Datasheet

Rotary Scan Hyperspectral Imaging System

ATH3010

Features

- High sensitivity hyperspectral imager
- 13 megapixel visible light camera, spectral integration;
- High-performance image sensor, extremely cost-effective
- High stability high blue lighting source, power adjustable
- Full target surface high imaging quality optical design, point row spot diameter less than 0.5 pixel
- The objective lens interface is standard C-Mount, and the objective lens can be replaced according to user requirements
- Band range: 400-1000nm
- Hyperspectral resolution: 1.3 nm
- Maximum Angle of view: 31.7°
- Minimum instantaneous field of view Angle: 1.2 mrad
- Excellent imaging performance

Application

- Agricultural application: pest monitoring, nutrient monitoring, disaster assessment, crop yield estimation, etc
- Forestry: Tree categories identification, Phytomass, nutrient elements, forest health etc.
- Water Environment: Water quality parameters, water waste spatial distribution and migration analysis
- Soil pollution: heavy metal waste
- Minerals: Mineral mapping, ingredients explore, metallogenic prognosis etc.
- City： Urban planning, road monitoring, landscape vegetation monitoring, environmental protection

Description

ATH3010 is a miniature hyperspectral imager with small size and light weight.

In addition to small size and light weight, the ATH3010 has the characteristics of high spatial resolution, high spectral resolution and wide imaging range. ATH3010 at the same time built-in high stability high blue lighting source, and the power is adjustable, no additional light source.

The ATH3010 is composed of two parts: hyperspectral imager and automatic electric rotary table. The high spectral instrument is based on high efficiency transmission grating technology and has good aberration characteristics.

The ATH3010 can also be installed on a tripod or pole, and add automatic calibration device, weather monitoring sensor, etc., so as to achieve a long time, large area scan of the target.

Model	Spectral channels	spatial channels
ATH3010	1088	2048
ATH3010-4	2048	2048

ATH3010

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Items	ATH3010	ATH3010-4
Spectral Range	400-1000nm	400-1000nm
Spectral Resolution	1.3 nm	1.3 nm
Sampling Interval	0.37nm	0.37nm
F-number	F/2.6	F/2.6
Detector	CMOS	CMOS
Detector Interface	USB3.0	USB3.0
Supply Power	USB powered, 3.4W	USB powered, 3.W
Detector Target Size	11.26mm x 5.98mm	11.26mm x 11.26mm
Detector Original Resolution	2048 × 1088	2048 × 2048
Detector Original pixel size	5.5 µm x 5.5 µm	5.5 µm x 5.5 µm
Bit Depth	12 bits	12 bits
Slit Width	25 µm	25 µm
Recommended Way To Merge Cells	4x4 or 2x4	4x4 or 2x4
Spatial dimension effective pixel number	512 or 1024	512 or 1024
Spectral band number	272 or 544	512 or 1024
Angle of view (FOV)	15.2°@f=35mm	15.2°@f=35mm
Instantaneous Field of view (IFOV)	0.7mrad@f=35mm	0.7mrad@f=35mm
Maximum frame frequency	340 fps	140 fps
Size	306 mm x 300 mm x 162mm	306 mm x 300 mm x 162mm
Weight	小于 5.5 Kg	小于 5.5 Kg
Operating temperature	-10 - 50°C	-10 - 50°C
Storage temperature	-30-70°C	-30-70°C
Number of spectral channels	≥1024 (2x pixel merge mode)	≥1024 (2x pixel merge mode)
The number of spatial channels	≥ 512(2x pixel merge mode)	≥1024 (2x pixel merge mode)

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Scanning method	External push-sweep measurement
Data acquisition software	Flexible setting of exposure time, dynamic display of real-time hyperspectral image and spectral curve
Data analysis software	Without third-party software, it can obtain cluster analysis, single band, true and false color, more than 20 kinds of vegetation index (can be customized), three-dimensional image cropping, target spectrum recognition and other images with one click. All the above functions can realize unattended batch processing
software display	Dynamic real-time display of hyperspectral image, scientific light and dark focus, avoid human visual focusing error
Hyperspectral camera communication	USB3.0
Lighting source	High stability constant power high blue light surface source High stability constant power high blue light linear light source, through the optical mirror group to compress and stretch the point light source, improve the energy utilization rate
Line light source length (optional)	≥220mm@400mm
Line light source width (optional)	≤30mm@400mm
Service life (optional)	≥2000h

1.ATH3010 Image

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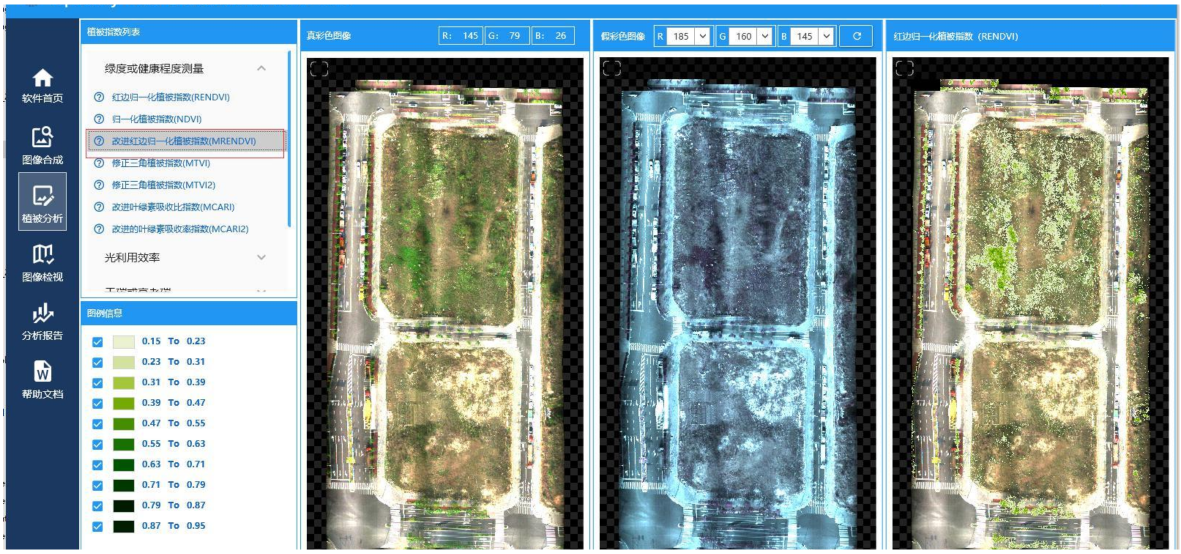
Last Generation of Rotary Scanning Imaging Spectrometers



