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Different Parameters of Image Fusion Using Steerable Pyramid Transformation

Sapna Sharma[1], Shweta Rani[2], Sushil Kakkar[3]

M. Tech Student, Department of ECE, Bhai Gurdas Institute of Engineering and Technology, Sangrur, India[1]

Associate Professor, Department of ECE, Bhai Gurdas Institute of Engineering and Technology, Sangrur, India[2]

Assistant Professor, Department of ECE, Bhai Gurdas Institute of Engineering and Technology, Sangrur, India[3]

ABSTRACT: Image fusion process is to combine information from two or more images of a scene into a single composite image that is more revealing and is more suitable for visual perception or computer processing. Image fusion main purpose is to improve the readability features of the image by processing the redundant data in multiple images. In present work, steerable pyramid transform has been adopted for fusion process. SPT (Steerable Pyramid Transform) is a powerful multi-scale, multi-orientation image decomposition tool. Due to its shift and rotation invariant property proposed method used steerable pyramid transform for image fusion. Compared to the source images, the fused image contains fine details and more features. DWT,BWT has been implemented widely for image fusion. But SPT allows for multiple arbitrary directions at each scale. Proposed method have employed three different fusion rules for calculating values of Information entropy, Standard deviation, Fusion Factor and compared the results for all pair of images using these rules. It has been found that steerable wavelet transform retain individual image information like edges, curves, boundaries of the fused image.

KEYWORDS: Image-fusion, SPT, Fusion rules, Image processing.

I. INTRODUCTION

The term fusion means to combine the information contained in several domains. Image fusion is the process of integrating information from two or more images into a single image. Pixel-based fusion is performed on a pixel-by-pixel basis.[7] It generates a fused image in which information associated with each pixel is determined from a set of pixels in source images to improve the enactment of image processing tasks. Fusion can be performed in three levels: (1) pixel level, (2) region level, (3) decision level. Image fusion mainly consist of two steps: decomposition of source image and selection of coefficients from the decomposed image.[7] Image fusion technology have been widely used in digital imaging, remote sensing, bio-medical images ,computer vision and so-on.[8].

II. STEERABLE PYRAMID TRANSFORMATION (SPT)

A steerable pyramid transform is useful to ensure robust sub-band fusion. Due to directional selective nature of steerable pyramid filters, it efficiently deals with the images containing contours and textures and performs fusion effectively.[6] It is known that the edge and line information can be obtained by derivative-based operations. The research can be divided into two groups: one is the multi-resolution pyramid itself ; the other is the fusion rule, which is defined as the the way to combine the coefficients in the transform domain. SPT divide the whole image into two sub bands that is high pass and low pass band. Further the low pass is sub divided into four orientations to get better result for each pixel, this process continue upto 3 scale 4-orrientation sub-bands[9]. The pyramid extracts features of the image in the transform domain and the fusion rule fuses these coefficients effectively and accurately.

