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Review on Improved Image Fusion Approach

Praveen Kumar K¹, Megha P Arakeri²

^{1,2}M S RAMAIAH INSTITUTE OF TECHNOLOGY, Bangalore

pavishiv13@gmail.com¹, meghaarakeri@gmail.com²

Abstract —Image fusion is the process of blending all the essential information from multiple images, and their incorporation into fewer images, generally a single one. The single image which is accessed by image fusion gives more information and is rigorous than any single source image. This image encompasses all the important information. The image fusion is not only purposed to diminish the amount of data but also to frame images that are more convenient and pertinent for the machine and human approach. Certain situations in image processing need both high spectral and high dimensional information in a single image, which is important in remote sensing. Image fusion techniques involve filtering, enhancing and decomposing the images for better results. This paper emphasizes on the imperative and efficient approaches for image fusion.

Keywords—Visible image, Infrared image, Retinex theory, Laplacian and Gaussian pyramids.

1. INTRODUCTION

The images used for fusion process are infrared image and visible image with low light. The most cruciality of visible and infrared image fusion is to combine the effective information and generate a new image which has higher certainty and reliability for computer and human vision. In day and night and also in different type of weather, infrared images can discriminate targets from their backgrounds based on the radiation contrast. By disparity, visible images can furnish texture information definition and with high dimensional resolution in a persistent manner with the human visionary system. Therefore, it is an exciting way to integrate these two types of images, which can blend the pros of detailed textural information present visible images and thermal radiation details in infrared images.

There are different approaches for image fusion. Principal Component Analysis is the domain fusion method. The redundancy in the image could be reduced or eliminated by using this method. This paper emphasizes on the algorithms called Retinex theory and Laplacian pyramid. Edwin Land proposed the theory of human color vision for color perceptions in real scenario is called Retinex. Retinex is an algorithm for enhancing the image, which includes two phases, estimation of the illumination and normalization. This algorithm improves the contrast, illumination and sharpness of the image. It has been used as a computational model for interpretation of image.

A band pass image set is known as Laplacian pyramid, in which each image is a band pass filtered image of its prior image. We can obtain band pass image by taking the difference between low pass images at Gaussian pyramids successive levels. The main stages of Laplacian pyramid are decomposition and reconstruction. Using Laplacian pyramid one can harmlessly stitch images together, by smoothing the boundary in a scale-dependent way to avoid boundary artifacts. Laplacian pyramid results in creation of high reliable image from a set of images taken with different focal lengths and shutter speeds.

2. LITERATURE SURVEY

There are many techniques, image fusion can be done. One of them is Brovey Technique. The BT was introduced by an American scientist named Brovey. This technique usually involves red-green-blue (RGB) color transform method therefore it is called the color normalization transform. Brovey Technique was usually used to minimize the short comes of multiplicative methods. It is an easy



methodology to merge different sensory data. It encompasses up all the corresponding spectral features of each pixel and then mutate all luminance data into a panchromatic image with high resolution clarity. It is aggregation of arithmetic operations. It usually normalize spectral bands prior they are multiplied with the panchromatic image.

Retinex theory involves the below basic formula that combines input image and Gaussian function.

$$R(x, y) = \log L(x, y) - \log [G(x, y) * L(x, y)]$$

Where $L(x, y)$ is input image, $G(x, y)$ is Gaussian function, $*$ is a convolution operator and $R(x, y)$ is output image.

As retinex involves estimation and normalization, as soon as elimination is finished, illumination could be normalized by taking the difference between approximated illumination and logarithms of the input image. This robust prerequisite signifies that the approximated illuminations are discontinuous at locations where the input image has active intensity discontinuities.

Retinex method hardly fills the gap between the image captured and direct view. There are two retinex methods. Jobson et al was the person who proposed this method which can either provide dynamic range constriction or tonal depiction. Later the Multi Scale Retinex was proposed which will render both. To overcome grey world contraventions for some images, multi scale retinex is followed by a color reclamation step. It melds all the essential ingredients to estimate the human visionary performance with a computation that is quite fairly simple and automated. So this is a productive technique for enhancing any image that endure from lighting deficiencies generally experienced in landscapes and architectural interiors and exteriors.

An image pyramid merges a band pass set or low pass replica of the image, individual copy describing pattern information of a disparate scale. Consistently, in an image pyramid the higher levels will intensify on the lower spatial frequencies and every level is a factor two smaller as its antecedent. An image pyramid does enclose of all the crucial information required to rebuild the source image.

