Study on Extraction of Soil Information from Hyperspectral Remote Sensing

Xiujie Yuan[1, a], Xinyang Yu[1, b], Chunyan Chang[1, c]

[1] *National Engineering Laboratory for Efficient Utilization of Soil and Fertilizer Resources, College of Resources and Environment, Shandong Agricultural University, Tai'an, Shandong, 271018*

**E-mail: xyyu@yic.ac.cn*

Abstract: The development of precision agriculture urgently requires remote sensing technology to provide its rapid and accurate surface information. For soils, soil moisture, soil organic matter content, soil roughness, soil texture and other characteristics are important information needed in precision agriculture. As a research frontier and hotspot of international remote sensing science, hyperspectral remote sensing technology can overcome the shortcomings of conventional remote sensing by adopting the advantages of conventional remote sensing on crop monitoring, such as large area, timely and non-destructive. Through its fine spectral superiority, Accuracy of dynamic monitoring and analysis of crop health status and environmental factors affecting crop yields, with the potential to quantitatively characterize the characteristics of the features. Hyperspectral remote sensing is characterized by its high spectral resolution in the study of agricultural soil and vegetation characteristics.

Keywords: Soil information, Hyperspectral remote sensing, Extraction and Mining

1. INTRODUCTION

In the past 20 years, such as crop science, agronomy, soil science, plant protection science, resource environment science and intelligent agricultural equipment and automatic monitoring technology, system optimization decision support technology, Spatial information support under the assembly integration, the formation and improvement of a new "precision farming" technology system and carried out a wide range of experimental practice. The practice of "precision farming" should analyze the spatial distribution of farmland crop yield and crop yield factors, and carry out locating variables according to the difference of spatial community. Therefore, it is important to obtain information on the identification and processing of the differences in the distribution of these spatial distributions in farmland for the optimization of crop management decisions. Positioning variables prescription farming requires geographic information systems and support for geospatial data collection, updating and remote sensing monitoring of farmland spatial information remote sensing technology with differential GPS support.

Remote sensing is a measure of the reflectance spectrum of the solar radiation energy or the radiated electromagnetic wave spectrum information of the object itself. The wavelength and energy of the electromagnetic wave reflected and radiated by each object are closely related to the inherent characteristics and state parameters of the material itself. The digital image obtained by the camera or the scanning photoelectric sensor mounted on the remote sensing platform contains a wealth of different electromagnetic spectral energy reflecting the nature and state of the object, from which the different radiation wavelengths can be extracted, and the statistical analysis Object identification. Remote sensing is not a direct measure of soil moisture, soil nutrient, crop nutrient level, grain and yield, quality and other information in precision farming management. However, the reflection or emission spectrum showed information obtained by remote sensing sensor characteristics inversion. In this way, it is necessary to use data analysis tools to find the correlation between remote sensing data and soil and plant characteristics. Once this relationship is established, we can reason large-scale farmland conditions. In general, remote sensing data can be used as a layer of geographic information system to supplement field data such as soil fertility, weed and pest, and to supplement the RS layer to make the RS layer consistent with the geographical position of other data layers. In the application of remote sensing and geographic information system, we can use the following steps: Collect remote sensing data and process data into data; double-check the image and analyze the statistical data; Ground the remote sensing data, according to the information obtained on the farmland prescription countermeasures. Identify the relationship between the measured variables and crop conditions; According to the information obtained on the farmland prescription countermeasures. At present, satellite remote sensing data can meet the "precision farming" needs of the spatial resolution, but not yet used for community-based crop production of precision management. However, the remote sensing technology field of farmland and crop hyperspectral image information processing and imaging technology, sensing technology and "precision farming" technology system need to be addressed in real-time, fast farmland information collection advanced sensing technology research and development closely Related. The time series images obtained by remote sensing can show the temporal and spatial variability of farmland crop growth due to the spatial reflectance spectral variability of farmland soil and crop characteristics. The images collected at different times in a season can be used to determine crop growth and Conditional change. A series of Earth observation satellites will be launched in recent years based on the commercial interest in "precision farming" in the remote sensing industry. By 2005, more than 40 such satellites will be serviced and will be used in "precision farming" Technical system plays an important role.

