Satellite Image Feature Extraction - using Panchromatic Sharpening

Deepa D. Divate, Prof. Dr. K.V. Kulhalli, Smita S. Patil

***Abstract*—** Satellite data has been successfully used for various applications. Satellite images of different spatial resolutions are commercially available. But most times available satellite images are in compressed form, also of very small size and low resolution. This makes quite difficult to read useful data from an images for particular application. To overcome this difficulty we can preprocess that image to obtain panchromatic image, by using PAN-sharpening method. This Sharpened image can be used in various application such as vegetation detection, water bodies detection, highways detection etc. and to extract important features from image data such as area calculation. This will make a description, implementation or understanding of the scene more informative and user friendly by machine.

Index Terms— Satellite images, spectral resolution, spatial resolution, Image sharpening, panchromatic image, Pan-sharpening method, feature extraction.

I. INTRODUCTION

The images of earth taken by revolving satellite can be used in various application area. Before extracting information from image we can pre-process it by Pan-sharpening method. "Pan Sharpening" is shorthand for "Panchromatic sharpening". It means using a panchromatic (single band) image to sharpen" a multispectral image. In this sense, to "sharpen" means to increase the spatial resolution of a multispectral image. A multispectral image contains a higher degree of spectral resolution than a panchromatic image, while often a panchromatic image will have a higher spatial resolution than a multispectral image. A pan sharpened image represents a sensor fusion between the multispectral and panchromatic images which gives the best of both image types, high spectral resolution AND high spatial resolution. To obtain more understandable and application oriented satellite image, we will perform Pan-sharpening of that image.

II. Methodology

The proposed system to sharpen satellite image and extract the feature Fig.1.

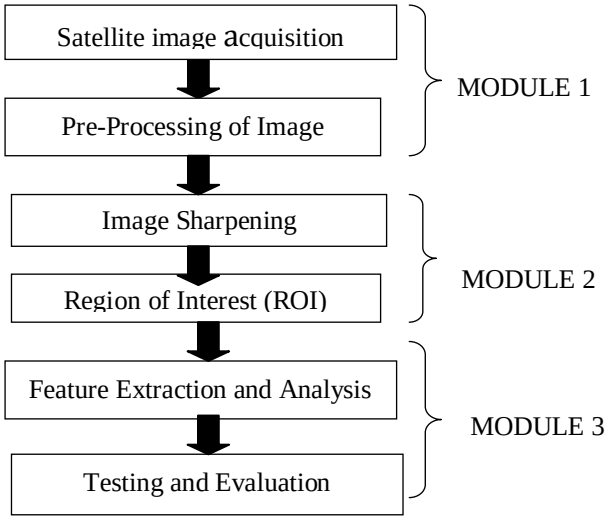
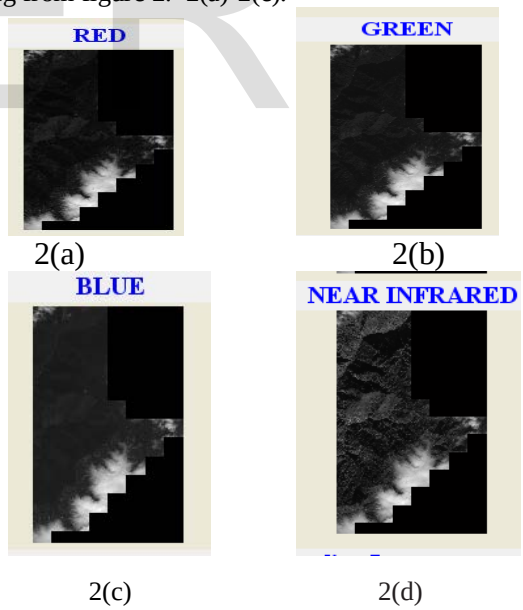


Fig.1. Block Diagram of proposed system to sharpen satellite image and extract the feature.

The above mentioned block diagram includes three modules:

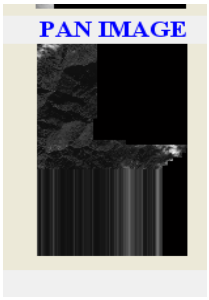
A] MODULE 1:

1. Image Acquisition: The satellite image is taken from mentioned reference database [1]. Here images are available in the .mat form as R, G, B, NIR and PAN content of input image, which contains written information of image not direct images. We are not using available .mat file for the image preprocessing. These are converted into .tif file and can be considered for preprocessing. These are shown in the following from figure 2: 2(a)-2(e).



2(a) 2(b)

2(c) 2(d)



2(e)

Figure 2:
(2a)Red content of image in .tif form
(2b) Green content of image in .tif form
(2c) Blue content of image in .tif form
(2d) NIR content of image in .tif form
(2e) PAN image in .tif form

2. Image Pre-Processing: These R, G, B, NIR and PAN contents are considered to construct final input image for the system. Now this final input image will be used for pan-sharpening. It is shown in following figure (3).

