



AN IMPROVED METHOD FOR IMAGE ENHANCEMENT OF REMOTE SENSED IMAGES USING FUSION METHODS

Ishpreet Kaur

Department of Computer Engineering,
Punjabi University, Patiala
Punjab, INDIA

Nirvair Neeru

Department of Computer Engineering,
Punjabi University, Patiala
Punjab, INDIA

Abstract: Image Fusion is a strategy that concentrates significant data from at least two source pictures into single scene. The need of Image Fusion for high determination on panchromatic and multispectral pictures or true pictures for better vision. The objective of Image Fusion (IF) is to incorporate reciprocal multisensory and multitemporal data into one new picture containing data, the nature of which can't be accomplished something else. The term quality, its significance and estimation rely upon the specific application. This paper gives a writing survey on the systems of Image Fusion like simple average, select maximum, PCA, DWT, DCT and so forth. Image Fusion is done to get a more upgraded and instructive and greater quality picture from at least 2 pictures that are taken from totally extraordinary perspectives, totally unique detecting element, completely diverse modular and distinctive temporal. The application zones of Image Fusion combination incorporate both military and residential capacities and even restorative capacities. Interpolation is the strategy for stretching or enlarging an image from a smaller actual image to bigger resultant image. In this paper we have discussed an outline of interpolation with DWT for amplifying the picture. We have explored distinctive Image Fusion Strategies for improving the image determination and better.

Keywords: Image Fusion, Interpolation, DWT

I. INTRODUCTION

Image Processing is a wide zone of examination for understudies. It offers option of quantities of fields and territory in which investigation work can be completed. Image Fusion is one such field inside the range of picture preparing amid which changed looks into are being completed to show signs of improvement comes about. Image Fusion is the method of getting an a considerable measure of instructive and best quality picture from at least 2 images. The images that are melded are all the more most likely to be taken of same viewpoint and same sensors however these may well be of different indicators, totally extraordinary modular, fluctuated central and shifted temporal. Image Fusion is the way toward joining data from various pictures of various methodology, center, view, sensors and time into single data. The intertwined picture contains both reciprocal and additionally excess data from source pictures. The combined image gives a superior depiction than the source pictures and furthermore it has better quality. A decent combination process ought to incorporate the repetitive data however in the meantime ought not over-burden the melded picture. It likewise ought not present any ancient rarities or commotion in the picture. with fast headways in innovation, it is currently conceivable to acquire data from multi source pictures to deliver an excellent combined image with spatial and ghostly data [1]. Image Fusion is a component to enhance the nature of data from an arrangement of pictures. Vital uses of the combination of pictures incorporate medicinal imaging, minuscule imaging, remote detecting [2], PC vision, canny robots and observation frameworks. Image Fusion gives a powerful method for diminishing this expanding volume of data while in the meantime separating all the valuable data from the source pictures. Multi-sensor information regularly introduces

reciprocal data about the locale reviewed, so Image Fusion gives a successful technique to empower examination and investigation of such information.

II. IMAGE FUSION DOMAIN

Image fusion methods can be broadly classified into two groups-spatial domain fusion and transform domain fusion. In order to achieve optimum fusion result, various fusion techniques had been tested by many researchers. In this review, a few algorithms/ techniques have been discussed:

Spatial Domain Fusion In spatial area fusion, one straight forwardly control pixel image to deliver alluring outcome. The fusion technique, for example, averaging, select maximum, brovey transform (BT) strategy, Principal Component Analysis (PCA) and Intensity –hue-Saturation (IHS) change, High pass channel approach, Discrete cosine Transform (DCT) based strategies talked about beneath fall under spatial area approaches. Another vital spatial area strategy is high pass sifting based strategies .The hindrance of spatial space combination is that it create spatial twisting in a fused picture, i.e. turns into a negative factor while one go for additionally preparing.

