

RESEARCH ON FALSE COLOR IMAGE COMPOSITE AND ENHANCEMENT METHODS BASED ON RATIO IMAGES

Liang Jun^{a, b, *}, Chen Songwei^c, Li Duanyou^{a, b}, Wang Bin^a, Liu Shuo^d, Zhou Liming^a

^a Yangtze River Scientific Research Inst, Wuhan 430010, China - keyindex@163.com

^b Research Center on Water Engineering Safety & Disaster Prevention of MWR, Wuhan 430010, China - keyindex@163.com

^c Taizhou Radio&Television University, Taizhou 318000, China - chensw@tztvu.zj.cn

^d The Institute of Remote Sensing Applications, Chinese Academy of Sciences (IRSA/CAS), Beijing 100101, China

Commission WG VII/6

KEYWORDS: Remote Sensing image; Ratio Image; False Color Image Composite Method; Texture Analysis; Sliding Window Method ; the Optimal Scale ;OIF method;

ABSTRACT:

By referencing rock spectrum reflection curves, the effective bands of remote sensing images are selected which are treated with ratio processing in this paper. False color composition is proceeded by two ratio images and a single band. After this, the single band restored the terrain detail information which is lost in the other two ratio images. Then sliding window method is used to analysis the distribution of texture. A series of characteristic matrix are generating by computing the characteristic value of different scales of the windows which including the texture statistical information of remote sensing images. In this paper OIF(The Optimum Index Factor) method is adopted to proceed the objective evaluation which can find the optimal scale of sliding windows and to proceed the false color composite with ratio characteristic matrixes. The size of optimal sliding windows is found by multiple tests on contrasting image and referencing ground resolution of remote sensing images.

1. INTRODUCTION

By researching different bands characteristics of RS images, ratio processing is proceeded by selecting several bands in this paper. The method of false color composite is proceeded by ratio images in order to find the region distribution information with rich with mineral content which will be benefit for prospecting work.. Then the OIF(The Optimum Index Factor) value is used to estimate the quality of the images we have got. Finally the optimal sliding window is discussed by using sliding window method by the end of process.

2. RATIO ENHANCEMENT METHOD

Ratio enhancement is an often used image enhancement method, which make pixel brightness of two different bands divided with the propose of generating new ratio image. Though making the relevant bands divided considering the reflection peaks and the absorption peaks, the content proportion of specific information is improved and other unnecessary information is depressed. And this method can decrease the intensity roughness caused by the effect of reflectivity and terrain slope.

For example, watching the iron ore mineral spectrum curve, we can find that there is a strong reflection peak in band 5 curve, and there are two strong absorption peaks in the same wavelength in band 1 and band 4. In order to increase the information of iron element, two different ration combination can be selected. One is that band one divided by band five, the

other is that band four divided by band five. And the following image is a ratio image which can be obtained by dividing with band one and band five.

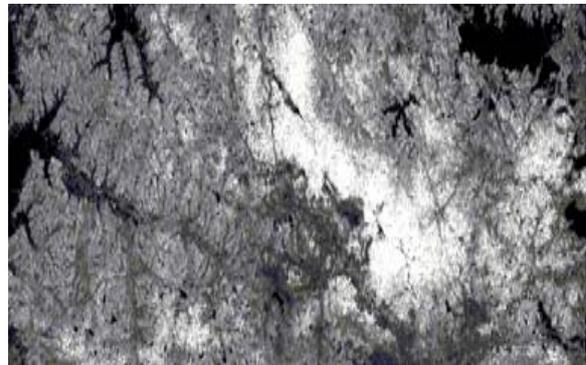


Figure.1 Ratio image of band five and band one

3. FALSE COLOR IMAGE COMPOSITE OF RS IMAGES

Human eyes can distinguish teens gray scales for grey image. However for color image, the capability of human eyes is stronger than that of grey one. People can distinguish more than 13000 different colors by machine[1,2]. So the method of False Color Image Composite is most commonly used for visual interpretation. Three grey images can combined into one color image which can show us more different objects features.

*Correspondence to: Liang Jun(E-mail: keyindex@163.com) or Chen Songwei (E-mail: chensw@tztvu.zj.cn)

The main weakness of ratio image is lost the reflection intensity information of ground objects. In order to remedy the deficiency, one origin band and two ratio images can be combined into one color image[3].

In this paper, the method of combining two ratio images with one original band is researched. Because this method reserve not only absolute radiometric information which have missed in ratio images, but also some terrain detail information which can distinguish some objects on the ground. It is easier for people to interpretation.