Figure (3): Final input image to the system

B] MODULE 2 :

3. Image sharpening: The database available for satellite images are in the compressed form. Therefore, it is difficult to extract important features from image for an application. To obtain more precise data from an image sharpening operation is performed. This process replaces segmentation operation. Sharpening is an efficient process of transformation which brings out more details of image than before. Different techniques are available for Sharpening. PAN Sharpening is the recent technique to sharpen the image, so that the pixels of the image are clearly visualized. There are number of pan algorithms available according to various applications. Some of them are listed below:

a). IHS algorithm
b). Wavelet
c). PCA
d). PXS
e). Brovery

Out of all these, we may consider IHS algorithm in future dissertation work.These algorithms requires different parameters of input image. In the present work of proposed system some of the parameters are extracted. Such as:

i. PSNR (Peak signal to noise ratio)
ii. Maximum correlation coefficient

Also, pixel value of final input image are calculated with SHIFT and FLTERING HR operation.

In future dissertation some more parameters will be calculated and will be used in PAN-algorithm to sharp the image.

The obtained results in MATLAB are tabulated in following Table:

I. Weighted Vectors with SHIFT operation:

	1	2	3	4
1	-58.7227	-58.7248	-58.726	-58.7272
2	-58.7268	-58.7289	-58.7302	-58.7314
3	-58.7302	-58.7323	-58.7336	-58.7348
4	-58.7334	-58.7355	-58.7368	-58.738
5	-58.7367	-58.7388	-58.7401	-58.7413

	5	6	7	8
1	-58.7288	-58.7307	-58.7329	-58.7352
2	-58.7329	-58.7349	-58.737	-58.7393
3	-58.7364	-58.7383	-58.7405	-58.7427
4	-58.7395	-58.7415	-58.7437	-58.746
5	-58.7428	-58.7448	-58.747	-58.7492

Table(1): Weighted Vectors with SHIFT operation

II.Down-sampling filter Parameters:

	1	2	3	4
1	-8.5924e-05	-2.1782e-04	-5.8440e-04	-0.0011
2	-2.1977e-04	-5.5496e-04	-0.0015	-0.0029
3	-5.8073e-04	-0.0015	-0.0039	-0.0076
4	-0.0011	-0.0028	-0.0076	-0.0146
5	-0.0017	-0.0043	-0.0113	-0.0218
6	-0.0019	-0.0048	-0.0129	-0.0249
7	-0.0017	-0.0043	-0.0113	-0.0218
8	-0.0011	-0.0028	-0.0076	-0.0146
9	-5.8073e-04	-0.0015	-0.0039	-0.0076
10	-2.1977e-04	-5.5496e-04	-0.0015	-0.0029
11	-8.5924e-05	-2.1782e-04	-5.8440e-04	-0.0011

Table (2a)

	5	6	7	8
1	-0.0017	-0.0019	-0.0017	-0.0011
2	-0.0042	-0.0049	-0.0042	-0.0029
3	-0.0113	-0.0129	-0.0113	-0.0076
4	-0.0218	-0.0249	-0.0218	-0.0146
5	-0.0326	-0.0372	-0.0326	-0.0218
6	-0.0372	0.9576	-0.0372	-0.0249
7	-0.0326	-0.0372	-0.0326	-0.0218
8	-0.0218	-0.0249	-0.0218	-0.0146
9	-0.0113	-0.0129	-0.0113	-0.0076
10	-0.0042	-0.0049	-0.0042	-0.0029
11	-0.0017	-0.0019	-0.0017	-0.0011

Table (2b)

	9	10	11
1	-5.8440e-04	-2.1782e-04	-8.5924e-05
2	-0.0015	-5.5496e-04	-2.1977e-04
3	-0.0039	-0.0015	-5.8073e-04
4	-0.0076	-0.0028	-0.0011
5	-0.0113	-0.0043	-0.0017
6	-0.0129	-0.0048	-0.0019
7	-0.0113	-0.0043	-0.0017
8	-0.0076	-0.0028	-0.0011
9	-0.0039	-0.0015	-5.8073e-04
10	-0.0015	-5.5496e-04	-2.1977e-04
11	-5.8440e-04	-2.1782e-04	-8.5924e-05

Table (2c)
Table (2): Down-sampling filter Parameters

III. Performance parameters

Sr. No.	Parameters	Operation	
		SHIFT	**FILTERING HR**
1.	**PSNR (dB)**	-58.72	-58.72
2.	**Max. correlation coeff.**	73.108	73.108

Table(3):Performance Parameters

C] MODULE 3 & MODULE 4:

In the module 3 one of the pan-sharpening algorithm will be implemented on the input image and ROI will be decided. (eg. Green land). In module 4 feature of the ROI can be extracted (eg. area) depending upon application area

III. FUTURE WORK

The Module 1 is implemented & has achieved satisfactory results. The work under Module 3 i.e. extraction & analysis of features of ROI & Module 4 is still in progress whose results will soon be revealed.

