Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 4, 2021, Pages. 3728 - 3734
Received 05 March 2021; Accepted 01 April 2021.

Multi Scale Image Fusion through Laplacian Pyramid and Deep Learning on Thermal Images

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ABSTRACT

Scale is an imperative parameter in image processing. Images can contain different objects and regions with variations in size as well as variations in resolutions. Appearance of objects in the image mainly depends on the scaling parameter. In order to analyse the images in a better way it is necessary to represent images in different scales because a single scale image is restricted to a fixed bounded window. To have useful information from the available images there is a necessity of representing images in a multi scale fashion. Thermal imaging means producing visible images from invisible thermal radiation that is it is a method of generating images with the help of heat given to the object. Development of thermal images took place in 1950^{s} and 60^{s} for the purpose of military applications. In this paper, focussed in providing advanced and enhanced fusion on thermal images by using multi scale laplacian pyramid in combination with deep convolutional neural networks. The proposed approach includes fusion method based on laplacian pyramid and deep learning on thermal images for clinical applications, The results of this method shown improved results in identifying abnormalities in the medical images with the help of seven different image metrics.. In the fields of defence and law enforcement object or person identification is needed for their work. The resultant fused image of the second method gave better image metric values in order to provide more significant visual information.

Keywords: Image Fusion, Deep Learning, Neural Networks, Lapalacian Pyramid

Introduction

Image fusion examination is predominantlyowing to the fashionableimprovements in the arenas of high resolution, robust,multi-spectral and cost in effect image sensor policy technology. Subsequentlya few decades ago, with the outlineImage fusion has emerged as the most advanced of these multisensory imaging techniques remained an emergentarena of examination in medical imaging, remote sensing, military and civilian avionics, night vision, concealed weapons detection, Various monitoring and protection system implementations, including autonomous vehicle navigation [6,3]. At hand has been anallocation of enhancement in enthusiasticHigh spatial and spectral resolution in real-time imaging systems, as well as faster sensor technology, are thriving. The elucidation for datastraining can be happened by aanalogousintensification in the quantity of dispensation units, using more rapidly Digital Signal Processing (DSP) and greatermemorial devices. This explanationconversely, can be prettyexclusive. Picture fusion algorithms at the pixel level symbolize an effectiveexplanation to this problematic of operativeallied information surplus. Pixel Level fusion effectuallylessens the quantity of information that necessities to be handleddeprived of any substantial loss of valuableinfo and also assimilatesinfo from multi-scale images[1]. Explicit stimulation for the exploration work has derived from the requirement to progress some proficientimage fusion systems, as well as enhancements to existing fusion technologies [9].

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Moreover, a Non-Destructive Testing (NDT) has be situated a widespreadexploration technique castoff in manufacturing product estimationas well as for troubleshooting in exploration work without causing mutilation, which could save time and money. In attendance has continuously been the prerequisite of specificinnovative feature recognition techniques centred on DCNN, for recognition of pretentious tissues of Breast owed to the cancer and likewise identification of persons or objects throughout night times and in abnormal meteorological conditions which supports to defence officers [7]. Exhausting the Laplacian Pyramid centred Multi -scale analysis techniques, It is possible to achieve distortion-free fusion, resulting in less input information loss [8,13,14]. In addition, the proposed creative fusion techniques in this effort show enhancement in terms of quantifiable and qualitative evaluation points of observation as compared to some of the existing image fusionprocedures. The objective of this paper is

1. To get enhanced fused quantitative and qualitative image by reducing the blur from the fused image.
2. To improve the PSNR values of fused thermal images (low, high level feature extraction) related to medical field.
3. To maintain the true color of image even after performing fusion.

Literature Review

Various algorithms on image fusion have been proposed. Those algorithms have been proven effective in many applications. One of the algorithms is byusing the concept of change vector with different directions and this one is applied for different images by changing the threshold value[2,4]. This method shows better presentation in the proportional changes of the landset image of various applications[5].The ERG [12] method indications a global error for changing the local detection resolution with high impact factor of multi temporal images. This method does not necessity any parameters to acquire the metamorphosis image. This one is independent of number of spectral band and other parameters of an image. The UIQ[6] method is very easy to determine and it can switchnumerous types of noisy images and changes in information of an image. It measures the difference between original mage and container with respect of loss of correlation and contrast distortion of an image. A piecewise correlation between the original image and the container image can provide good valuable information for changing the image location[14]. The MAD[10] method concentrates app spectral variations of multi temporal images. It also provides the optimal change for different multi image. All of the exceeding image the metamorphosis image is calculated by detracting the pixel form multi temporal images[11,15]. Finally the threshold method is applied to identify the changes of empirical images by using statistical methods.