ATH3010 software interface

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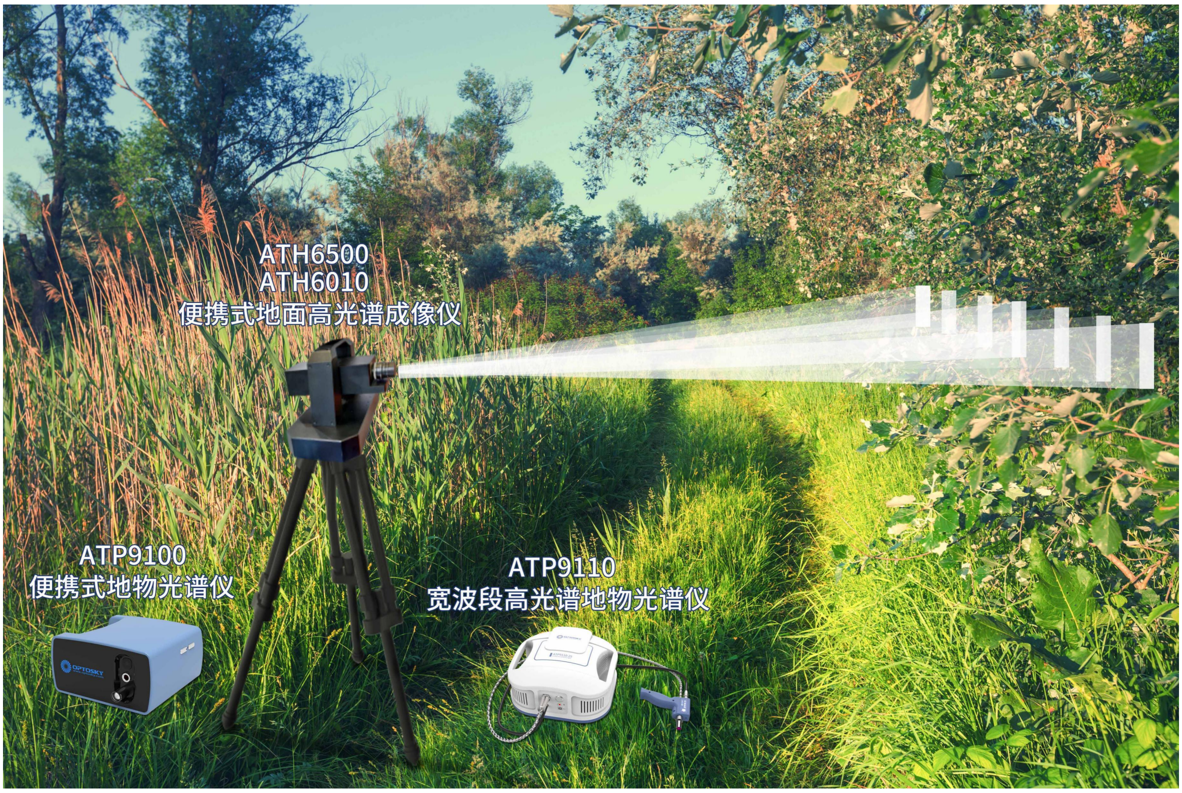
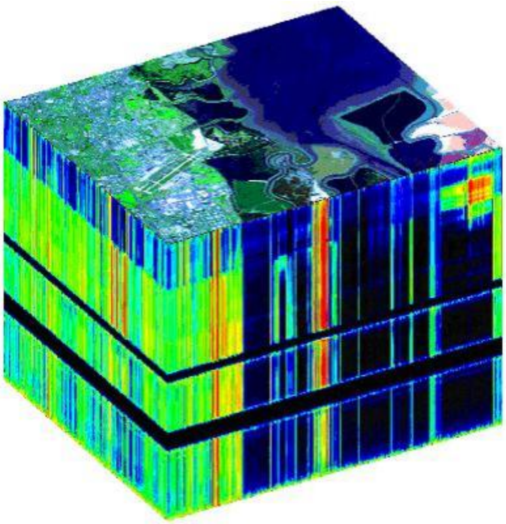
2. Application Scenarios



The use of hyperspectral imager and ground feature spectrometer

3. Application



Data cube captured

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Drone experiment

Outdoor experiment scene I

Outdoor experiment scene II

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Outdoor experiment scene III

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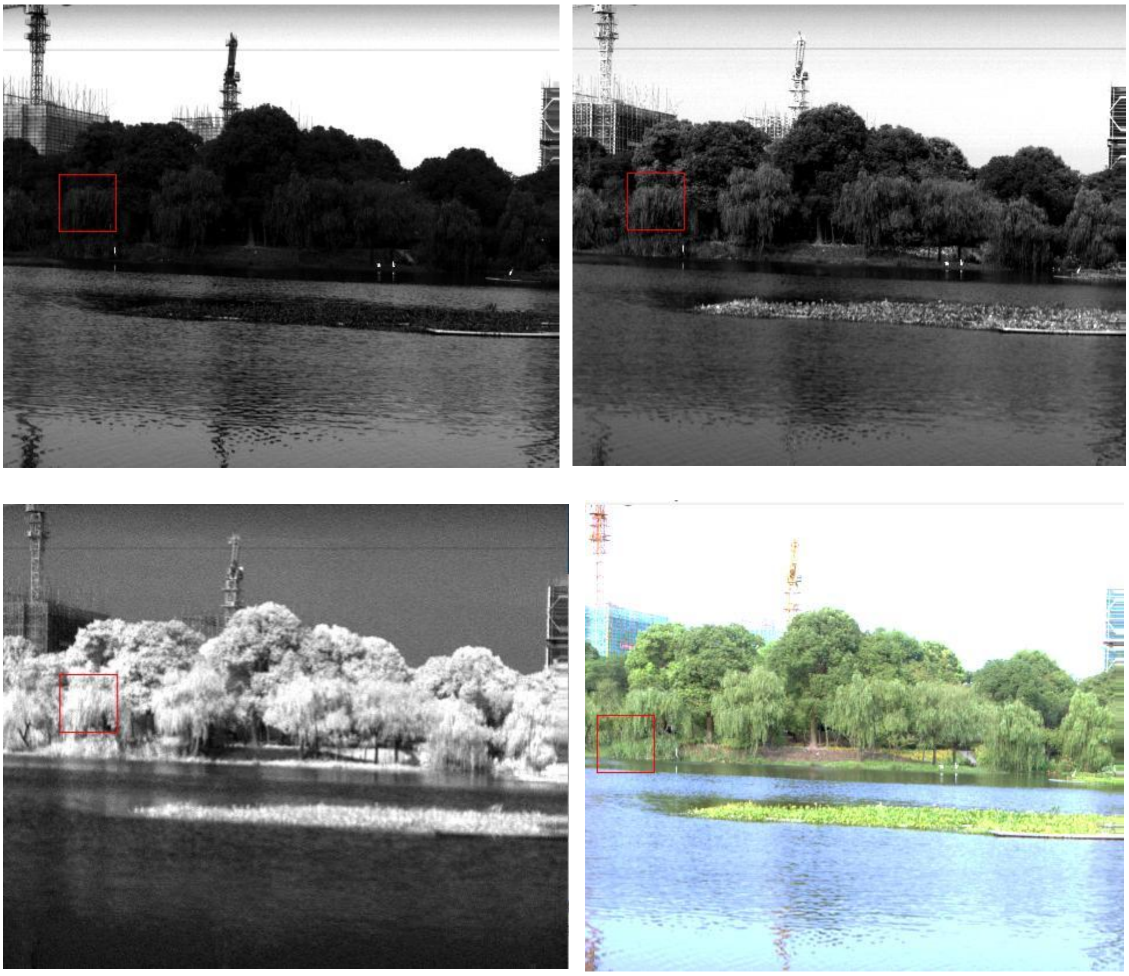
Outdoor experiment scene IV

Outdoor experiment sceneV

2.1. Field vegetation test with portable ground hyperspectral imager

We use portable ground hyperspectral imager to collect spectral data for field vegetation, tower crane and land features, and perform spectral display, comparison and analysis based on single band image and color image. Through the single band image, it is known that all kinds of ground objects have obvious differences in different bands, and the difference before different objects can be observed by mapping to the spectral curve. The following are the final obtained spectral curve comparison diagram, single band image and color image:



Field hyperspectral test imaging; (a) Band 50 images; (b) Band 100 images (c) Band 200 images; (d)RGB composite image