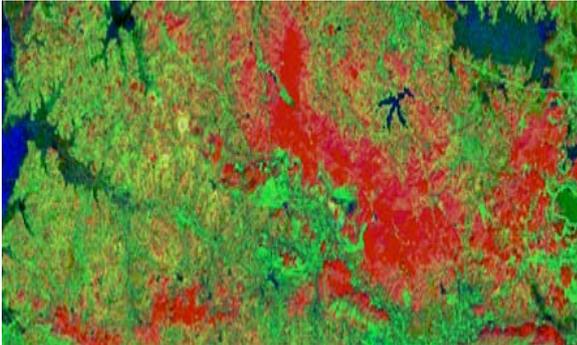


Figure.2 False Color Image

Figure 2 is a hybrid false color image . In the image ,the Red band is the ratio of band five and band one ,and the Green band is original band one ,and the Blue band is the ratio of band five and band one . The image is combined by two ratio images and one original band together which show us a better effect one . Not only can it show us some important things on the ground, but also some details of terrain. The effect is better than that of tradition method dealing with in specialty fields such as mineral.

However, this method still has some disadvantages[4]. Abnormal of tonality will cause some difference of color in the image. In RGB color system, color is defined by the proportion of tricolor. The change of each one of tricolor will cause that of color characteristic. The color can hardly described by number well and truly. And the levels of number can hardly expressed by a certain color, too.

4. THE OPTIMUM INDEX FACTOR(OIF) METHOD

Because the combination of R,G,B band is really complex and changeable, the final result of image is different. In some cases, it is difficult to choose a appropriate combination scheme for false color composite of ratio images or select a color to describe the specific information.

How to select the most useful combination achieving the best reinforcing effect? Nowadays two methods have been adopted[5]. First is to select the most suitable bands which can identify different geologic body. The other is to select the bands depended on statistical characteristics of images.

4.1 the Formula of OIF Method

In this paper, through researching the effect of ratio false color composite image of RS images, the method of OIF (The Optimum Index Factor) is discussed. Chavez ec a1. has been

put forward a formula to calculate OIF(The Optimum Index Factor) by using three standard deviation and correlation coefficient.

$$OIF = \sum_{i=1}^3 SDi / \sum_{j=1}^3 |CCj| \quad (1)$$

In the formula (1), SDi means the standard deviation. |CCi| means the absolute value of correlation coefficient. Standard deviation represents the discrete degree. The more value it will be ,the more radiation intensity difference we can see. And the less of the |CCi| ,the less of repeated degree .

The bigger OIF value we have calculated, the more information the color image contains. And the less redundancy information it is. So it is easy to understand that the biggest OIF value represents the prime combination.

4.2 the Disadvantages of OIF Method

In the paper, in order to find a suitable combination scheme, the OIF method is used to evaluating them objectively. Although the method of OIF value is effective on representing the display effect and narrowing the possible wave bands combination, the disadvantages are very obvious[6,7].

- (1) The OIF value embodies that of image information entropy of from one side and there is no necessary association between the value of OIF and image quality evaluation.
- (2) Some images with similar bands combination have similar OIF value, unfortunately their display effects are dissimilar obviously.
- (3) The best image combination maybe not just the image of the analyst wanted with special information.

5. RELATIONSHIP BETWEEN THE OIF VALUE AND THE SCALES OF THE WINDOW

First two ratio image we talked above are filtered by sliding window method with different scales. Then two new characteristic matrix we have got are synthesized into a false color image with a original band. Finally we calculate the OIF value.

For the sake of discussion, a simple expression is provided. R=band51 mean a new characteristic matrix which can be got by filtered with different scales of window after band one divided by band five . The scales of filter window are set in different sizes. Such as 3×3、5×5、7×7、9×9、11×11、13×13、15×15、17×17、19×19、21×21、31×31、41×41. Based on the formula of OIF, the OIF value is closely related not only the scale of sliding window but also the choice of original band [8,9].

Research area of RS image is Tieshan mining area in Daye city , Hubei province. Because it is a big opencast mine area where the research data is relatively comprehensive. And the prospecting criteria alteration zones can be found easily which will affect some RS bands a lot. So the OIF value is

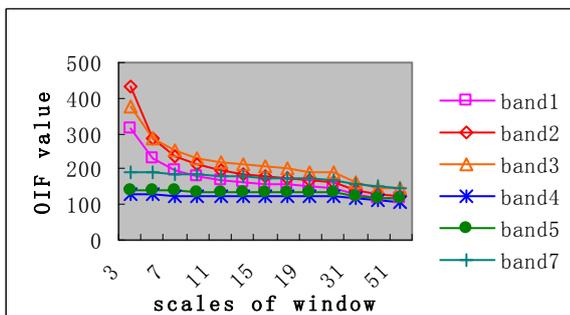
calculated by above methods we have talked. Then the OIF value we have got can be statistical analysis for finding the optimal sliding window.