Proposed Method

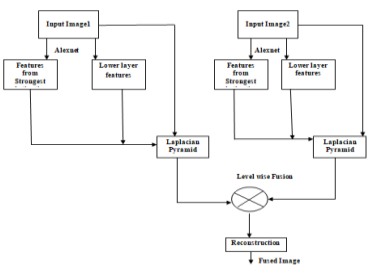

Figure 1. Operational flow for the proposed fusion method

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For the input image 1 obtain the feature map using the AlexNet neural network. The feature map is collected by merging the strongest activation channels of Alexnet. The channel 33 in convolution layer 1 and the channel 27 in convolution layer 5 are found as strongest channels and they have strong features of images.

1. Similarly feature map for the input image 2 is also obtained from the AlexNet neural network.
2. Laplacian pyramid levels are constructed for both the input images.
3. Same size laplacian pyramid levels from both the images remain fused using Average method of fusion rule.
4. Perform the reconstruction process of laplacian pyramid to get the single fused image.
5. Image quality metrics namely SNR, PSNR, DENT, CORR, RMSE are measured for the fused image by taking input images as reference images.
6. The measured fused image metrics are compared with another multi-scale fusion method DWT.

Experimental Results

Quantitative Analysis:

Table 1Quantitative observation

Fusion method	RMSE	DENT	CORR	SNR	PSNR
DWT	8.354 8.64	1.574 0.490	1.06 0.92	11.46 7.28	62.342
Laplacian pyramid	4.936 5.114	4.03 2.92	1.110 0.952	12.94 11.54	65.061
Deep CNN and Laplacian pyramid	2.986 2.95	4.63 3.54	1.114 0.952	24.78 19.79	76.754

1. The RMSE value for DWT fusion method is more that is the value of RMSE increases when the dissimilarity among the input also fused image increases. Proposed method is showing less value of RMSE that means similarity is more between the inputsimagesalso the fused image.
2. The Difference of Entropy value gives the structure information of the image and a high value indicates the quality image. Clearly from the table 4.3 proposed method exhibiting high DENT value when compared with DWT technique.
3. The Cross correlation metric nearly same for both the methods.
4. Lastly both SNR and PSNR metrics are high in the proposed fusion method. High value of these two measures indicates a quality image.

Qualitative analysis:

Figure 2(a) is the input image1, (b) is the input image2, (c) is the fused image which is having high visual appearance than the two input images. Figure 3.1 to 3.5 are the activation channels in

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convolution layers 1 and 5 for input images, strongest channels (33 and 27) from convolution layers 1 and 5.