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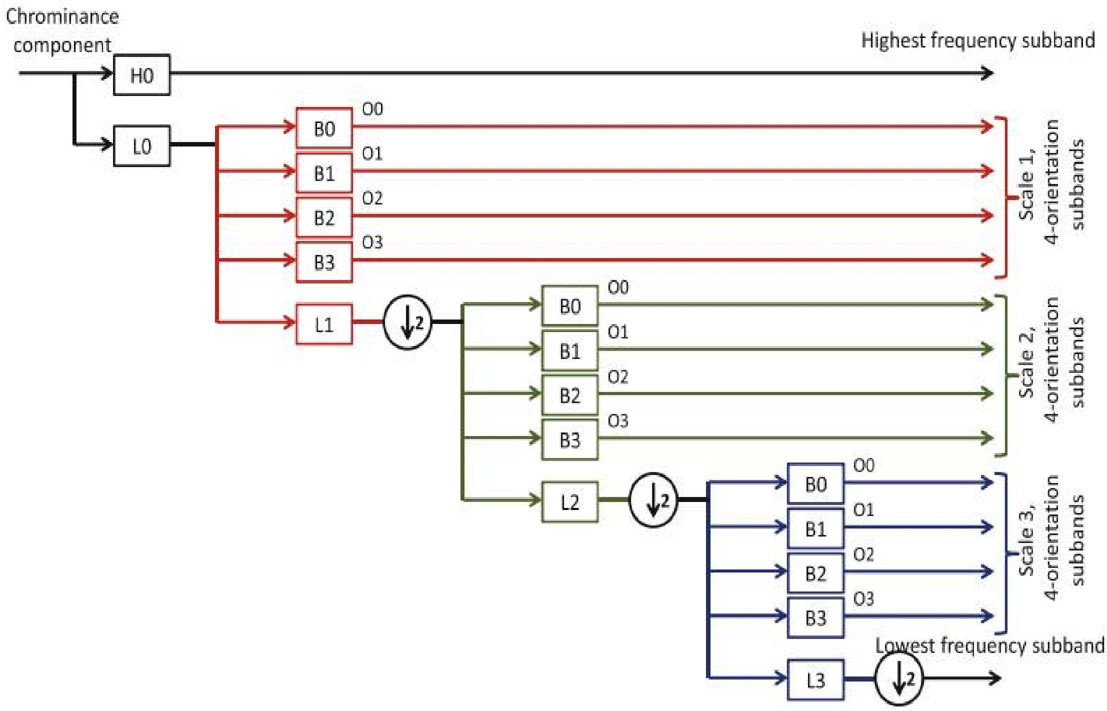

Fig 1: Sub-band decomposition in SPT[13]

III. PROPOSED WORK

Collect number of database images which have same scene view but different focus location. Apply multi-level steerable pyramid wavelets on each image and extract their low and high frequency coefficients at each level and at each orientation. Apply different fusion rules i.e. simple average of coefficients, maximum of coefficients and minimum of coefficients for low and high frequency coefficients and apply inverse of steerable pyramid wavelets to get the fused image. Compare the results of different combinations of fusion techniques with database images using some similarity measurement.

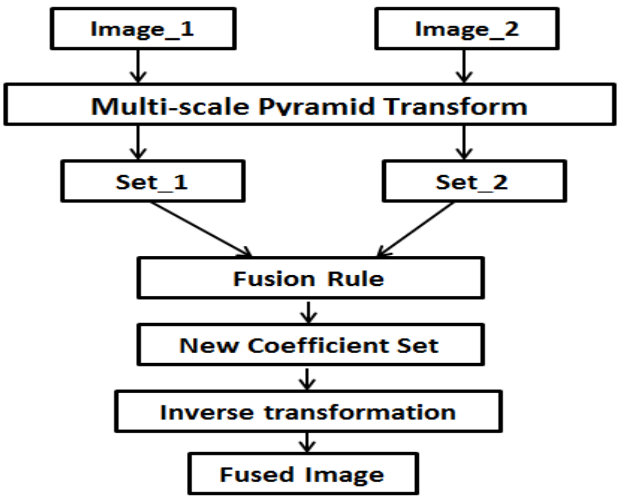

Fig 2: Flowchart chart of the proposed algorithm[7]

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4. Quantitative evaluations: Evaluation of fusion is done on the basis of statistical measure of different parameters:

1. **Standard deviation**: It is usually used to represent the deviation degree of the estimation and the average of the random variable. The standard deviation mainly replicates the discrete degree between the pixel gray and the mean value. [13]

$$\sigma = \sqrt{\sum_{i=0}^{L-1} (\mathrm{i} - \bar{i}) h_F(\mathrm{i})}, \qquad i = \sum_{i=0}^{L-1} i h_F(\mathrm{i})$$

2. **Entropy**: Every pixel is defined by its position and also by its grey scale levels. For an image which is having L grey levels, the entropy is defined as. It is calculated as follows:

$$Q = -\sum_{i=0}^{L-1} P_i \log_2 P_i$$

3. **Fusion Factor:** A higher value of FF indicates that fused image contains moderately good expanse of information present in both the images. However, a high value of FF does not suggest that the information from both images is symmetrically fused.