The concrete contents are as follows:

窗口尺寸 波段组合	size=3	size=5	size=7	size=9
-band1-	316.4495	229.9329	198.9636	181.0253
-band2-	431.3088	286.9773	237.6239	211.1394
-band3-	377.6173	285.1752	251.4869	231.3289
-band4-	128.9929	126.7493	125.1496	122.9298
-band5-	142.4992	140.998	139.3708	136.8546
-band7-	192.24	190.5205	187.5389	183.2421
窗口尺寸 波段组合	size=11	size=13	size=15	size=17
-band1-	169.5374	164.2567	160.0913	155.4631
-band2-	194.6742	186.542	180.3785	174.1038
-band3-	217.9556	212.1879	206.9307	199.9323
-band4-	121.3445	122.3527	123.1257	122.8622
-band5-	134.9143	135.7672	136.3186	135.7962
-band7-	178.3932	176.9705	176.1066	174.2258
窗口尺寸 波段组合	size=19	size=21	size=31	size=41
-band1-	150.7933	147.8115	129.5668	118.4827
-band2-	168.0672	164.1161	141.8316	128.638
-band3-	193.1976	188.7883	163.6851	148.5688
-band4-	122.0708	122.2362	115.5704	109.892
-band5-	134.7398	134.6939	126.3652	119.1299
-band7-	171.8355	171.0026	159.2047	149.9347

* -band1- mean the combination of band51-band1-band54

Table 1. OIF value statistical table



* -band1- mean the combination of band51-band1-band54

Figure 3. Relationship between the OIF value and the scales of the window

6. CONCLUSION

Combine discussing the OIF value with the scales of sliding window, which make the final results more extensive meaning in different scales. Because of different sizes represent different scales in sliding window method, the OIF value which calculated represent the distribution situation of different scales.

It can be concluded the following points by contrasting display effect of many images and referencing Figure 3 relation between the OIF value and the scales of the window.

(1)the optimal sliding window is 3×3 . The origin dada in this paper is ETM+ RS image whose ground resolution is 30 meters. So 3 pixels in the image mean 90 meters in the actual length. In this scale, most of medium and large-scale geological phenomena can be recognized easily in the image. And small geological phenomena will be filtered which will decrease the disturbance from the theme. In this scale of window, RS image has the better effect than that of any other else scales. The more large of the scale is, the worse of display effect will be.

(2)The deduction can be confirmed by Figure 3. relation between the OIF value and the scales of the window. When the scale is 3×3 , the OIF value is larger than others which means that there is the richest information in the scale of image. In the OIF curve, it is clearly that the OIF value decreases with the increase of window scale. And information decreases with the increase of window scales, too.

ACKNOWLEDGEMENT

The author is grateful for support through the following Grants: project of central scientific research institution with public welfare (YWF200809 and YWF0721/AQ01, YWF0723/AQ03)

REFERENCE

- [1] Manik Varma,2004,.Unifying statistical texture classification frameworks. *Image and Vision Computing*, vol(22),pp:1175-1183
- [2] M.Unser,1999,Multiresolution Feature Extraction and Selection for Texture Segmentation. *Pattern Analysis and Machine Intelligence*. Vol.21(4)
- [3] Bea Thai,1999 Spatial Filter Selection Selection for Illumnation-Invariant Color Texture Discrimination. *Computer Vision and Pattern Recognition-Volume 2* 06 23-06, Fort Collins, colorade.
- [4] S.E.Grigorescu,N,Petkov, and P.Kruizinga,2000,A Comparative Study of Filter Based Texture Operators Using Mahalanobis Distance International conference on Pattern Recognition-Volume 3 09 03 - 09, Barcelona,Spain
- [5] H.Cheng and C.A.Bouman,2001,Multiscale Bayesian segmentation using a trainable context model,*IEEE Transaction on Image Processing*, 10(4):511-525
- [6] DeWouwer G V, Scheunders P ,Dyck D V,2001,Statistical texture characterization from wavelet representations.*IEEE Singal Processing Letter*, 8(5):125-128
- [7] G.Val de Wouwer, P.Scheunders,D.Van.Dyck,1999,Statistical texture characterization from wavelet representation, *IEEE Traction on Inamge Processing*, 8(5):592-598
- [8] Novak I D,Soulakellis N,2000.Identifying geomorphic features using LANDSAT-5/TM data processing techniques on Lesvos,Greece.*Geomorphology*,34:101-109

- [9] Zhang Y. A new merging method and its spectral and spatial effects[J].*INT J Remote Sensing*,1999,20(10):2003-2014