvature* where objects have a minimum length scale in the image. This property holds for cartoons and geometrical diagrams and text.

1.1 Curvelet Transform

The Curvelet change like as wavelet change is a Multiscale change with edge items filed by scale and area parameters. Not at all like the wavelet change parameters and the Curvelet pyramid contains objects with a high level of directional particular city. Furthermore the Curvelet change is in light of a certain anisotropic scaling guideline which is not the same as the isotropic scaling of wavelets. The components comply with a scaling law where the length of the backing of an edge components and the width of the backing are associated by the connection width ¼ length2. These properties are extremely fortifying and have officially leaded to a scope of fascinating admired applications for instance in tomography and in experimental calculation. A comprehension of the Curvelet change idea opens one's eyes to the way that in two and higher measurements new Multiscale representations are conceivable that having properties distracted by wavelets and having empowering basic components. While it is conceivable that this new

thought will be immediately overlooked with the progression of time we feel that the exceptionally novel elements of the change – anisotropy and anisotropy scaling - compel further investigation for the moment.

The Curvelet transform (CVT) is a multi-scale transform proposed by Candes and Donoho and is derived from the Ridgelet transform The Curvelet transform is suited for elements which are smooth away from discontinuities across curves then the Fourier Transform does not handle point's discontinuities well because a discontinuity point affects all the Fourier Coefficients in the domain. The Wavelet transform handles point discontinuities well and doesn't handle curve discontinuities well. Curvelet transform handles curve discontinuities well as they are designed to handle curves utilizing only a small number of coefficients and Curvelet transform has several applications in various areas such as image denoising, image fusion, Seismic exploration, Turbulence analysis in fluid mechanics and so on. Curvelet Transformation is an enhancement technique to reduce image noise and to increase the contrast of structures of interest in image. Compared to other techniques this technique can manage the vagueness and ambiguity in many image reconstruction applications efficiently.

II. TECHNIQUES USED

Following are the two main techniques which are used to enhance the results of curvelet images:

2.1 Neural Network (NN)
Neural network is set of interconnected neurons which are used for approximation of universal. Artificial neural networks are composed of interconnecting neurons that are artificial neural networks may either be utilized to pick up a comprehension of natural neural systems and for taking care of manmade brainpower issues without fundamentally making a model of a genuine organic framework. The genuine or natural sensory system is exceptionally mind boggling in which fake neural system calculations endeavor to extract this multifaceted nature and concentrate on what might theoretically matter most from a data handling perspective. Great execution (e.g. as measured by great prescient capacity and low speculation lapse) or execution copying creature or human mistake examples can then be utilized as one wellspring of confirmation towards supporting the theory that the reflection truly caught something essential from the perspective of data. Another impetus for these reflections is to diminish the measure of calculation needed to mimic manufactured neural systems.

2.2 Support Vector Machine (SVM)
It is primarily a classifier in which Width of the margin between the classes is the optimization criterion, i.e. empty area around the decision boundary defined by the distance to the nearest training patterns. These are called support vectors. The support vectors change the prototypes with the main difference between SVM and traditional template matching techniques is that they characterize the classes by a decision boundary which is not just defined by the minimum distance function. The concept of Support Vector Machine was introduced by Vapnik. The objective of any machine that is capable of learning is to achieve good generalization performance that given a finite amount of training data. The support vector machines have proved to achieve good generalization performance with no prior knowledge of the data.

The principle of an SVM is to map the input data onto a higher dimensional feature space nonlinearly related to the input space and describe a separating hyper plane with maximum margin between the two classes in the feature space. The SVM is a maximal margin hyper plane in feature space built by using a kernel function. These results in a nonlinear boundary in the input space and the optimal separating hyper plane can be determined without any computations in the higher dimensional feature space by using kernel functions in the input space. There are some commonly utilized kernels include:-

a) Linear Kernel
$K(x, y) = x, y$

b) Polynomial Kernel
$K(x, y) = (x. y+1) d$

SVM Algorithm

i. Define an optimal hyper plane.
ii. Extend the above definition for non linear separable problems.
iii. Map data to high dimensional space where it is easier to classify with linear decision surfaces.

III.PROPOSED WORK

There are various phases in the following points that describes the working of proposed work:

Phase 1:
First an opening GUI for this implementation is developed. After that a code for the loading the images in the Matlab database is developed.

Phase 2:
Develop a code for the edge detection using the canny edge detector. After that we get the Edge Image of loaded image.

Phase 3:
Develop a code for the Curvelet Transform and apply it. With the help of the Curvelet transform we got the fused image of loaded image.

