SPECTRAL DATA ANALYSIS OF GROUND OBJECTS IN CHAO LAKE BASIN

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1. INTRODUCTION

Based on a great deal of spectral data for different kinds of ground objects which were denoised by wavelet transform method, the spectral characteristics and changing rules of water, paddy field, wheat, cole and vegetable greenhouse in Chao Lake basin were analyzed with ASD portable spectrum analyzer by field investigation and plot survey[1-3]. The spectral data of typical ground objects in Chao Lake basin were also processed by using mathematics technology such as de-noising technology of derivative spectrum technology and normalization processing technology.

2. METHODOLOGY

2.1. Wavelet transform method

After the measured data are transformed to reflectivity, the abnormal sampling data should be eliminated. The wavelet transform method, whose 'window size' changes with frequency variation, decomposes the spectral data into a series of block signals with different frequency according to resolution. Then the block signals in special position or within special frequency range could be processed conveniently. During the wavelet transform decomposition process, the concrete wavelet function is not needed. We can reconstruct the signal after the process of decomposition. The spectral data are denoised by the db3 wavelet in level 5 in this paper.

2.2. Derivative spectrum method

The influence of low-frequency noise on aim spectrum is limited by the derivative spectrum method. Because of low order derivative method is not sensitive to noise, it is more effective in practice[4].

2.3. Normalization processing method

The normalization processing method is propitious to decreasing the influence of environmental background and measurement condition on absolute value of reflectivity.

3. CONCLUSION

1) From the measured data(fig.1), according to the existence and size of reflectivity peaks near 700nm, we can judge the eutrophication degree of all the sampling points. So from fig.2 we know the sampling point of Tangxi bayou and Fifteen mile bayou have the highest chlorophyll concentration; the sampling point of Sancha bayou, Nanfei bayou, West-half lake area take second place; the sampling point of Lake center has the lightest degree of eutrophication.

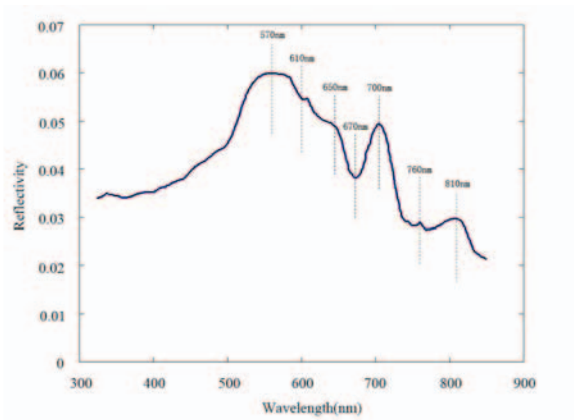


Fig.1. the representative water reflectivity of Chao lake

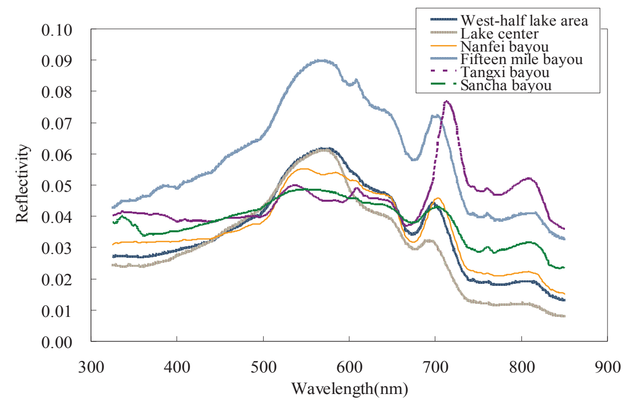


Fig.2. the contrasting figure of water reflectivity between Chao Lake and bayou sampling points

2) Fig.3 is the spectrum curve figure of wheat and cole. There is a steep slope between 700nm and 800nm, which is the red edge. In the range of wavelength less than the red edge, the reflectivity of wheat is lower than that of cole; both reflectivity increase rapidly during the red edge range; but after the cross near 730nm, the reflectivity of wheat is higher than that of cole.