FF = MAF + MBF, where MAF and MBF are mutual information among source images and fused image

V. EXPERIMENTAL RESULTS

Different blurred input images are taken and then fusion process is done using steerable pyramid transformations. Different parameters are calculated like entropy, standard deviation, fusion factor. Input images are:

Input pair of image one[13]

Input pair of image two[13]

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Experimental results show that this method combine focus region from both images effectively which results in better content of fused image than individual images. Entropy defines as information contained in the image, gives better results. For Standard Deviation different results were found for all different images. Fusion faction is the sum of mutual information m1 and m2. It is found that Fusion Factor increases when average rule was used. Resultant Image clearly demonstrates that information from the two different image combine into a single fused image which contains complete information of both input images. In this paper, we have presented two set of input images and their corresponding fused images with three different rules. SPT (Steerable Pyramid Transform) is a powerful linear multi-scale, multi-orientation image decomposition technique.

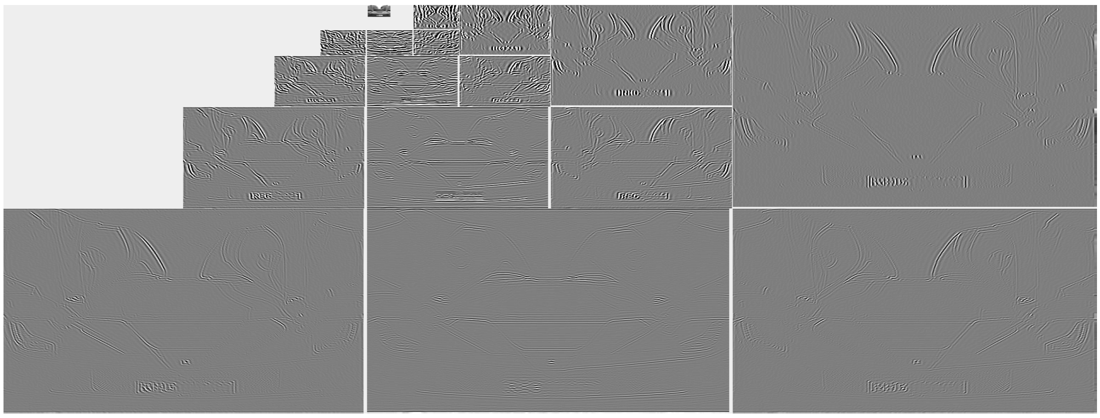

Fig 1: SPT on original image upto four levels.

Results with steerable pyramid transform for pair one

Fusion method used	Entropy	Standard deviation	Fusion factor	Mutual information M1	Mutual information M2
Average Rule	7.6560	59.7069	14.7426	7.3730	7.3696
Min Rule	7.6556	59.5444	14.2750	7.1373	7.1377
Max Rule	7.6918	60.1453	14.0879	7.0446	7.0434