2. ANALYSIS AND TREATMENT OF SPECTRAL DATA OF SOIL LABORATORY

The collection of soil information in "precision farming" is to obtain information from the perspective of soil environmental conditions and nutrient level affecting crop growth in order to analyze the reasons for the difference in spatial distribution of yield in yield map, to develop information on fertilization, Farming, planting and other distributed positioning prescription decision. The soil information mainly includes soil fertility, soil texture, soil water content, soil organic matter content and so on. Because of its spatial and temporal variability, soil information such as topography and soil is relatively stable and spatiotemporal variability. Type, structure, phosphorus, potassium and organic matter content, pH value, tillage depth, etc ; spatial and temporal variability of farmland soil information, such as nitrogen content and soil moisture content. However, the traditional farming in the farmland land as a uniform soil fertility, soil fertilization. However, from the perspective of precision agriculture, the distribution of soil nutrients in a plot is often uneven, if the use of conventional fertilization technology, will inevitably lead to the fertilization of the place "not enough", should not be applied or only the amount of local use Too much, both causing waste, rising costs, but also cause environmental pollution, and even lead to lower average yields. Therefore, to fully understand the differences in field fertility, according to fertility differences in precision fertilization is a very important solution.

Soil color is an easy-to-observe soil property that is often used to describe soil properties and distinguish soil types. It reported that the US Department of Agriculture used the Munsen color method to standardize the color of the soil, and the subsequent study used this method to determine the color of the soil. The three characteristics of the Munsell color are usually marked in the order of hue, lightness, and chroma. Hue, refers to the color of the appearance, or distinguish the color of the name or color of the type, color and color has nothing to do with the color. Lightness (Value) refers to the color of the degree of brightness, the level of brightness that is close to the degree of white or gray. Chroma refers to the strength of color, also said that the saturation of the color (Saturation), pure and impure pure color. Measurement of the color properties of the Munsell color According to the standard test specifications, the samples are placed on a neutral background (medium to white), illuminated with natural or artificial daylight. Samples were observed by observers of normal color vision. Choose a window without sunshine. The light is illuminated by the observer next to the upper part of the table and into a horizontal plane 45 ". A black cloth ceiling is placed above the working surface to prevent the light from the above objects from being reflected to the surface of the sample, causing errors along a vertical direction to observe the sample, the degree of deviation is just enough to avoid the observation of the forehead of the reflection. Munsell Color Atlas select two adjacent Munsell constant tone pattern or color card, the sample tone between them in the sample on each side Put a piece of gray paper cover the sample and color card, so that only see the sample and each picture on a color card, the paper block in a color card a color card on the move to find the most Match the sample color card. Estimate the brightness value, chroma and hue.

Soil organic matter is an important source of various nutrient elements in soil, especially nitrogen and phosphorus. In general, soil organic matter content is an important indicator of soil fertility. The composition of soil organic matter is very complex, including three kinds of substances: little decomposition, still maintain the original form of animal and plant residues; 2) animal and plant residues semi-decomposition products and microbial metabolites: 3) decomposition and synthesis of organic matter the formation of humus. Soil organic matter and soil total nitrogen content between a certain correlation, it can be measured from the organic matter to estimate the approximate content of soil total nitrogen. In the field of soil organic matter research is more commonly used in capacity analysis. In the presence of excess sulfuric acid, the organic carbon is oxidized by oxidizing agent potassium dichromate, and the remaining oxidant is dropped back with the standard ferrous sulfate solution to calculate the organic carbon content from the amount of oxidizing agent consumed. This method, the soil in the carbonate without interference, the method is quick and easy. Soil organic matter content can be obtained by multiplying the organic carbon content by a conversion factor. The specific measurement methods and steps are shown in the "Soil Agrochemical Analysis" edited by Nanjing Agricultural University.