Average Method: It is a pixel-based technique that smothering any noise in the source picture. It is all around archived actuality in which one takes the pixel by pixel normal of the source pictures. It is one of the least complex picture combination strategy the real symptom of normal is that it decrease differentiate. The average is one of least difficult strategy for stifling any noise in the source picture with significant reaction of normal is that it diminished contrast. Numerically can be composed as:

$$(i,j) = [(i,j)Y(i,j)]/2 \quad (I)$$

Where (i,j) and $Y(i,j)$ are two source images

Maximum Method: This calculation takes the best estimation of every pixel, for example, $P(i, j)$ from source pictures and contrast with every others. The best pixel esteem is then appointed to the comparing pixel of new picture. It is one of the straight forward and speediest calculations yet additionally modify the otherworldly data of the source picture.

$$P(i, j) = \sum \sum \max. X(i, j)Y(i, j) \quad m j=0 \quad l i=0 \quad (II)$$

Brovey Transform (BT): Brovey Transform method otherwise called color normalization change, depends on the red-green-blue (RGB) shading change and idea of power regulation. Its motivation is to standardize the three multispectral groups for RGB show. The essential methodology of the brovey change, where the information estimation of each band of low spatial and high otherworldly determination multispectral (MS) band are partitioned by the whole of the MS groups and consolidated by the high spatial and low ghostly determination panchromatic (PAN) informational collection. The resultant picture has both high spatial and otherworldly determination that is require in numerous remote detecting application. Therefore it is the most simplest strategy that it builds the differentiation in the low and high end of the picture histogram for joining information from various sensors, with the restriction that lone three groups are included.

Principal Component Analysis (PCA): PCA based Image Fusion likewise called as Karhunen – Loeve change or the Hostelling change, enhance spatial determination of the picture. It is a subspace demonstrates in which the central part is connected to the multispectral groups. The PAN is histogram coordinated to first PC1. It is then supplant the chose part with PAN symbolism and the converse PCA change takes the intertwined datasets once more into the first multispectral include space. The primary important segment is taken to be along the heading with the most extreme fluctuation. The second principal component is compelled to lie in the subspace opposite of the main vital segment and so on [5]. PCA has significant preferred standpoint that a discretionary number of groups can be utilized with hindrance that it is touchy to the territory to be hone and create combination comes about that may shift contingent upon the chose picture.

The PCA is broadly utilized as a part of picture pressure, picture grouping and highlight extraction [6]. In PCA based image fusion is taken to get the palm print utilized as a part of get to control and criminological applications. Various components were removed from this palm print containing upgraded data. Mohamed R. Metwali [5] utilized coordinate HPF and PCA procedure that concentrate high recurrence part from PAN picture to give fused image predominant spatial determination and least otherworldly bending and assessed that spatial nature of its is higher than HPF combination strategy and tantamount to the PCA and Gram–Scmidt combination technique.

Intensity-hue-saturation (IHS) Transform: It is most well known fusion procedure utilized as a part of business picture preparing frameworks and in light of the RGB color space. It save more spatial component and more required useful data

with no shading mutilation. It is turned into a standard methodology in picture examination for shading upgrade, include improvement; change of spatial determination and the combination of divergent informational collections [4]. In this system the accompanying step are performed:

- (a) Perform picture enlistment (IR) to low determination MS to high determination PAN and resample to same determination as the PAN picture and change three resample band of the MS from RGB space into IHS parts. (b) The PAN histogram is coordinated to the histogram of the "I" segment and supplant the I segment with histogram coordinated PAN picture. (c) Compute the IHS to RGB changes to get the RGB of new intertwined MS. Firouz Abdullah *et al* [4] utilize IHS change based picture combination to investigate diverse IHS change recipes and show correlation in term of different lists. This paper announced that systematic procedure of deviation record (DI) is more valuable for measuring the ghostly mutilation than Root mean square mistake (RMSE).

Transform Domain Fusion

In Transform Domain Fusion, spatial space parts are moved into recurrence area utilizing Fourier change in light of the fact that spatial bending can be all around dealt with by recurrence area approaches on picture combination. The fusion strategies, for example, wavelet change, Laplacian pyramid based techniques examined beneath fall under this methodologies [3]. The techniques demonstrate a superior in spatial and phantom nature of the fused picture and have been accomplishing consideration of scientist in wide range of use[7].

Wavelet Transform: Wavelet theory is basically augmentation of the Fourier hypothesis, in this manner it gives great determination in both time and recurrence. Wavelet change is an intense scientific apparatus that has been widely utilized as a part of picture handling. It is a well known system in breaking down signs. At the point when disintegration is played out, the estimate and detail part can be isolated 2-D Discrete Wavelet Transformation (DWT) changes over the picture from the spatial space to recurrence area [1]. Wavelet can be joined with part of known flag utilizing enlargement, withdrawals (scaling), translational (movements) or incorporation procedures called convolution to extricate data from an obscure flag[8]. Wavelet change can comprehensively order into discrete, stationary and multi – determination based.

