NATURAL-COLOR IMAGE SIMULATION BASE ON SPECTRUM ANALYSIS

Jinxiang Shen [1, 2] *Liao Yang* [1] *Jiancheng Luo* [2] *Zhan feng Shen* [2]

1. Remote Sensing and GIS Application Laboratory, Xinjiang Ecology and Geography Institute, Chinese Academy of Science, 818, South of Beijing road, Urumqi, Xinjiang, 830011
2. Institute of Remote Sense Application, Chinese Academy of Science, Beijing, 100101

1. INTRODUCTION

Some satellites (such as SPOT and IRS-P6) cover only two visual spectral bands (green and red) except these locate in the near infrared to thermal infrared region. As a result, natural-color image cannot be formed, as blue band is necessary in the red, green, and blue combination [1]. The issue greatly influenced the application of remote sensing data in many areas such as virtual reality, terrain simulation, and visual interpretation. In this study, a spectrum analysis approach is adopted to simulate natural-color image. The method consists of two steps: (1) Adjusting the spectrum-library's spectrum scale according to the image's band spectrum , and form some spectrum bands; (2) Fitting the relationship between spectrum's blue band and other bands by Back-Propagation artificial neural network (BP-ANN), and simulating image's blue band by using that relationship and finally form natural-color image. Experiment shows that the simulated natural-color image is much more excellent in both visual effect and spectrum information than others.

2. METHODOLOGY

2.1 work flow

There are two important steps in our work, one is spectrum scale adjusting and the other is spectrum analysis and natural-color image simulation. The whole work flow is shown as follow:

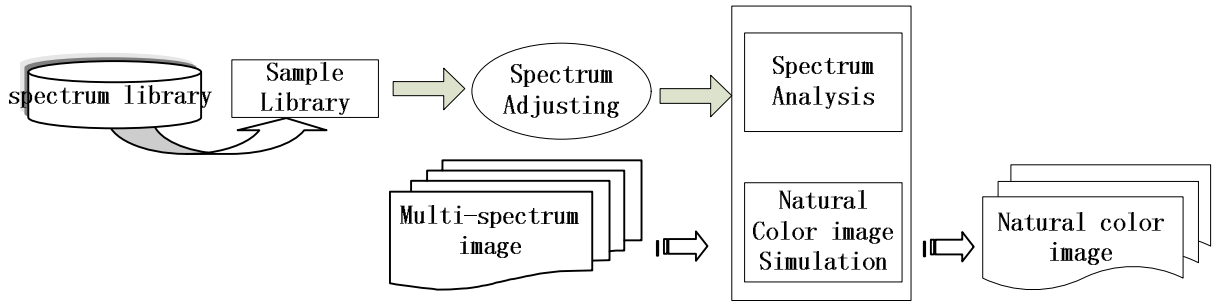


Figure.1 The work flow of the spectrum analysis based natural-color simulation

2.2 spectrum scale adjusting

In order to adjust spectrum-library's spectrum scale to image's spectrum scale, spectrum integration of the spectrum-library is computed by the reference of image's bands setting. In the process of spectrum integration, the integration range of the blue band can refer to that of the other images which have a similar spatial and spectrum resolution.

2.3 spectrum analysis and natural-color image simulation

In the process of the spectrum analysis and natural-color image simulation, the BP-ANN is used to simulate the relationship between the spectrum's blue band and other bands. In order to exclude the difference between spectrum- library's spectrum and the image's spectrum in spatial scale and other data acquisition condition, the relative spectrum angle value is used to put into BP-ANN. The simulating process consists of two steps: (1) **training**: take blue band(take the blue band as an example, also could be the other band) as a standard band to compute the value of $\sin\angle ROG_{lib}$, $\sin\angle NirOG_{lib}$, and $\sin\angle SwirOG_{lib}$ ($\angle ROG_{lib}$ is a relative spectrum angle of the red band and green band) as the inputs value, and compute $\sin\angle BOG$ as target value to train BP-ANN. (2) **simulating:** compute the image's $\sin\angle ROG_{image}$, $\sin\angle NirOG_{image}$, and $\sin\angle SwirOG_{image}$ value and take them into trained BP-ANN, and get an output value of

$\sin \angle BOG_{image}$. Through the value of the green band and $\sin \angle BOG_{image}$, it can be the blue band value and then generate the natural-color image.