How much calcium carbonate content affects many characteristics of the soil, such as the extent of soil leaching, the extent of soil development and development, soil acidity, the presence and effectiveness of soil nutrient elements, soil salt saturation, soil-adsorbed cation species, soil structure, soil microflora, and whether the soil is alkalized and alkalized when the salt is improved is related to calcium carbonate. Determination of soil inorganic carbonate in many ways, one is the rapid neutralization method that is, add a large number of standard acid in the soil, so that with the role of carbonate, excessive acid reuse of standard lye back. The second is to add hydrochloric acid to the soil, the resulting carbon dioxide gas device to measure its volume or with standard lye to absorb carbon dioxide, and then titration with the standard acid remaining alkali, or carbon dioxide soda lime weighing. The content of soil calcium carbonate was determined by carbon dioxide. In this study, the calcium carbonate content was determined using the gas method.

Soil spectral reflectance measurements were carried out in the laboratory by using the ASDPorFR portable spectrometer to obtain the spectral reflectance of soil spectra in the 350 nm region. Spectral resolution in the visible part is 1.4lun, in the near infrared part of the Zlun. Field angle of the spectral probe in the zenith from the soil sample surface 40cm, to reduce the background scattered light effect, the light source from the soil surface 70. m capable of providing parallel light to a 1000W halogen lamp. The zenith angle of the light source is 150. The device is used to limit the effect of surface roughness on reflectivity due to shading of soil particles. The light source is connected to a power regulator to avoid the effects of voltage fluctuations. The measured instability is evaluated by multiple measurements of the same target, removing less than 370 mn and above 2300 mn, and the root mean square error (RMS) E is less than 0.002.

3. HYPERSPECTRAL REMOTE SENSING IMAGE PRETREATMENT AND SOIL INFORMATION EXTRACTION

The task of spectral scaling (also known as wavelength scaling) is to determine the center wavelength and bandpass width of each spectral band of the instrument output. The task of radiometric calibration is to determine the quantitative relationship between the output signal of each channel and the ground and the spectral radiation brightness.

Spectral calibration is to use a monochromatic parallel light source to obtain the spectral response curves of the various channels of the imaging spectrometer to determine the center wavelength and bandwidth of each channel in order to obtain an accurate target spectral reflectance curve. Laboratory spectral calibration equipment generally include light source, monochromator, parabolic mirror parallel light tube, microcomputer screw system, etc.: light standard two spectral sections: that can be visible to the near infrared band and cut infrared Band.

Radiation calibration is to use the quasi-spectral radiant light source provided by the national unit of measurement to establish the quantitative relationship between the spectral radiance of the imaging spectrometer entrance and the digital output of the detector to determine the response of the spectral channels of the imaging device. Calibration coefficient, the actual image of the radiation calibration Radiation calibration is generally divided into a single step: the first step, with the national statutory measurement department to provide the standard spectral irradiance lights and standard from the plate, the spectral radiometer Standard The second step, with the calibration of the spectral radiometer on the integrating sphere light source calibration, to determine the spectral radiance value. The first few steps, the imaging spectrometer at the calibration of the integral spherical light source for a halo, you can get the imaging spectrometer output signal spectral radiation! Radiation set, mainly including only one aspect of the content: stability, linearity and responsiveness.

4. CONCLUSION

The development of precision agriculture urgently requires remote sensing technology to provide its rapid and accurate surface information. For the upper soil, the soil moisture content, soil organic matter content, upper soil roughness, soil texture and other characteristics of precision agriculture is an important information. As a frontier and hotspot of international remote sensing science, hyperspectral remote sensing technology can improve the accuracy of agricultural classification through its fine spectral superiority, besides the advantages of conventional remote sensing, such as large area, timely and non-destructive monitoring of crop, dynamic monitoring and analysis of crop health and environmental factors affecting crop yields. By virtue of its extremely high spectral resolution in the study of agricultural soil and vegetation characteristics, Hyperspectral remote sensing is showing extraordinary research potential.

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