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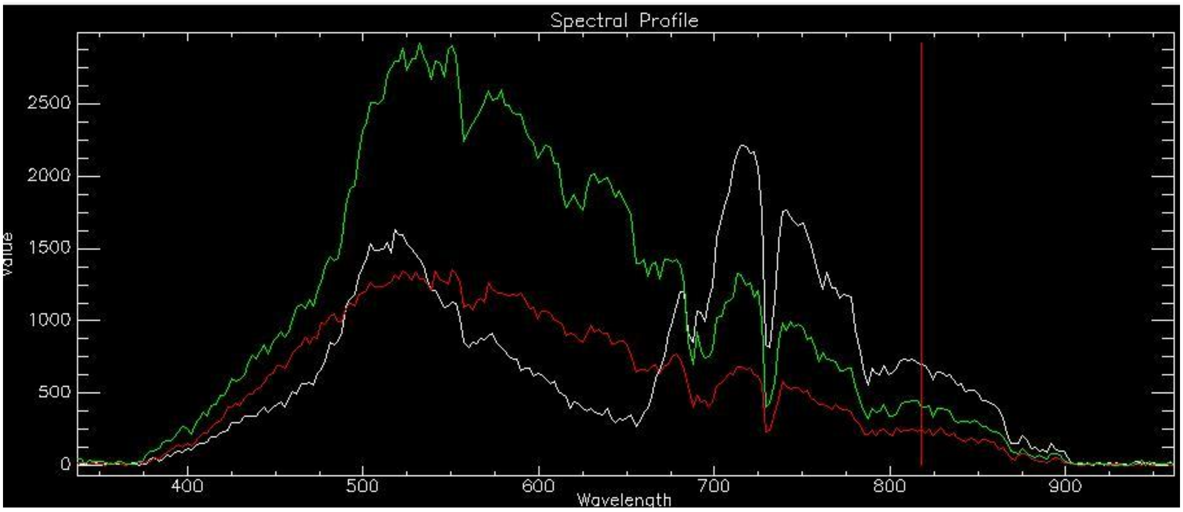
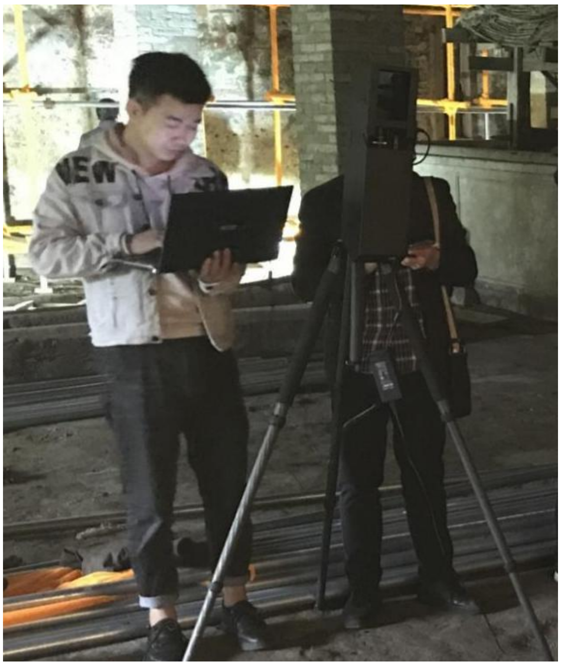


Comparison of spectral curves

2.2. Archaeological murals test with portable ground hyperspectral imager

At present, hyperspectral is very suitable for the spectral image recording of antiques, murals, oil paintings and archaeological sites because of its characteristic of "fingerprint spectrum" that can capture materials. The following figure shows the hyperspectral imager test of ancient murals in a local temple in Sichuan Province and the final spectral band data.

Our company relies on hyperspectral image analysis to completely and truly restore the state of color and mural painting, solve the problems of fading, covered areas, damage and other aspects, providing new clues for the study of all aspects of the painting, but also provide an important basis for cultural relic restoration, cultural relic identification and cultural relic protection.



Real survey map

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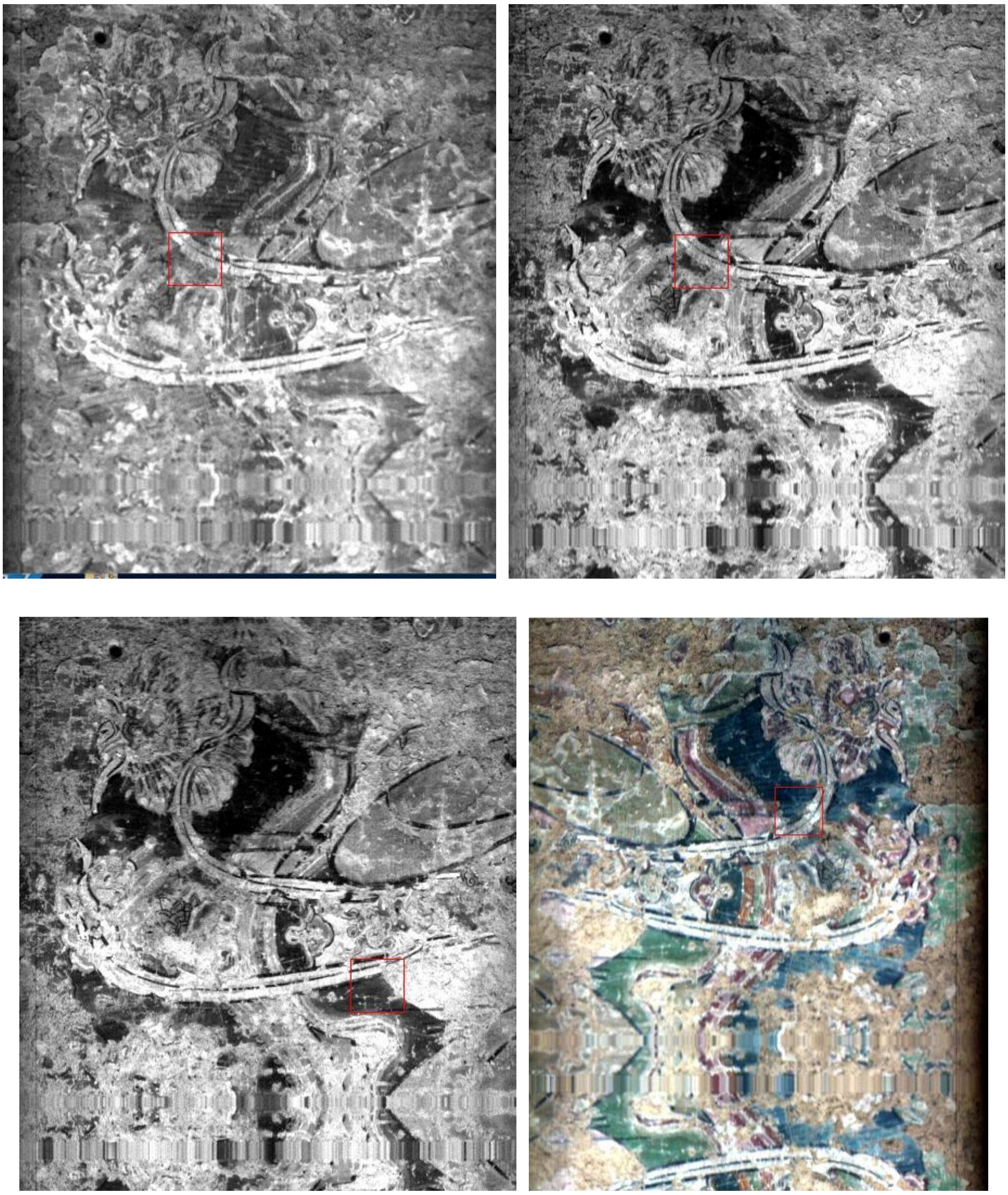