III. INTERPOLATION

Interpolation is the technique for amplifying the littler low determination image to a bigger high determination image which can be characterized as Image Scaling. While approximating the estimation of proceeds with work by utilizing discrete specimen is likewise characterized as an interpolation. Normally gray scale images are cleaned by two methods Pixel based and Patch based. Segmentation is used for cleaning the shading images (RGB images). Additionally, noise can be evacuated by taking diverse size and states of fix and afterward utilizing both. Interpolation is the way toward exchanging image starting with one determination then onto the next without losing picture quality. In Image handling field, picture interjection is imperative capacity for doing

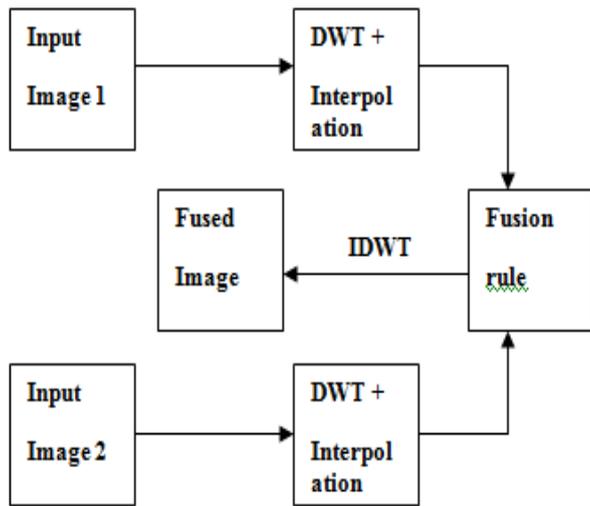
zooming, improvement of picture, resizing any numerous more[9].

- Bilinear Interpolation:

The interpolated point is loaded with four nearest pixel's weighted normal in this technique. Here in this strategy we perform two straight additions, in level bearing and after that direct interpolation in vertical course[10]. In Bilinear Interpolation strategy we compute four insertion capacities for matrix point.

IV. PROPOSED ALGORITHM

In this proposed algorithm, Aerial pictures are used as input images. Input images having unuseful particles noise like blur, salt pepper, Gaussian etc. Our aim is to merge both images to form solo image containing relevant, complete information, noise free. The block diagram of proposed algorithm of image fusion is shown as:



Block diagram of proposed Method of Image Fusion

The steps involved in proposed algorithm are:

1. The two images are applied as input, must be registered to be fused.
2. DWT is applied for decomposition of an image.
3. Interpolation type is selected i.e bilinear interpolation
4. Various fusion methods are implemented on above coefficients of image 1 and image 2.
5. Finally inverse DWT is applied on fused coefficients map to form resultant image

V. EXPERIMENT AND RESULT

The result of Aerial image fusion is represented by displaying resultant output images. The parameters used to evaluate quality are Peak Signal to Noise Ratio (PSNR), Mean Square Error (MSE). The Quality metrics parameters are shown in Table I. the evaluation of images using Average, Maximum, Minimum and PCA fusion rule is implemented in table II.