Phase 4:
After that code for the Neural Network and SVM Algorithm is developed. With the help of Neural Network and SVM analysis of proposed algorithm is done. Also MSE and PSNR values are calculated and plotted.

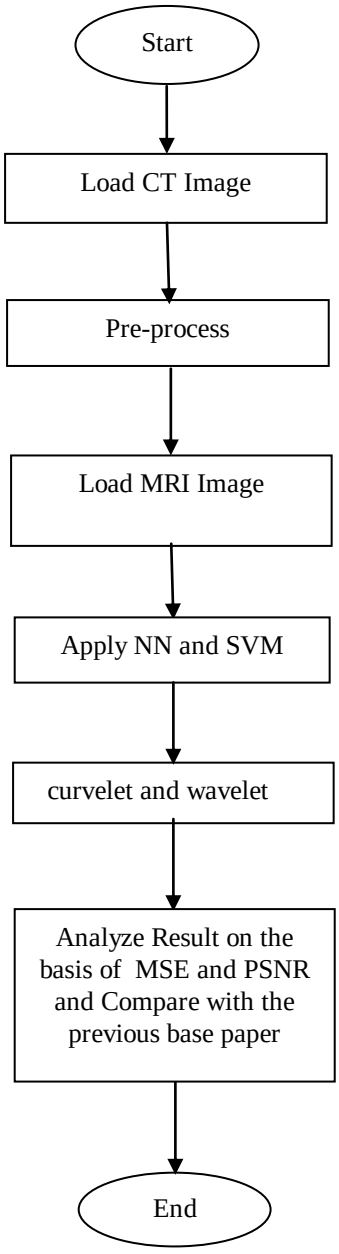

Figure 1: Flowchart of proposed work

IV. PARAMETERS USED

4.1 PSNR: PSNR is the ratio value between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. The PSNR of the fusion result is defined as follows:

` PSNR= $10\text{Xlog}\left(\frac{(f_{max})^2}{MSE^2}\right)$

where fmax is the maximum gray scale value of the pixels in the fused image. Higher the value of the PSNR is better the performance of the fusion algorithm.

4.2 MSE: A commonly utilized reference based assessment metric is the Mean Square Error (MSE). The MSE between a reference image R and a fused image F is given by the
Following equation:

$$\text{MSE} = \frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}\left(R(m,n) - F(m,n)\right)^2$$

Where R (m, n) and F (m, n) are the reference and fused images respectively and M and N are image dimensions. Smaller the value of the RMSE is better the performance of the fusion algorithm.

V. RESULTS AND DISCUSSION

In the following figures, result of proposed algorithm is highlighted.