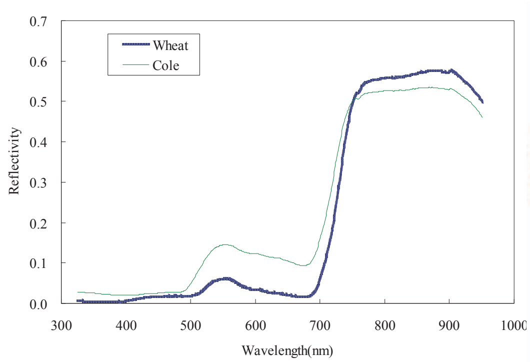


Fig.3. The spectrum curve figure of wheat and cole

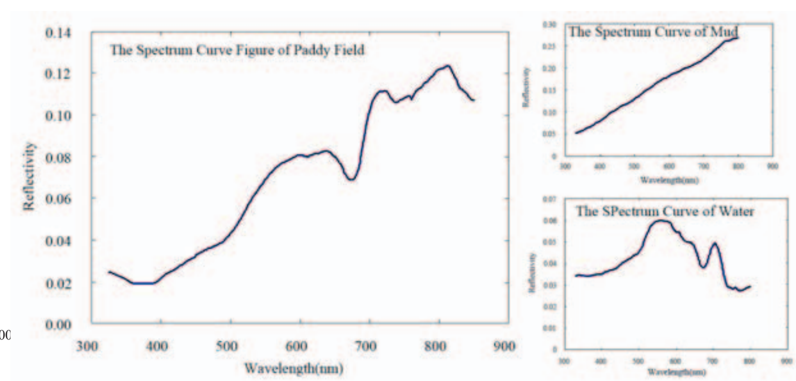


Fig.4. The spectral curve figure of paddy field

3) In April, the paddy filed is ploughed but not planted, so the spectral curve figure is admixture spectrum of mud and water. The trend of curve is similar to that of mud which the admixture reflectivity increases with wavelength raises, but the positions of peak and valley are similar to that of water body. The admixture spectrum is released by using linear mixing spectral model. Using the restricted least square method, we can obtain the percentage of

mud reflectivity in the admixture spectrum of paddy field is 40%, and the percentage of water reflectivity is 60%(Fig.4).

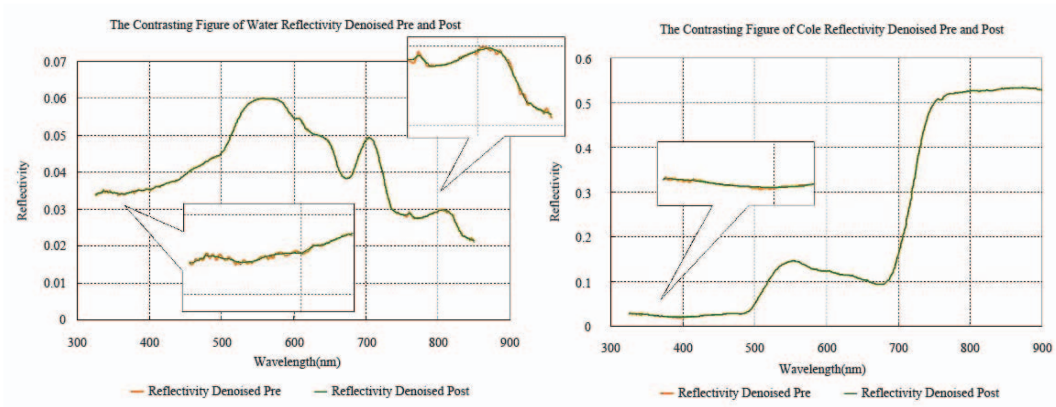


Fig.6. The contrasting figure of reflectivity denoised pre and post

4) Fig.5 is the spectral curve figure of plastic greenhouse, which is measured in three directions. There is a steep slope between 700nm and 750nm, and the slope rates of shaded halves, shed top and light halves are 0.0008, 0.0010 and 0.0014. The reason of the slope existence may be the contribution of vegetable reflectivity in the greenhouse. However, because the plastic is semitransparent, the reflection curves increase limited.

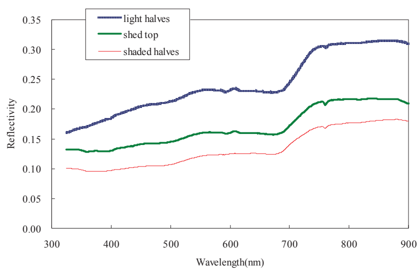


Fig.5. The spectral curve figure of plastic greenhouse

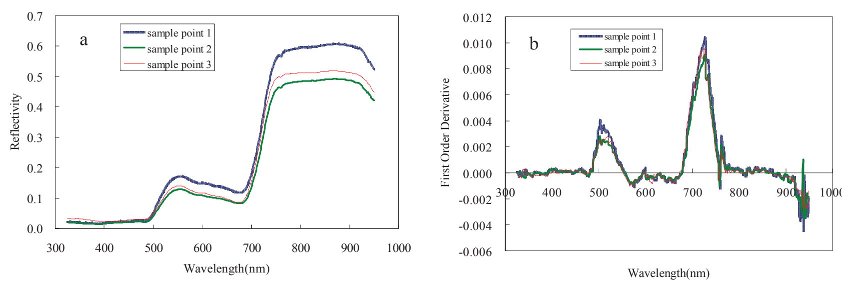


Fig.7. The reflectivity curve and first order derivative spectrum curve of cole

5) After applying the wavelet transform to spectral curve, we discover that the curve is smoother and its basic trend is clearer. Fig.6 shows that wavelet transform has advantage in de-noising because it could remove the noise from signal as well as preserve the detail information.