Hyperspectral imaging of archaeological murals; (a) Band 50 images; (b) Band 150 images; (c) Images of band 200; (d)RGB composite image

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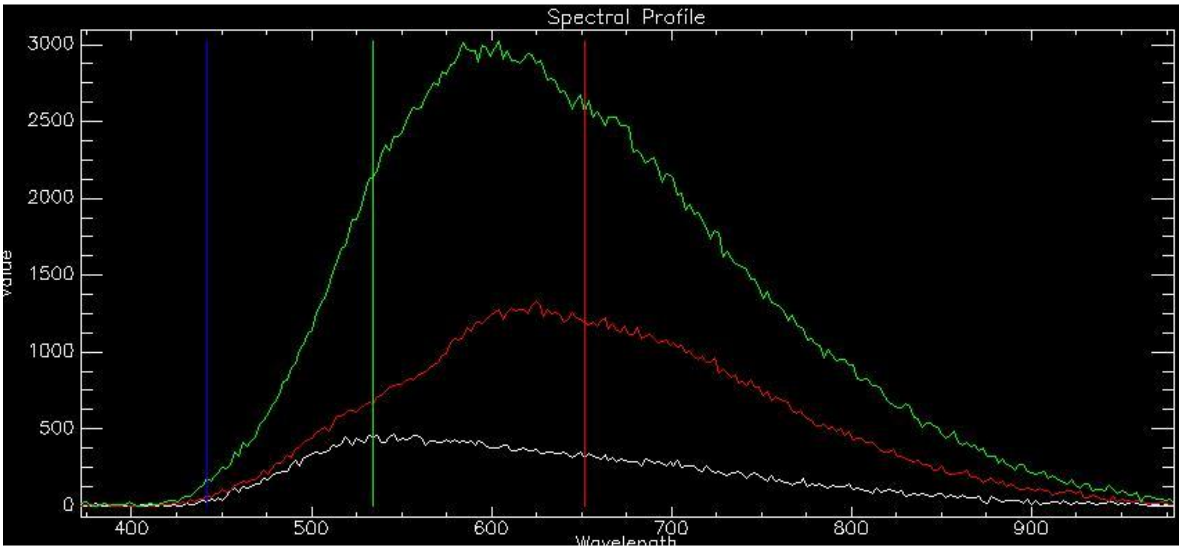

Comparison of spectral images

2.3. Application of hyperspectral imager in maize drought identification and classification

Maize is one of the most important food crops in the world and the first food crop in China. Northern China is the main corn producing area. Due to the changes of temperature and precipitation distribution, drought has become an important factor affecting corn yield in these areas. With the continuous improvement of agricultural fine management requirements, it is of great significance to accurately and efficiently identify maize drought grade.

Traditional crop drought identification methods mainly use satellite multi-spectral remote sensing images to calculate vegetation index to obtain drought conditions. However, limited by weather, transit time and low spatial resolution, satellite images are not satisfactory in terms of timeliness and accuracy. With the development of UAV technology, it has become possible to obtain ultra-high resolution remote sensing images conveniently and flexibly, which has provided a new way to solve many agricultural problems in recent years. With the development of deep neural networks, the proposed full convolutional neural networks further improve the accuracy of remote sensing image semantic segmentation task.Using the ATP9000 UAV hyperspectral imager produced by Optosky (now renamed ATH9010), Liu Chang from Jilin University designed and implemented a deep learning semantic segmentation method for maize drought identification and classification.

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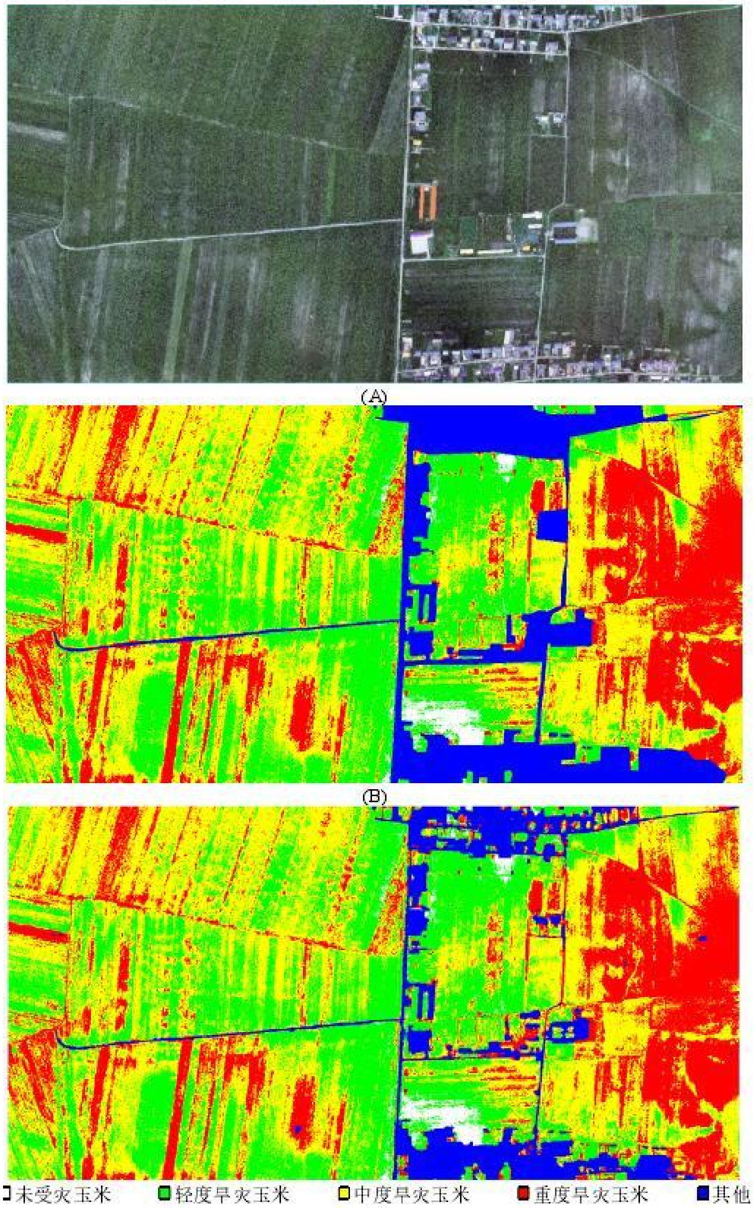


Liu Chang of Jilin University applied hyperspectral imager to study the classification of maize drought, and adopted the ATP9000 UAV hyperspectral imager produced by Optosky (now renamed ATH9010). Using different algorithms, the UAV hyperspectral imager can also investigate more complex types of disasters, such as waterlogging, insects and hail, which will also cause crop loss and economic losses.

2.4. Application of hyperspectral imager in industrial sorting

With the development of NIR hyperspectral technology, JIANG et al. tried to use NIR hyperspectral technology to detect impurities in cotton, especially the application of short-wave NIR hyperspectral technology, which significantly improved the detection rate of plastic film compared with conventional methods. Hyperspectral imaging technology is an image data technology based on very many narrow bands. The image information and spectral information of samples can be obtained at the same time of sample imaging. Common hyperspectral data processing methods include Partial least squares (PLS), Support vector machine (SVM) and Artificial neural network (Artificial neural network). ANN).