IV. CONCLUSION

This Sharpened image can be used in various application such as vegetation detection, water bodies detection, highways detection etc. and to extract important features from image data such as area calculation, This will make a description, implementation or understanding of the scene more formative and user friendly by machine.

V. REFERENCES

[1]. Hussein A. Aly ,GauravShrma,-*"A regularized Model-based optimization framework for Pan-Sharpening"*,IEEE Transactions on IMAGE PROCESSING. Volume 23, No 6, June 2014.

[2]. Jiang C., Zhang, H., Shen H., Zhang, L.– *"Two-Step Sparse Coding for the Pan-Sharpening of Remote Sensing Images"*, IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, Volume 7, Issue 5, PP. 1792 - 1805, May 2014.

[3]. Liangpei Zhang, HuanfengShen, Wei Gong, and Hongyan Zhang – *"AdjustableModel-Based Fusion Method for Multispectral and Panchromatic Images"*IEEE Transactions on Systems, Man, and Cybernetics, Part B: Cybernetics, Volume: 42 , Issue: 6 , PP. 1693 – 1704, Dec. 2012

[4] Yun Zhang , Mishra, R.K.- *" A review and comparison of commercially available pan-sharpening techniques for high resolution satellite image fusion"*, IEEE International conf. on Geoscience and Remote Sensing Symposium (IGARSS), 2012ISSN :2153-6996, PP 182 – 185, July 2012

[5]. Shutao Li, and Bin Yang – *"A New Pan-Sharpening Method Usinga Compressed Sensing Technique"*,IEEE Transactions on Geoscience And Remote Sensing, Volume 49, No. 2, PP 738 - 746, February 2011

[6]. K. Panetta, S. Agaian, Y. Zhou, and E. J. Wharton- *"Parameterized logarithmicframework for image enhancement"*, IEEE Trans. Syst., Man, Cybern. B, Cybern.,Volume. 41, Issue. 2, PP. 460–473, Apr. 2010.

[7].Garzelli, A., Nencini, F., Capobianco, L.- *"Optimal MMSE Pan Sharpening of Very High Resolution Multispectral Images"* , IEEE Transactions on Geoscience and Remote Sensing, Volume:46 , Issue: 1 , PP 228 – 236 , Jan. 2008

[8].Boccardo, P., Mondino, E.B., Tonolo, F.G.*" Urban areas classification tests using high resolution pan-sharpened satellite images"* , 2nd GRSS/ISPRS Joint Workshop on Remote Sensing and Data Fusion over Urban Areas, 2003. PP 268 – 272, May 2003.

[9]. L. Wald,- *"Some terms of reference in data fusion,"* IEEE Trans. Geosci. Remote Sens., Volume 37, Issue 3, PP. 1190–1193, May 1999.

[10]. V. P. Shah, N. H. Younan, and R. L. King, *"An efficient pan-sharpening method via a combined adaptive PCA approach and contourlets,"*IEEETrans. Geosci. Remote Sens., Volume: 46, no. 5, pp. 1323–1335, May 2008.

[11]. C. Thomas, T. Ranchin, L. Wald, and J. Chanussot, *"Synthesis of multispectral images to high spatial resolution: A critical review of fusion methods based on remote sensing physics,"*IEEE Trans. Geosci.Remote Sens., vol. 46, no. 5, pp. 1301–1312, May 2008.

[12]. T. Ranchin, B. Aiazzi, L. Alparone, S. Baronti, and L. Wald,*"Image fusion—The ARSIS concept and some successful implementation*

*schemes,"*ISPRS J. Photogramm. Eng. Remote Sens., Volume.58,nos. 1–2, pp. 4–18, 2003.

[13] T. Ranchin and L. Wald, *"Fusion of high spatial and spectral resolution images: The ARSIS concept and its implementation,"*Photogramm. Eng.Remote Sens., Volume.66, no. 1, pp. 49–61, 2000.

[14]. C. A. Laben and B. V. Brower, *"Process for enhancing the spatial resolution of multispectral imagery using pan-sharpening,"* U.S. Patent6 011 875, Jan. 4, 2000.

[15]. X. Otazu, M. Gonzalez-Audicana, O. Fors, and J. Nunez, *"Introduction of sensor spectral response into image fusion methods. Application to wavelet-based methods,"*IEEE Trans. Geoscience and Remote Sensing,Vpolume 43, no. 10, pp. 2376–2385, Oct. 2005.