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Fusion of Images Based on Deep Dream of CNN and Laplacian Pyramid

B.Ashalatha[1], Dr. M.Babu Reddy[2]

[1]*Research Scholar, Computer Science Department , Krishna University, Machilipatnam, Andhra Pradesh, India*
[2]*Head of the department, Department of Computer Science, Krishna University, Machilipatnam, Andhra Pradesh, India*

Abstract- In Computer vision multi scale image fusion plays a vital role in describing the features of images. In this paper proposing an improved method for Multi scale Image Fusion using the latest deep convolutional neural network technique called Deep dream. This paper describes how the deep dream of images in neural network is combined with Laplacian pyramid to get the fused image. This paper mainly address the deep dream technology, how the fusion process carried out using the convolutional neural network deep dream images and laplacian pyramid, discussion on experimental results and finally effectiveness of our proposed method with the existing deep learning fusion methods.
Keywords –Image fusion, Convolutional neural network, Deep dream, Laplacian pyramid, PSNR

I. INTRODUCTION AND RELATED WORK

A Single Image cannot provide better discrimination of the scene. Generally single image provides partial regions or local regions of images. Distinct images of same scenery or background are fused together to form a single better discriminated image. From this fused image one can get more information of the image [1]. The main advantages of using fused images are sharper image resolution and improved classification. The fusion of images can be done in four different ways as mentioned in [2]. The Multi-view image fusion takes the features of two or more images that are having different intensities which are taken from different viewports and taken at the same time [3]. By this fusion process we have complementary information from different views. In Multi-modality fusion method images of different modalities like PET, CT, MRI, Visible, infrared, ultraviolet etc are fused. Using this method we can decrease the amount of data to emphasize band-specific information [4]. The multi-temporal fusion method operates on images of the same scene taken at different times. By temporal fusion process we can detect changes easily in the images. Detection of changes can recognize differences by perceiving of the object state at different times [5]. The multi focus image fusion method is categorized in two different classes based on their domain. One is Transform domain and another one is spatial domain [6]. Multi scale image fusion come under Transform domain of multi-focus fusion method. Now a day's Pyramid based multi scale image fusion plays an important role in identifying the regions of focused part of the image. The Pyramidal method is giving sharp and high contrast images that contain useful information. Pyramid construction of image contains a series of low pass or band pass filtered images. Each filtered image represents image data at different scales. We can observe the laplacian pyramid construction of an image and its reconstruction in [7]. Many researchers worked on fusion topic using laplacian pyramid by considering different aspects [8][9][10]. Some researchers worked out on this fusion process by applying convolutional neural networks with laplacian pyramid [11][12][13][14]. This paper uses the latest technology of deep learning namely deep dream of images. This deep dream is merged with laplacian pyramid image fusion in getting good results.

II. CONCEPTS USED

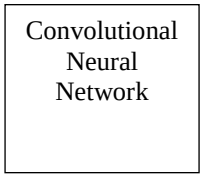
2.1 Deep learning–

Deep learning is a category of machine learning. The algorithms of deep learning are making effortless attempts in modeling high level abstractions of data. DCNN are belonging to the deep learning model. The reason why this model is called as deep means, they are having more than one hidden layer in their architecture. If we observe the hidden internal layers of CNN each layer provides higher level image features. Generally first layer provides information of basic features of the images like shapes, objects etc. The last layers have the information about complex features of the images.

2.2 Deep dream images –

Deep dream is a technique released by Google in 2015. Through its feature, visualization technique it generates strong visual features of images in combination with convolutional neural networks .As it is giving strong visual features it recognizes the objects or components of image in a better way [15]. A typical Application of deep dream is Deep dream project done by Google [16]. This technique improves the visual attributes of images. The researchers

of Google used deep dream visualization to decide whether the convolutional neural network rightly learned the correct and exact features of image or not [17]. The task of deep dreaming is taking the back propagated gradient activations and adding it back to the image and doing the same process again and again in a loop for each layer of the CNN. For example, take the max pool layer of CNN for an image. Find the gradient of this layers mean activation with respect to the input image. Add the gradient in a loop. Run the loop for specified (n) iterations. For



each iteration, gradient is added to the input image in a stepwise manner. After completion of all specified iterations, normalize the image by the maximum activation. Lastly add the normalized one to the original input image

III. METHODOLOGY

3.1 Create deep dream images for both the Input images.

Obtain the strong activations in channel 1 and 5 for the deep dream image1 using Alex net CNN.
Similarly obtain the strongest activations from channels 1 and 5 for the deep dream image2 using Alex net CNN.
Combine the Strongest activations in channel 1 and 5 to form the weight map of Image1 and similarly for image2.
Apply Laplacian Pyramid fusion technique on both the deep dreamed input images by considering their weight maps.
Measure the PSNR values with respect to both the input images.