A pyramid format consists distinct levels of an original image. These levels are accessed coercively with a low-pass filter by filtering the lower level image. First a Gaussian pyramid is done using a low-pass filter by filtering each level of image and then down sampling has been done. The image will get smaller and smaller as the level goes up. The below equation is used to get Gaussian pyramid of an image:

$$G_k = [\omega * G_{k-1}]_2$$

Where w is low pass filter. First by up sampling the $(k+1)$ th level of Gaussian pyramid, the (k) th level of Laplacian pyramid is obtained and the low-pass filtering is done. Then it is subtracted from the k -th level of Gaussian pyramid. It is represented in following equation:

$$L_k = G_k - 4\omega * [G_{k+1}]_2$$

Again here w is low pass filter. The source image is recreated by reconstruction part using the filtered, up sampled version of $(k+1)$ th level of Gaussian pyramid and the first level of Laplacian pyramid. The following equation yields the required Gaussian pyramid image:

$$G_k = L_k - 4\omega * [G_{k+1}]_2$$

3. PROPOSED METHODOLOGY

The proposed system for fusing image includes visible image and infrared image as inputs. Both type of images are enhanced by some methods and then decomposed to get high resolution fused image.

Steps of image fusion:

- Visible image is intensified by some image enhancement algorithm.
- Parallely, infrared image is intensified by some other image enhancement technique.
- Both the visible and infrared images after processing, are mouldered using decomposition methods.
- The decomposed images are used for image fusion.

Below figure. 1 depicts the overall proposed flow for fusing image:

The different and advanced image enhancement methods are used for processing visible and infrared images. And the same image decomposition method is used for both the images. The decomposed images are blended for image fusion.

A. Requirements

System Requirements:

64 bit windows 8 or higher version operating system is required. Minimum core 2 Duo or 2.4 GHz processor is needed. And minimum 4GB RAM is necessary.

Software Requirements:

MATLAB R2015a and above software is required.

4. CONCLUSION

Adopting the integral information in multiple images, to accomplish a optimum resolution and articulateness, then to obtain a simple and specific image is the goal of image fusion which demonstrates better performance under certain popular interpretation criteria, by fusing two multi focused images of the same scene, is the main aim of fusing image. The fused images provide more extensive and more rigorous narration, which is more conducive for machine perception and human visionary system and for further image-processing tasks.

Merging essential information from different source images of the particular scene to generate a new image which can yield extra visual data than the source images is the objective of image fusion. The visual information incorporated in the fused image is much more comprehensive and is much more conducive to do some consequent tasks when compared with the source images. There are multiple uses of image fusion namely agriculture, remote sensing, military and other fields since it has the capacity to not only intensify the accuracy of images and amount of visual data but also improve the efficiency of extraction and scrutiny of image quality.

For fusing images, different techniques and methods are used. Image fusion also employs some algorithms for several enhancements and decomposition. Intensity Hue saturation (IHS) is one of the general method of image fusion. Despite of this method is extensively used, an image cannot be decomposed into distinct frequencies such as low or high frequencies in frequency space. Hence this technique cannot be used to intensify certain image qualities. Brovery Transform is one of the approach for fusing the images. The drawback of this method is it produces a spectral distortion.

Considering the shortcomings of these methods this paper proposes a simple and efficient methodology for fusing images. This technique employs two advanced algorithms for image enhancement and one specific method for decomposition by which the input images are processed and decomposed respectively. Then the high resolution image with more accuracy is gained.

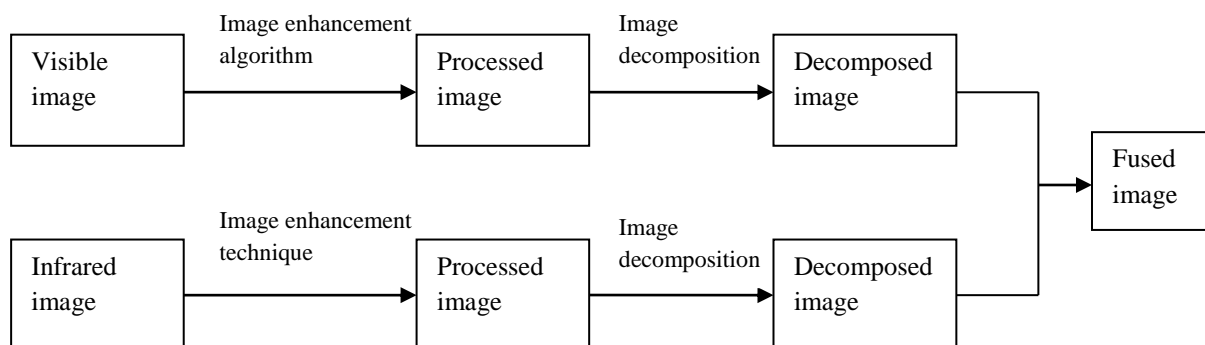


Fig. 1: Proposed flow diagram

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