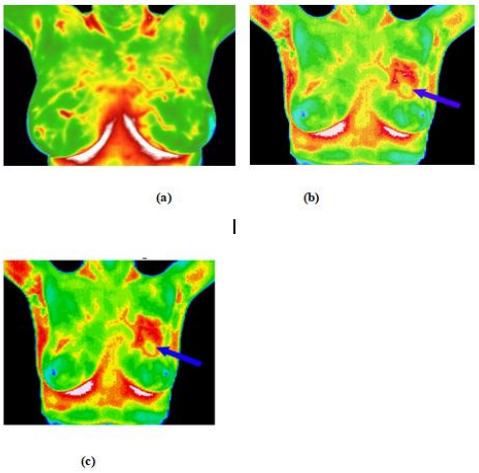

Figure 2. Qualitative observations of Breast images

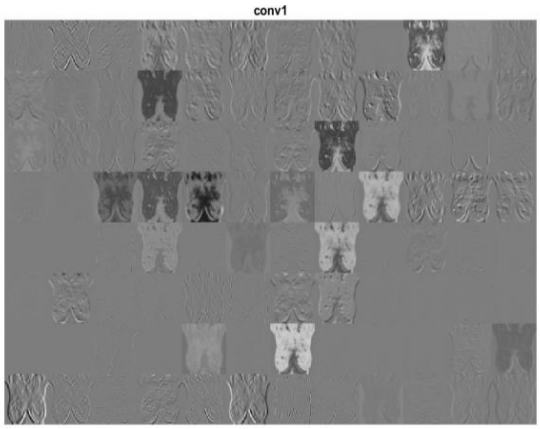

Figure 3.1.input image1 activation channels in convolution layer1

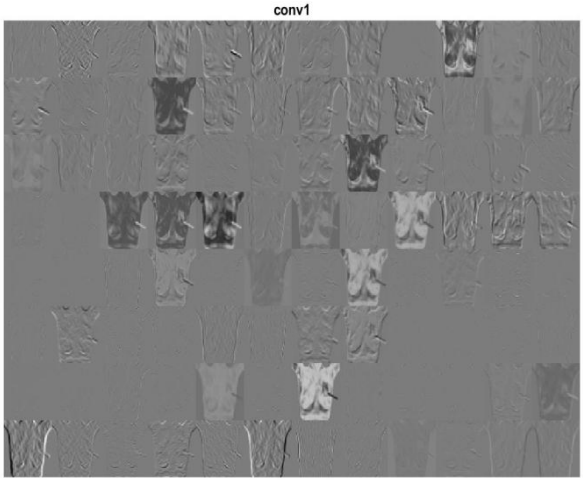

Figure 3.2.input image2 activation channels in convolution layer 1

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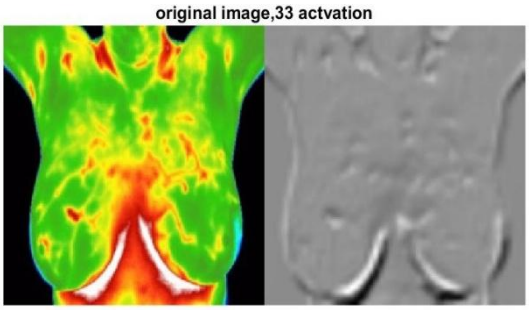

Figure 3.3. Input image1 33rd activation channel in convolution1

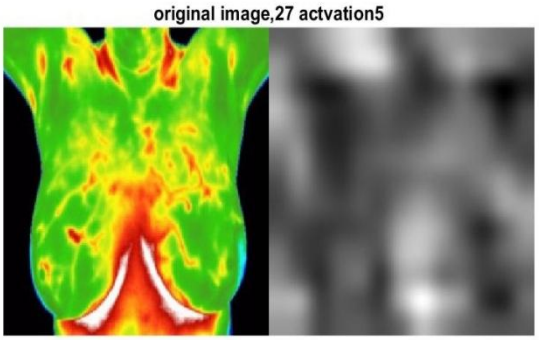

Figure 3.4. Input image1 27th activation channel in convolution5

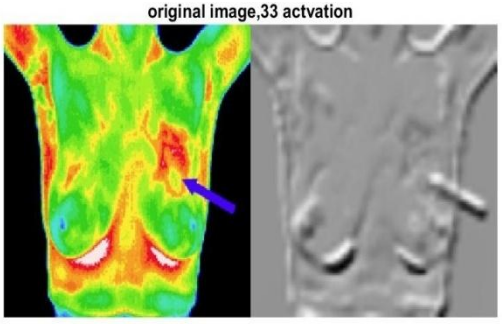

Figure 3.5. Input image2 33rd activation channel in convolution1

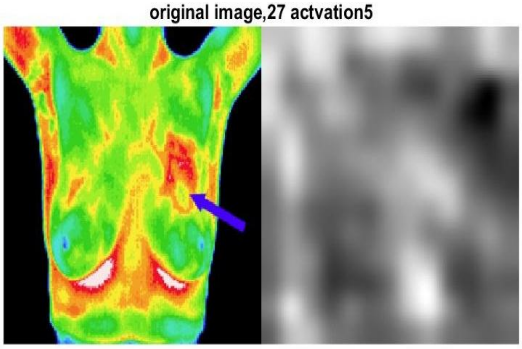

Figure 3.6. Input image2 27th activation channel in convolution5

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Conclusion

Deep Learning based Laplacian pyramid fusion is applied on the two breast cancer images. By using the extracted features from the images, Laplacian pyramid fusion method is carried out and the fused image showed better image quality measures. On the thermal images, Laplacian pyramid fusion method based on deep dream technique is applied and it was observed that the fused image quantitative results shows better values of PSNR which indicates the rich quality of image, and also showed a better visual quality in the fused image.

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