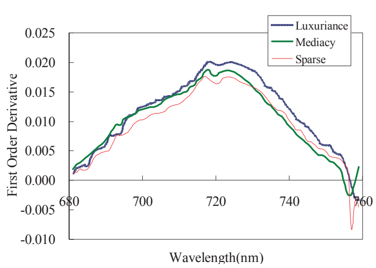


Fig.8. The derivative spectrum of cole

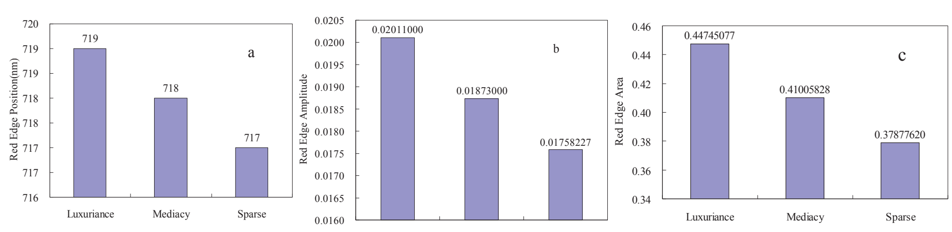
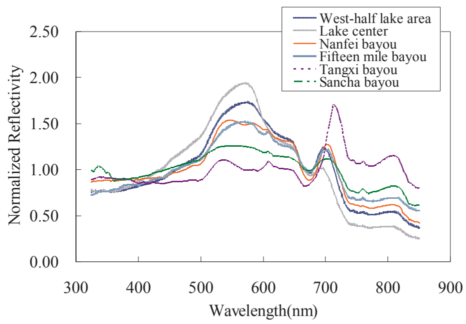


Fig.9. The parameter figure of red edge of cole

6) Derivative spectrum and normalization processing technology have better practicability in suppressing background effect and emphasizing the signal of objects. The sample point 1 and 2(fig.7a) are measured in the same time but differ from the sample point 3. Moreover, the canopy densities of sample point 1 and 2 are different.

But the three derivative spectral curves(fig.7b) have little difference. In addition, we obtain the double-peak phenomenon(fig.8) of plant derivative spectrum which depends on the canopy structure and biomass, thus this phenomenon could indicates the condition of plant growth. The red edge positions(fig.9a) of these three points are all near 718nm, thus the position don't depend on density. Fig.9b and fig.9c show that the values of red edge amplitude and area increase with the wavelenght raises[5]. The main reason is that larger density manifests more biomass, hence, there is a leap of reflectivity in the transition band which is distributed in 680-760nm range.



curves of Chao Lake and bayou sampling points

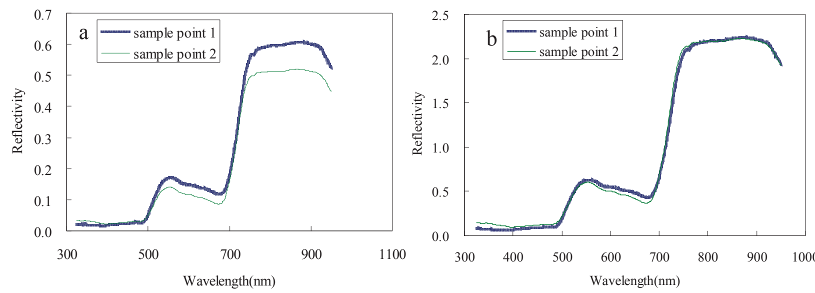


Fig.11 the normalized spectral curves of cole sampling points in different illumination conditions

Normalization processing method had better practicability in eliminating the influence of suspended matter on the reflectivity[6]. Fig.10 shows that the eutrophication degree of the sampling point of Fifteen mile bayou is not as severe as fig.1 shows. The evaluation of eutrophication could be more accurately by using the normalization processing method. In fig.11a ,The two cole sample points are measured in different illumination conditions. From fig.11b we know that the difference of the two curves are eliminated by the normalization processing method, which would enhance the accuracy of vegetation classification especially in near infrared band.

4. REFERENCES

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