3. RESULT

(1) First, an ETM+ image was selected as the reference image to do natural-color simulations with the proposed method (Figure. 2- Figure. 5).

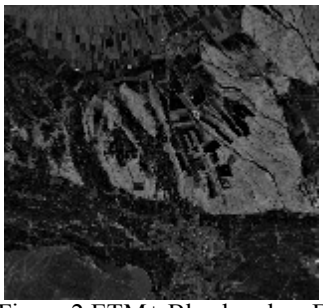


Figure.2 ETM+ Blue band

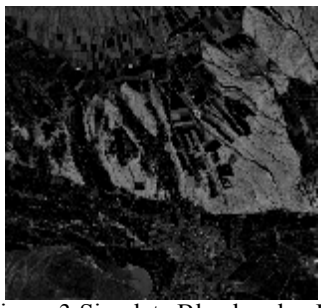
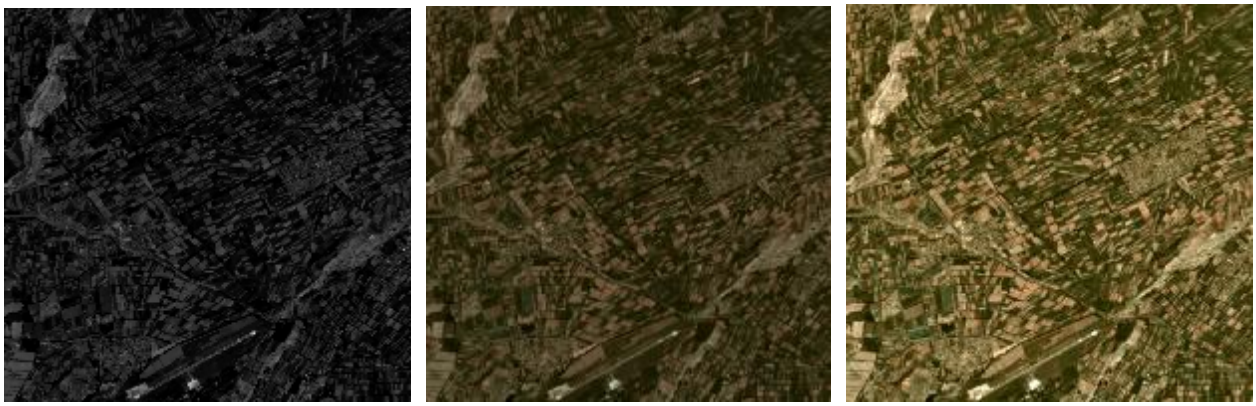


Figure.3 Simulate Blue band


Figure.4 ETM+ natural color


Figure.5 simulated natural color

(2) Take SPOT5 image as an example image which lack of blue band to do natural color simulation (Figure.6).



a. Simulated blue band b. Simulated Natural-color image c. After Contrast adjusted

Figure.6 SPOT natural-color simulation result

4. CONCLUSION

Our approach describes a complex relationship between the image bands by using quantitative spectrum analysis with the spectrum-library, and we successfully generated the natural-color image by using the relationship. Furthermore, we could use the approach to simulate other image bands what we need, and do other things with the newly created image bands. However, our approach relies on the BP-ANN to stimulate the spectrum library's bands relationship, so the spectrum library's feature counts and typicality directly affect the BP-ANN's training effect, and affect the natural color image simulation result.

6. REFERENCES

[1] Patra, S. K., Shekher, Manish, Solanki, S. S., Ramachandran, R. and Krishnan, "A technique for generating natural colour images from false colour composite images", *International Journal of Remote Sen*sing, 27:14,2977 — 2989, 2006

[2] Chi-Farn Chen, Huang-Yi Tsai. "A Spectral Transformation Technique for Generating SPOT Natural Color Image", *GIS DEVELOPEMENT* 1998.

[3] Thomas Knudsen. "Pseudo natural color aerial imagery for urban and suburban mapping", *International Journal of Remote Sensing*. 26:12, 2689-2698,2005