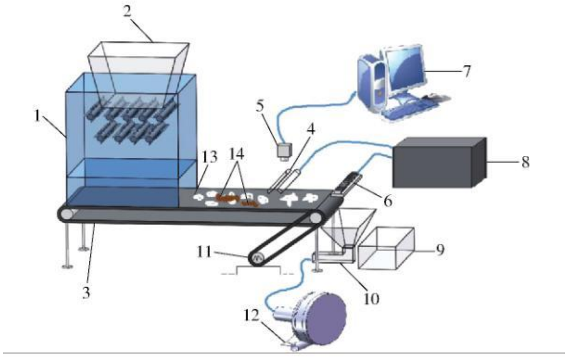
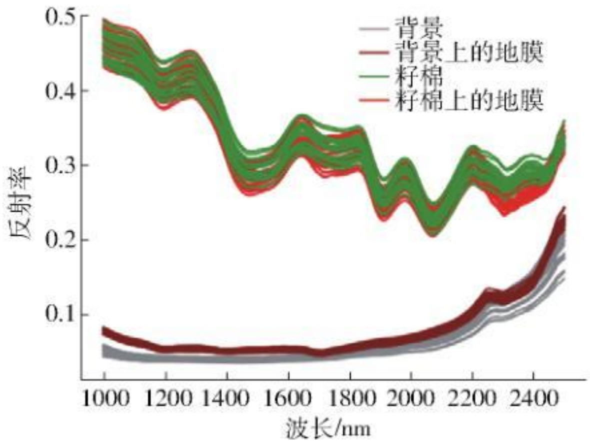


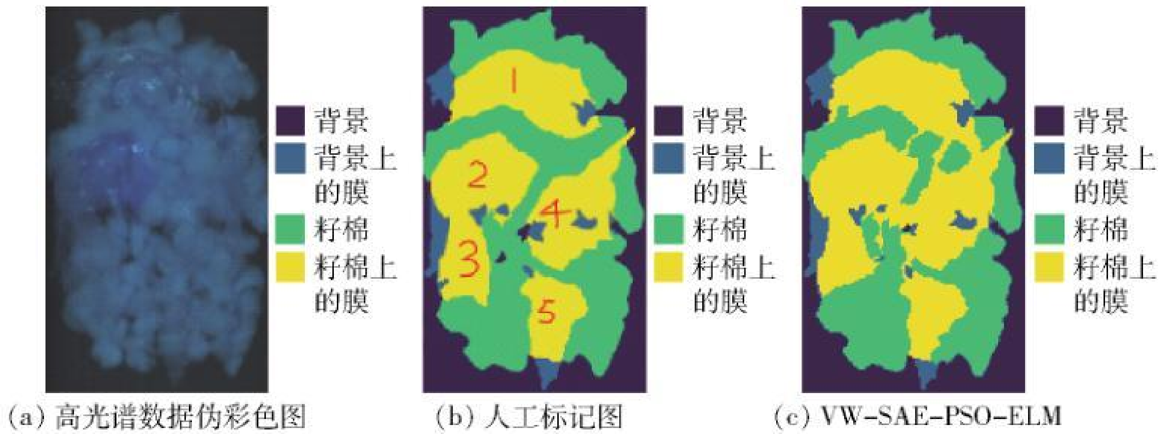
图 2 籽棉地膜分选系统示意图

Fig. 2 Schematic of film sorting system of seed cotton

1. 配棉箱 2. 进棉口 3. 输送带 4. 穹顶卤素灯 5. 高光谱相机 6. 高速喷阀 7. 工控机 8. 驱动箱 9. 籽棉收集箱 10. 废料收集箱 11. 伺服电机与编码器 12. 风机 13. 籽棉 14. 地膜



Application of hyperspectral imager in seed cotton sorting; (a) Functional composition of the system; (b) Reflection spectral curves of different substances



Application of hyperspectral imager in seed cotton sorting; (a) Manual marking; (b) Recognition results of hyperspectral imager

The external quality of apple is the most intuitive quality feature of apple, which directly affects the price of apple and consumer preference. In view of the difficulties and key points of apple appearance detection, based on machine vision technology, hyperspectral imaging technology and multi-spectral imaging technology, integrated image processing technology, pattern recognition method, stoichiometry method and spectral analysis technology, the physical quality (shape and size) of apple appearance and surface defects detection methods were studied. The detection system and algorithm developed on the basis of the above research provide the basis for the development of Apple external quality rapid online detection and classification equipment based on machine vision technology and multi-spectral machine vision technology.

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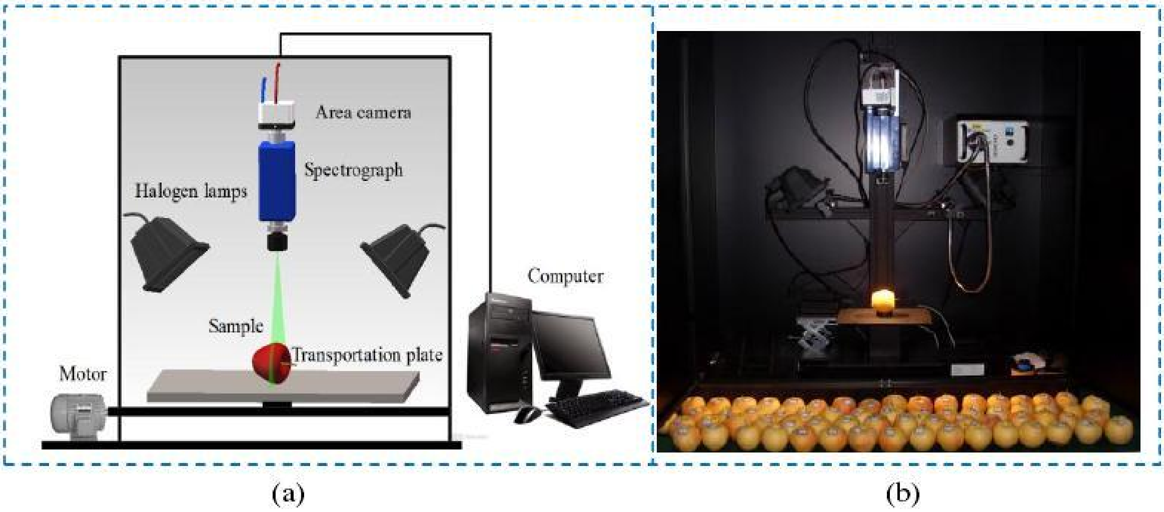
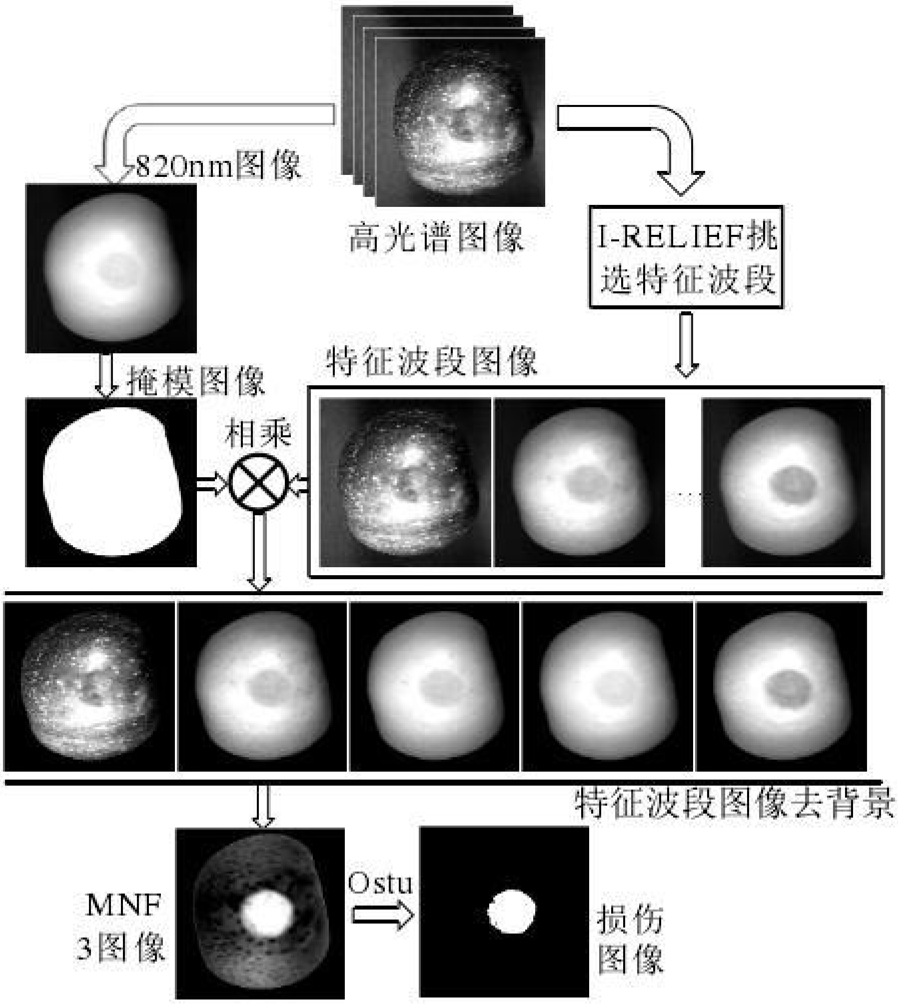