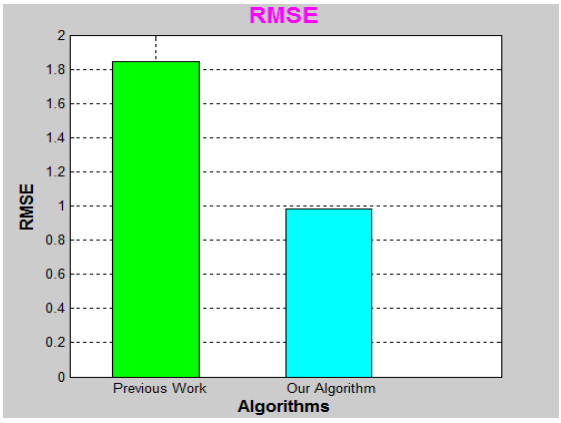

Figure 2: RMSE of previous and proposed work

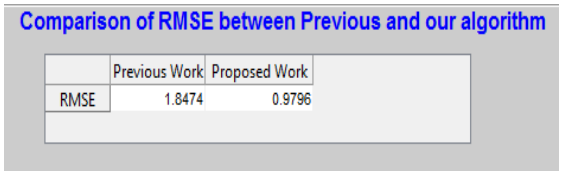

Figure 3: RMSE values

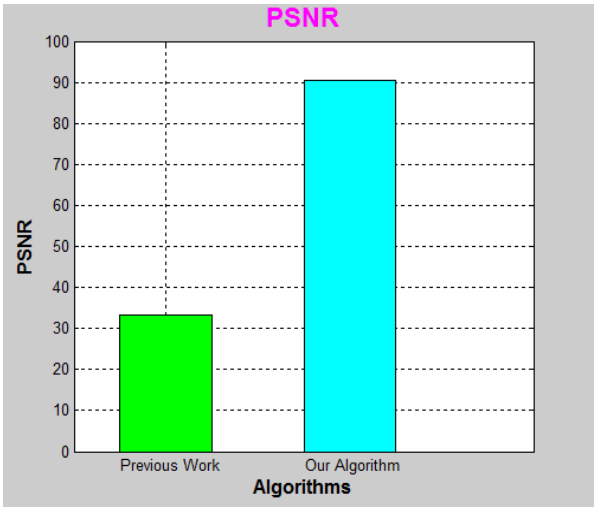

Figure 4: PSNR of previous and proposed work

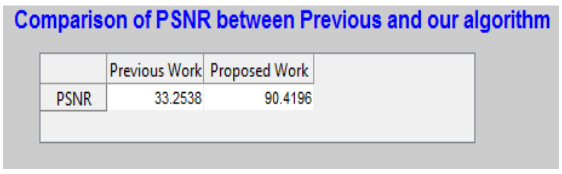

Figure 5: PSNR values

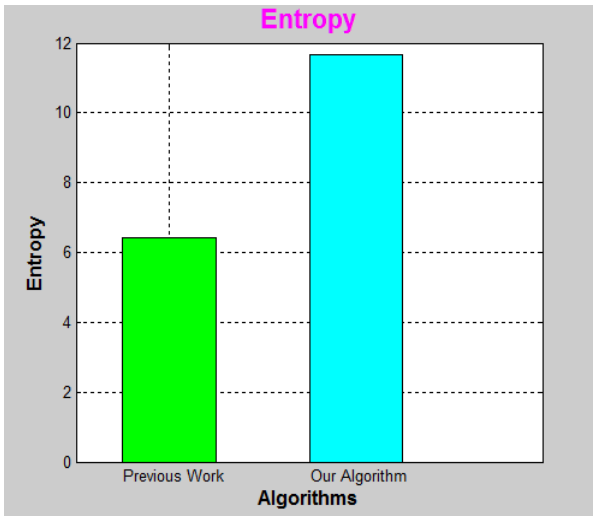

Figure 6: Entropy of previous and proposed work

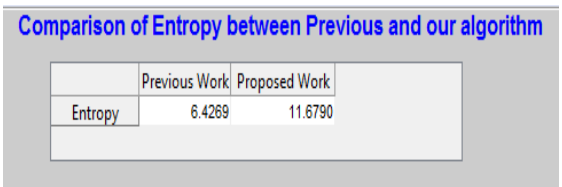

Figure 7: Entropy values

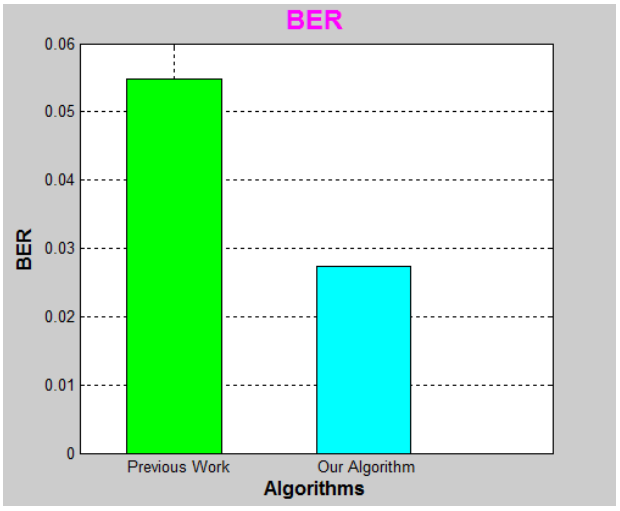

Figure 8: BER of previous and proposed work

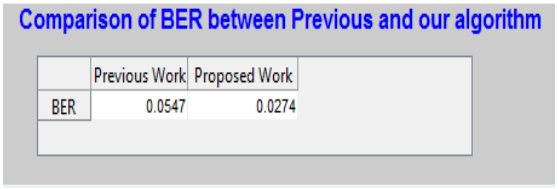

Figure 9: BER values

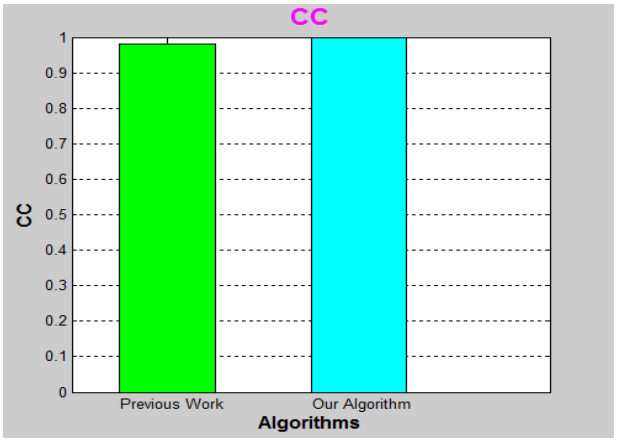

Figure 10: Correlation Coefficient of previous and proposed work

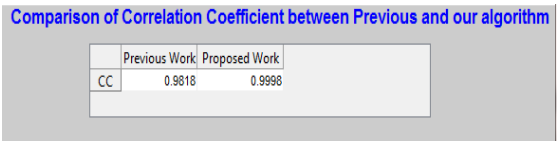

Figure 11: Correlation Coefficient values

CONCLUSION

In this firstly we load the medical images i.e., MT and CT. Then convert images to binary form. After that Neural Network and SVM Algorithm is developed. Develop a code for the wavelet and Curvelet Transform and apply it. We get the fused image with Neural Network and SVM. Then, MSE and PSNR values are calculated which is better

From the results it is concluded that the proposed algorithm enhances the performance,

Better PSNR and MSE value. Image Fusion algorithm doesn't degrade the quality of image. It is also less costly and more accurate in comparison to previous results.

ACKNOWLEDGEMENT

Thanks to my Guide and family member who always support and guide me during my dissertation. Special thanks to my father who always support my innovative ideas.

REFERENCES

[1] Vishal P.Tank, Divyang D. Shah,Tanmay V. Vyas, Sandip B. Chotaliya Manthan S. Manavadaria in 2013. They are purpose Image Fusion Based on Wavelet and Curvelet Transform.

[2] Jianwei Ma and Gerlind Plonka in 2012. He purpose A Review of Curvelets and Recent Applications.

[3] Multiresolution methods are deeply related to image processing, biological and computer vision, scientific computing, etc.