Fig:1 Original Input Image

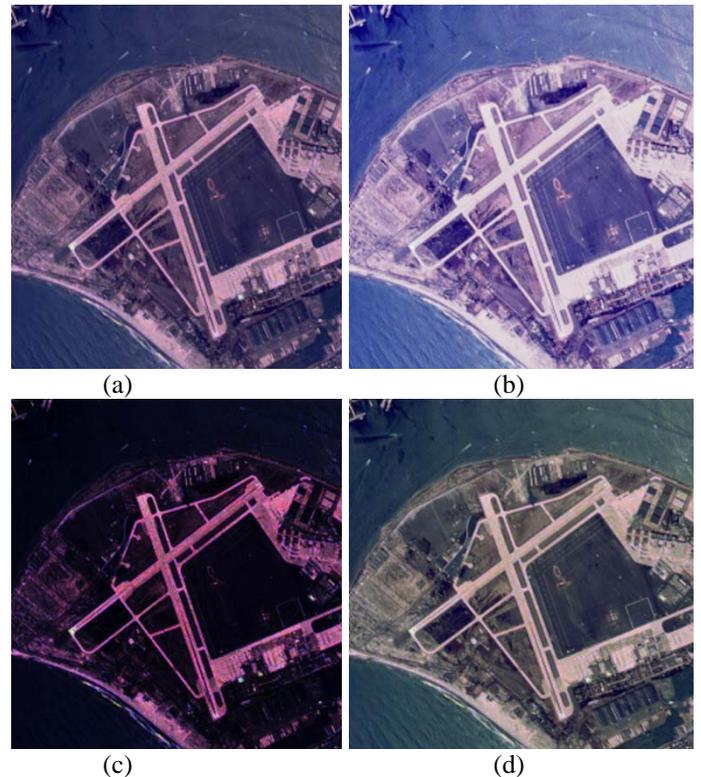


Fig 2: (a) Average (b) Maximum (c) Minimum (d.) PCA

Table II. Comparison of different Image Fusion Methods using DWT and Interpolation

	<i>PSNR (Image1)</i>	<i>MSE</i>	<i>Elapsed Time</i>
<i>Average</i>	<i>62.02</i>	<i>0.0408</i>	<i>1.423</i>
<i>Maximum</i>	<i>71.48</i>	<i>0.004</i>	<i>1.303</i>
<i>Minimum</i>	<i>71.39</i>	<i>0.004</i>	<i>1.502</i>
<i>PCA</i>	<i>64.71</i>	<i>0.0220</i>	<i>1.720</i>

VI. CONCLUSION

A method of combining the numerous pictures into one is called Image Fusion. This paper exhibits the overview of image fusion methods applying Spatial and Transform domain area. In this pros and cons of various image fusion methods are talked about. The spatial area procedures have picture obscuring issue i. e blurring problem. The combination of Transform domain (DWT) with interpolation and spatial space (maximum) enhances the execution. At long last this paper concludes that there is a need to build up the new technique that can defeat these restrictions.

VII. REFERENCES

- [1] Rani, Kusum, and Reecha Sharma. "Study of different image fusion algorithm." *International Journal of Emerging Technology and Advanced Engineering* 3, no. 5 (2013): 288-291.
- [2] Naidu, V. P. S., and J. R. Raol. "Pixel-level image fusion using wavelets and principal component analysis." *Defence Science Journal* 58, no. 3 (2008): 338-352.
- [3] Wang, Wencheng, and Faliang Chang. "A multi-focus image fusion method based on Laplacian pyramid." *Journal of Computers* 6, no. 12 (2011): 2559-2566
- [4] Al-Wassai, Firouz Abdullah, N. V. Kalyankar, and Ali A. Al-Zuky. "The IHS transformations based image fusion." *arXiv preprint arXiv:1107.4396* (2011)
- [5] Metwalli, Mohamed R., Ayman H. Nasr, Osama S. Farag Allah, and S. El-Rabaie. "Image fusion based on principal component analysis and high-pass filter." In *Computer Engineering & Systems*, 2009. ICCES 2009. International Conference on, pp. 63-70. IEEE, 2009.
- [6] Nirosha Joshitha, J. and R. Medona Selin. "Image fusion using PCA in multi feature based palm print recognition." *International Journal of Soft Computing and Engineering* (2012): P2.
- [7] Sahu, Akanksha, Vikrant Bhateja, and Abhinav Krishn. "Medical image fusion with Laplacian Pyramids." In *Medical Imaging, m-Health and Emerging Communication Systems (MedCom)*, 2014 International Conference on, pp. 448-453. IEEE, 2014.
- [8] Li, Gang, and Yifeng Dong. "Improved Image Fusion Algorithm Based on Wavelet Transform in EFVS." In *Computational Sciences and Optimization (CSO)*, 2014 Seventh International Joint Conference on, pp. 190-193. IEEE, 2014.
- [9] Gupta, Rajesh, and Deepak Awasthi. "Wave-packet image fusion technique based on genetic algorithm." In *Confluence The Next Generation Information Technology Summit (Confluence)*, 2014 5th International Conference-, pp. 280-285. IEEE, 2014.
- [10] Rani, Kusum, and Reecha Sharma. "Study of Image Fusion using Discrete wavelet and Multiwavelet Transform." *International Journal of Innovative Research in Computer and Communication Engineering* 1, no. 4 (2013).