The schematic diagram and physical diagram of hyperspectral imaging system developed by Dr. Zhang Baohua of Shanghai Jiao Tong University; (a) Schematic diagram; (b) Physical picture



Flow chart of Apple surface early damage detection algorithm

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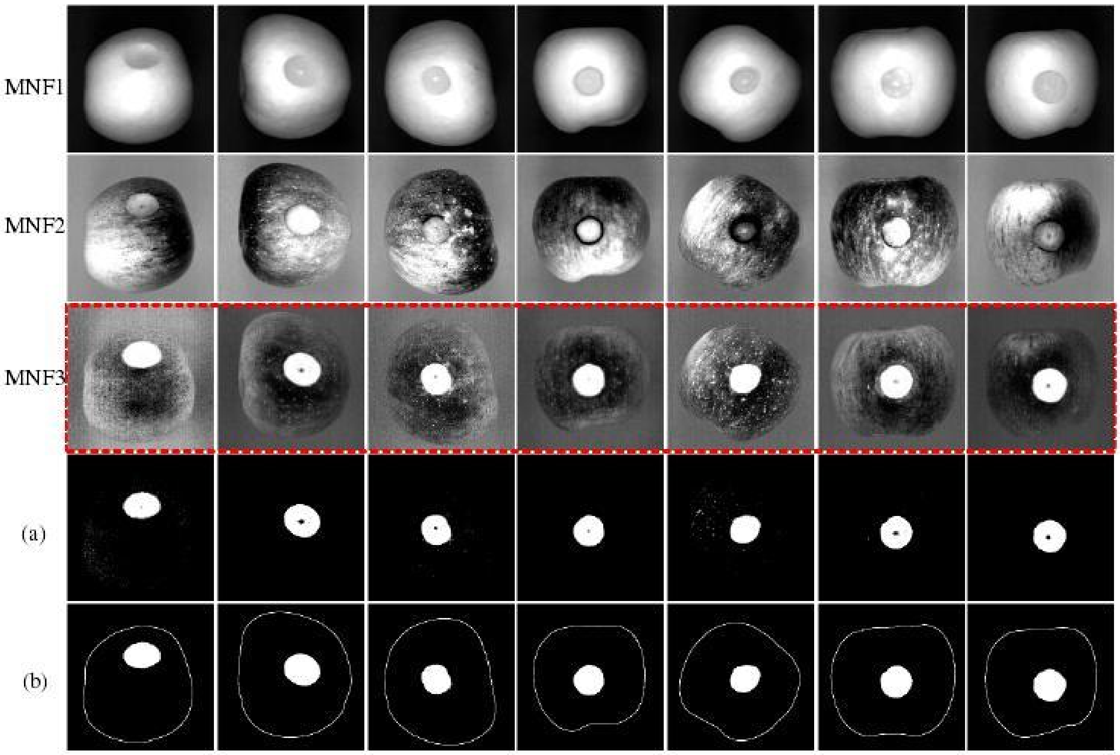
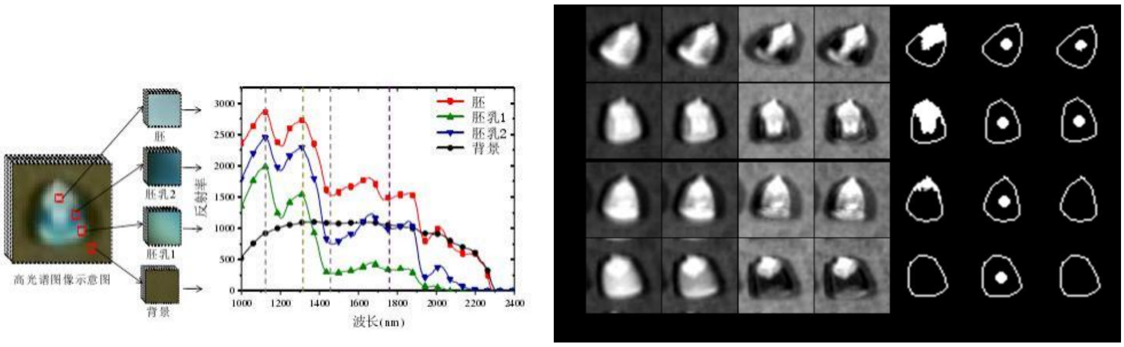
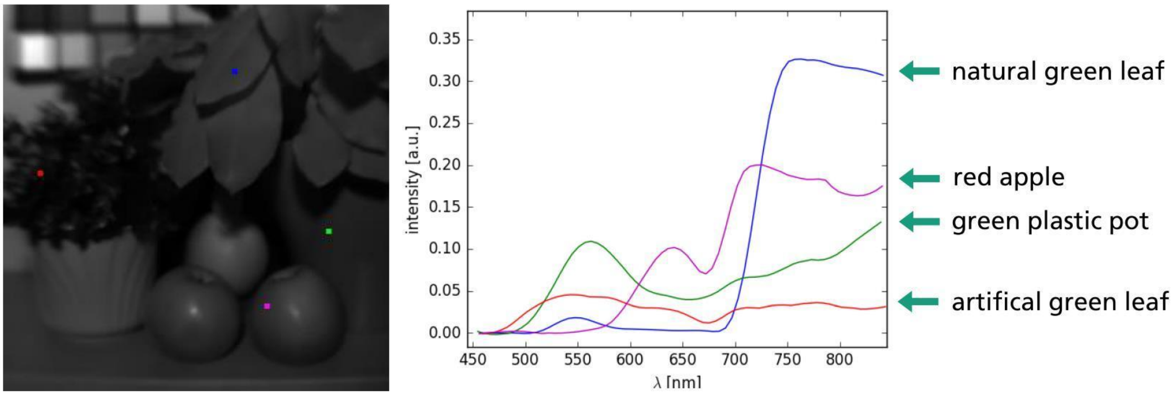