Table 1: Results for image first using different rule

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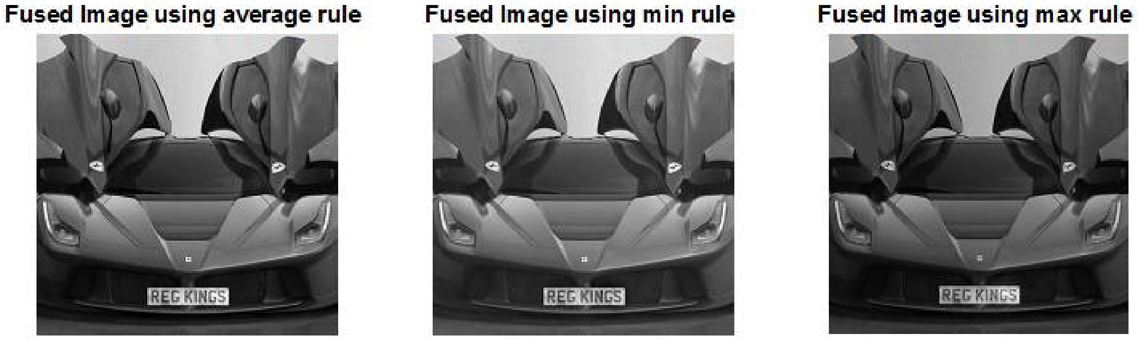
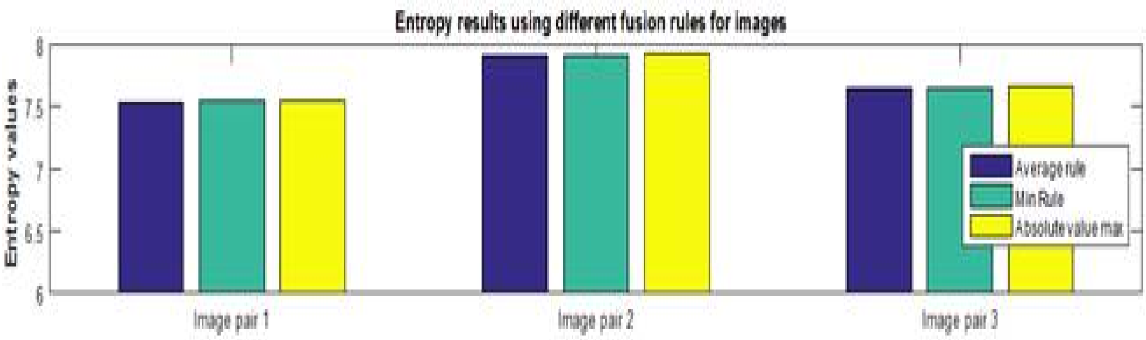


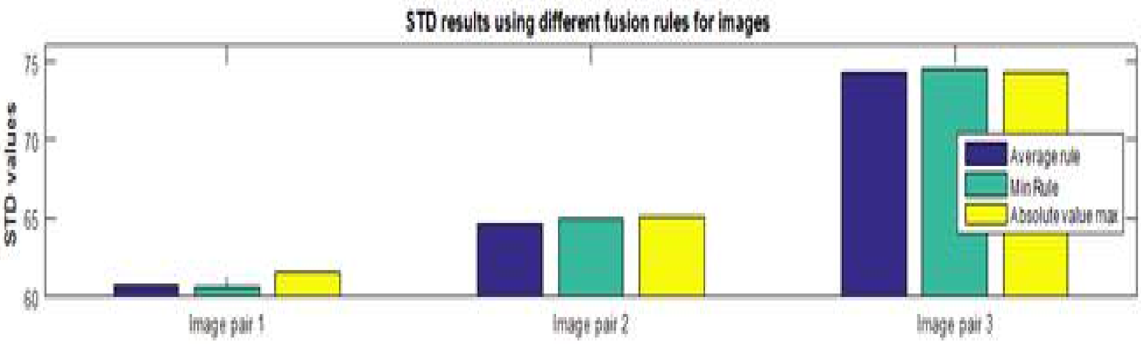
Results with steerable pyramid transform for pair two

Fusion method used	Entropy	Standard deviation	Fusion factor	Mutual information M1	Mutual information M2
Average Rule	7.5390	60.7167	14.6470	7.3269	7.3200
Min Rule	7.5417	60.5552	13.8363	6.9269	6.9094
Max Rule	7.5488	61.4859	13.6571	6.8351	6.8219