[4] Smt.G. Mamatha (Phd), L.Gayatri in 2012. They are purposed AN IMAGE FUSION USING WAVELET AND CURVELET TRANSFORMS.

[5] T. Ranchin and L. Wald, "Fusion of High Spatial and Spectral Resolution images: The ARSIS Concept and Its Implementation," Photogrammetric Engineering and Remote Sensing, vol. 66, 2000, pp. 49-61.

[6] L. Wald, T. Ranchin and M. Mangolini, "Fusion of Satellite images of different spatial resolution: Assessing the quality of resulting images," Photogrammetric Engineering and Remote Sensing, vol. 63, no. 6, 1997, pp. 691-699.

[7] J. Nunez, X. Otazu, O. Fors, A. Prades, V. Pala and R. Arbiol, "Multiresolution-based image fusion with addtive wavelet decomposion," IEEE Transactions on Geoscience and Remote sensing, vol. 37, no. 3, 1999, pp. 1204-1211.

[8] E. J. Cand`es, "Harmonic analysis of neural networks," A ppl. Comput. Harmon. Anal., vol. 6, 1999, pp. 197-218.

[9] E. J. Cand`es and D. L. Donoho, "Curvelets- A surprisingly effective non adaptive representation for objects with edges," in Curve and Surface Fitting: Saint-Malo, A. Cohen, C.Rabut, and L.L.Schumaker, Eds. Nashville, TN: Vanderbilt Univ. ersity Press, 1999.

[10] J. L. Starck, E. J. Cand`es and D. L. Donoho, "The curvelet transform for image denosing," IEEE Trans. Image Processing, vol. 11, 2002, pp. 670-684.

[11] J. L. Starck, E, J. Cand`es, and D. L. Donoho, "Gray and Color Image Contrast Enhancement by the Curvelet Transform," IEEE Trans. Image Processing, vol. 12, no. 6, 2003, pp. 706-717.

[12] E. J. Cand`es, "Ridgelets: Theory and Applications," Ph.D. Thesis, Department of Statistics, Stanford University, Standford, CA, 1998.

[13] D. L. Donoho, "Digital ridgelet transform via rectopolar coordinate transform," Stanford Univ., Stanford, CA, Tech. Rep, 1998.

[14] D. L. Donoho, "Orthonormal ridgelets and linear singularities," SIAM J. Math Anal., vol. 31, no. 5, 2003, pp. 1062-1099.

[15] M. I. Smith, J. P. Heather, "Fusion Technology Review of Image in 2005," Proceedings of the SPIE, Volume 5782, pp. 29-45, 2005.