Identification results of early decomposition of some apples and intermediate processing (a) decomposition segmentation results (b) final results



Application of 1000-2500 nm Hyperspectral Imager in Seed Separation of Maize (Dr. Chaopeng Wang, Northwest A&F University)



Natural green plants, artificial green leaves, green plastic, red apple spectrum

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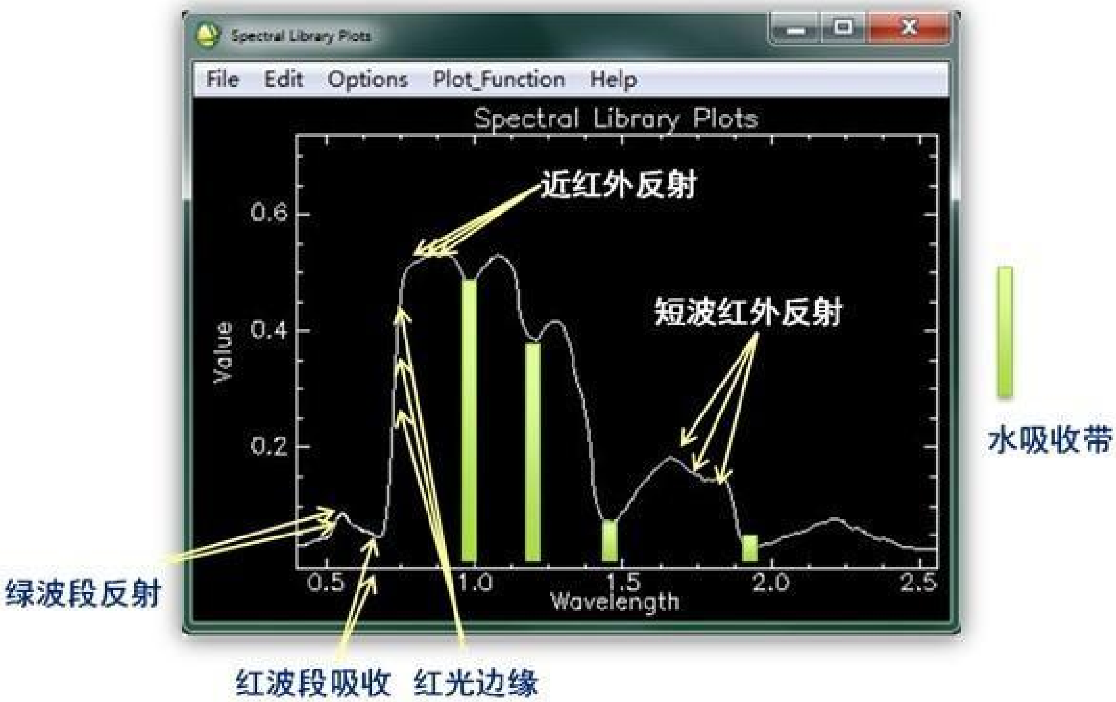
2.5. Application of hyperspectral imaging technology in precision agriculture

Uavs hyperspectral remote sensing system



Hyperspectral imager to measure the spectrum of green plants

Crop growth monitoring and yield prediction: Due to the different external factors, the internal composition and external morphology of crops will vary in each stage of their growth and development. The most important difference is leaf area index. Leaf area index (LAI) is a comprehensive index

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reflecting individual and population characteristics of crop growth.

Crop disease and pest control: Remote sensing technology can monitor the impact of diseases and pests on the growth and development of crops, track the growth and development of crops, analyze and estimate disaster losses, and monitor the distribution and activity habits of pests, so as to prevent the occurrence of pests.

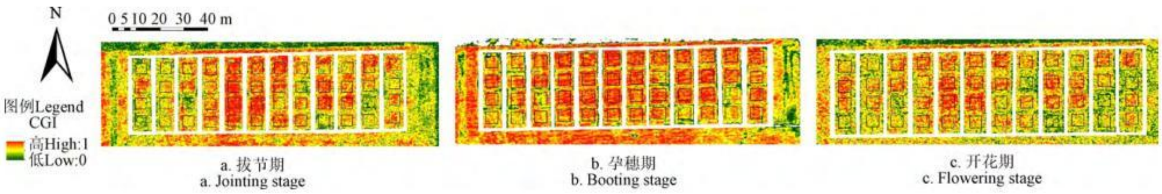
Crop drought monitoring: Remote sensing technology is used to monitor crop drought through crop vegetation index and canopy parameters.

Soil moisture content and distribution monitoring: under different conditions of thermal inertia, the difference between remote sensing spectra is very obvious. Therefore, a mathematical model between thermal inertia and soil moisture content can be established to analyze soil moisture content and distribution by remote sensing technology

Crop nutrient monitoring: The accuracy of nitrogen content in crops monitored by remote sensing technology is higher than that of other nutrient content

normalized difference spectral index (NDSI) was established using single band and any two bands in the range of 450-882 nm. ratio spectral index (NDSI), RSI) and simple spectral index (SSI), and calculated the correlation between CGI and

A partial least squares regression (PLSR) model was established based on partial least squares regression (PLSR). Using CGI as index, hyperspectral image of unmanned aerial vehicle was used to monitor the growth of wheat in 2015. Uav hyperspectral image inversion CGI accuracy is higher, can determine the overall growth difference of wheat, can provide a reference for monitoring wheat growth.