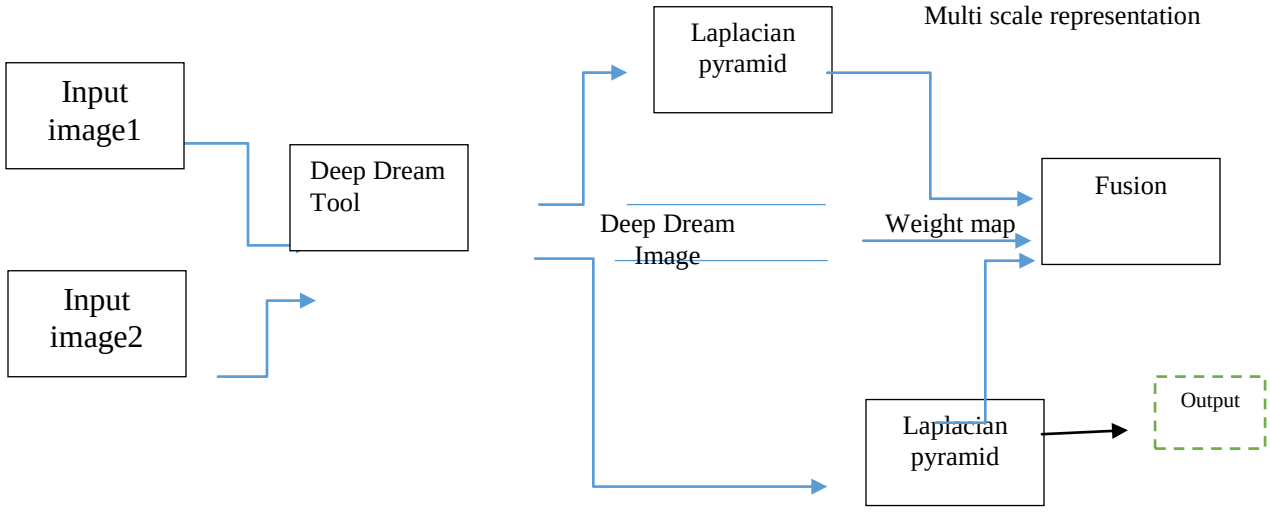


Fig 1. Schematic diagram of proposed fusion method

IV. EXPERIMENTAL RESULTS AND DISCUSSION

Peak Signal to Noise Ratio (PSNR) is one metric for evaluating the quality of images. For high quality images PSNR value is high. As we observe from the table it is clear that the proposed method for performing fusion is giving better results than the existing fusion methods.

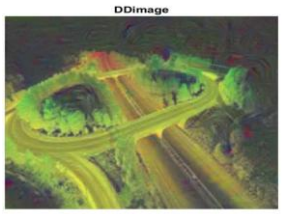
Type of Image	PSNR between Image1 and Fused image1 Using Laplacian and CNN	PSNR between Image2 and Fused image Using Laplacian and CNN	PSNR between Image1 and Fused image Using Laplacian and Deep dream of CNN	PSNR between Image2 and Fused image Using Laplacian deep dream of and CNN
LIDAR	54.76	51.93	84.99	58.64

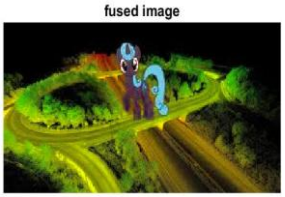
HDR	72.26	52.47	80.05	72.08
THERMAL	61.73	40.14	61.61	42.50

Table1. Measured values of PSNR

Input and output Images-

Lidar Input Image-1Lidar Input Image-2





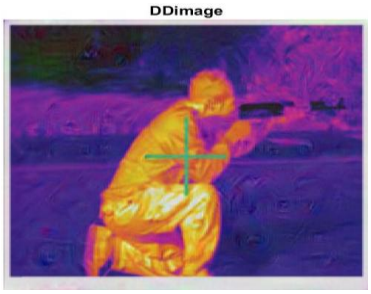
Deep Dream Image-1 Deep Dream Image-2 Fused Iidar Image

HDR Input Image-1 HDR Input Image-2 Deep Dream Image-1

Deep Dream Image-2 Fused HDR image

Thermal Input Image-1 Thermal Input Image-2

Deep Dream Image-1



Deep Dream Image-2

Fused Thermal image

V. CONCLUSION AND FUTURE SCOPE

An Improved Fusion method by using latest technology of Deep Dream image using Alex net neural network on multi scale laplacian pyramid images is implemented by using MATLAB. There is a scope to work on blurred fused images.

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