Table 2: Results for image second with different rules



GRAPH 1: Showing results for Information Entropy



GRAPH 2: Showing results for Standard Deviation

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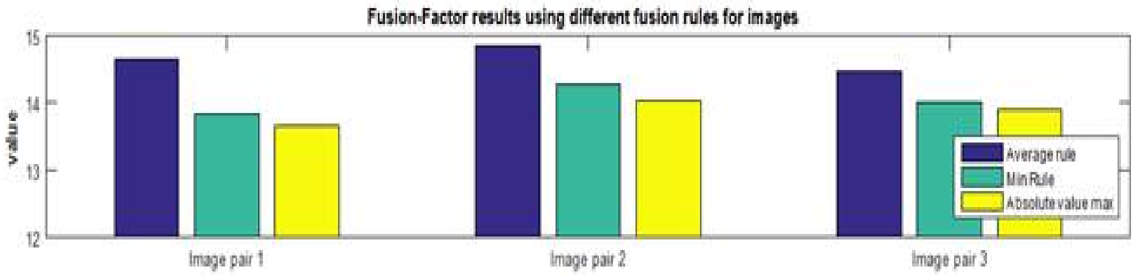

GRAPH 3: Showing results for Fusion Factor

VI. CONCLUSION

In the present work, steerable pyramid transformation are used for image fusion process because steerable pyramid transformation can work on four orientations which is beneficial for extracting the features of image. The proposed method performs better in all the cases. Out of Three rules average rule is found to be better than other two. The better results are because steerable pyramid transformation focus on image information like line, edges, curves, boundaries etc. This technique of steerable pyramid got improved results in image fusion than DWT. In future scope the research can extended to another properties of image like colour / intensity etc. The fusion technique can aslo be changed from pixel level to region level or decision level fusion.

REFERENCES

[1] Om Prakash, Richa Srivastav, Ashish Khare, "Biorthogonal Wavelet Transform Based Image Fusion Using Absolute Maximum Fusion Rule", ICT-2013.
[2] Hauxun zhang, xu cao, "A way of image fusion based on wavelet transform", IEEE 9th international conference on mobile ad-hoc and sensor networks, 2013.
[3] T. Stathaki, "Image Fusion: Algorithms and Applications", Academic Press, 2008.
[4]S. Li, J.T. Kwok, Y. Wang, "Combination of images with diverse focuses using the spatial frequency",Inform. Fusion 2 pp. 169–176, 2001.
[5] S. Li, B. Yang, "Multi-focus image fusion by combining curvelet and wavelet transform, Pattern Recogn". Lett. 29 pp. 1295–1301, 2008.
[6] Maruturi Haribabu,CH.Hima Bindu,Dr.K.Satya Prasad, "Image Fusion with Biorthogonal Wavelet Transform Based On Maximum Selection and Region Energy",International Conference on Computer Communication and Informatics, ICCCI- jan 03-05,2014.
[7] Om Prakash,A.K, "Pixel-level image fusion scheme based on steerable pyramid wavelet transform using absolute maximum selection fusion rule", International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT),2014
[8] S.chen, R. zhang,H. su, Z. tian, "SAR and multi-spectral image fusion using generalized HIS transform based on trous wavelet and EMD decomposition", IEEE sensors J., vo:10, no.3, pp 737-745,mar 2010.
[9] M. Subbarao, T. Choi, A. Nikzad, "Focussing techniques", Opt. Engg. 32, pp. 2824–2836, 1993
[10] J. Khan, S. Bhuiyan, R. Adhami, "Feature point extraction from the local frequency map of an image", Electr. Comput. Eng, pp. 1–15, 2012.
[11] C. Wu, Q. Wang, "A novel approach for interest point detection based on phase congruency", IEEE Tencon Conf. pp. 1–6, 2005.
[12] Bedi, S. S., Agarwal, M. J., & Agarwal, P. (2013). Image Fusion Techniques and Quality Assessment Parameters for Clinical Diagnosis: A Review. International Journal of Advanced Research in Computer and Communication Engineering, 2(2), 2319-5940
[13] S.Sharma, S.Rani, " SPT based image fusion using different fusion rules" 4th international conference on advancements in engineering and technology, pp 532-537,18-19 march ,2016