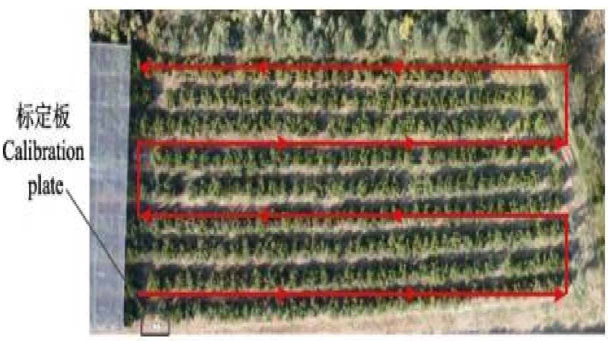


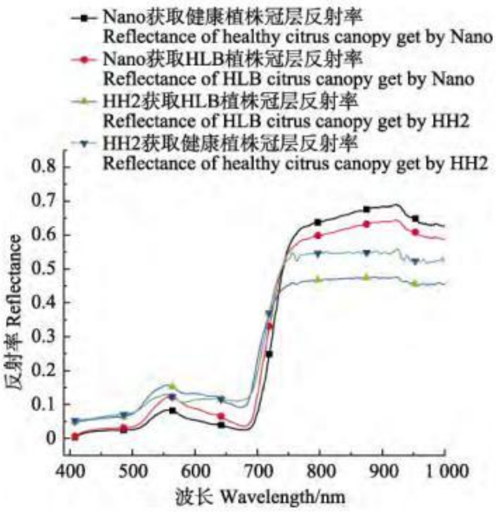
CGI inversion of wheat growth index

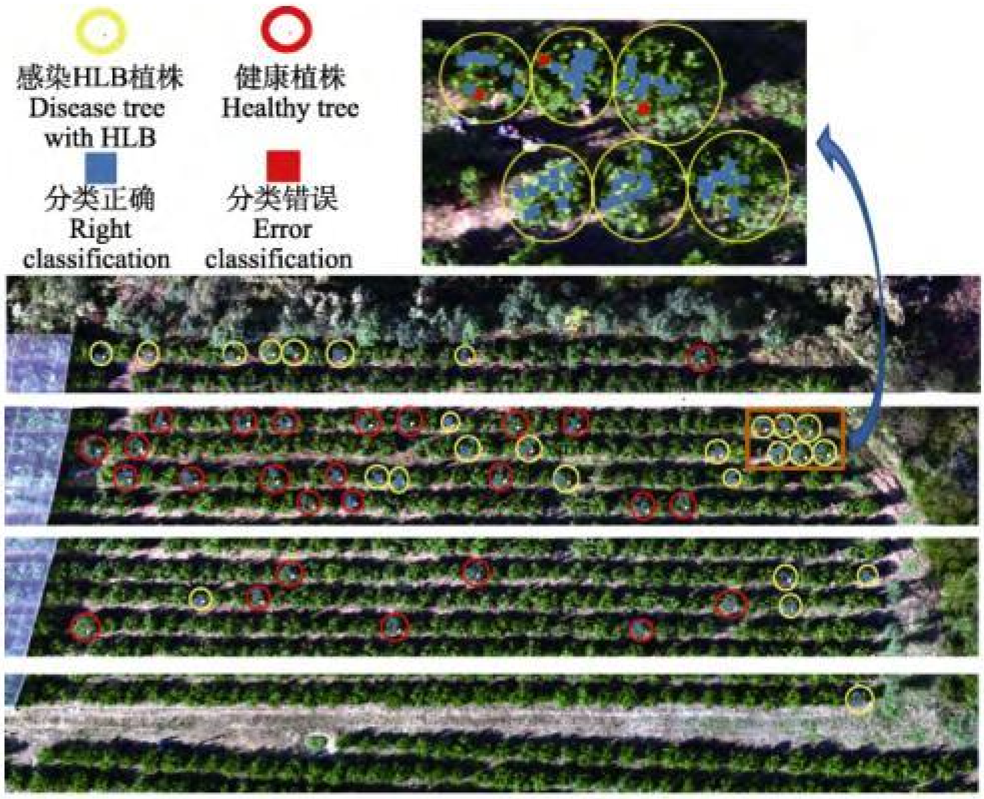
2.6. Application of forest health status

For pest monitoring, forest resource assessment

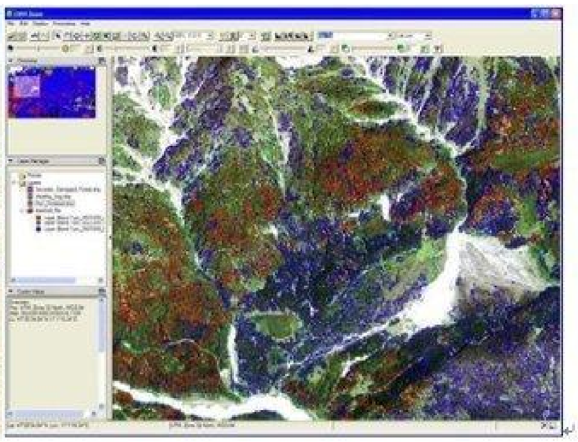
Principles: Vegetation health status is related to greenness index, leaf area index, leaf water content and light use efficiency.







Monitoring and Classification of Citrus Greening based on UAV Hyperspectral Remote Sensing (LAN Yubin et al., South China Agricultural University)



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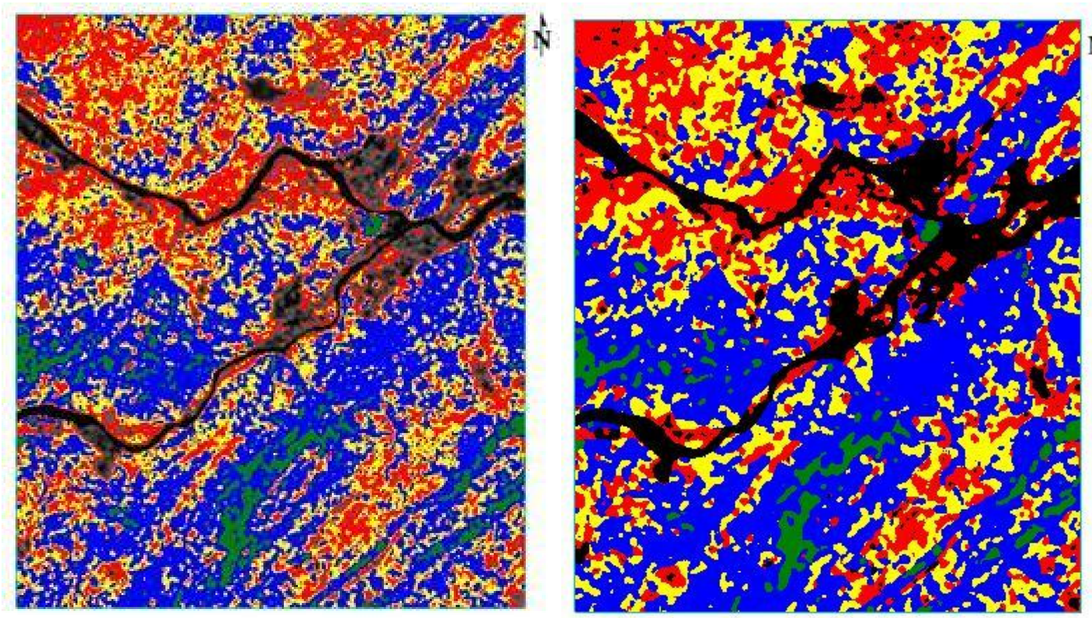

Health distribution map of Masson pine studied by Wang Shuang with hyperspectral imager from University of Electronic Science and Technology of China

2.7. Application of hyperspectral imager in geological exploration

Spectral remote sensing technology evolved from the multi-spectral remote sensing technology represented by Landsat, and took initial shape in the mid-1980s (Goets et al., 1985, Tong Qingxi et al., 2006). Due to its advantages of high spectral resolution and combination of atlas, hyperspectral remote sensing technology has the ability of fine detection and analysis of surface rock and mineral composition on a large spatial scale. It can not only provide macro images of the ground, but also determine the type and abundance of minerals and even the chemical composition of some minerals in the geological body in pixel level details (Wang Runsheng et al., 2010). In recent years, with the continuous development of hardware and data processing methods and software related to imaging spectrometers, the application of hyperspectral remote sensing technology in the field of geological survey has been accelerated. Hyperspectral remote sensing technology has played an important role in geological mapping, the definition and division of hydrothermal alteration zones, and the delineation and discrimination of mineralized abnormal areas from large metallogenic areas to medium-sized ore fields (e.g., Bierwirth et al., 2002; Lian Chang Yun et al., 2005; Kruse et al., 2006; Cudahy et al., 2007; Wang Runsheng et al., 2010; Liu Dechang et al., 2011; Yan Baikun et al., 2014; Yang Zian et al., 2015; Graham et al., 2017). As the theory of metallogenic systems (Wyborn et al., 1994) becomes more and more the guiding principle of prospecting practice, thematic mineral mapping of large ore clusters and metallogenic belt scales will provide key regional material composition information for predictive prospecting.

The spectral wavelength ranges used for mineral mapping include visible (400~700nm), near-infrared (700~1000nm), short-wave infrared (1000~2500nm), and thermal infrared (7000~15000nm). At present, the most widely used mining is the short-wave infrared region (1000-2500nm). Minerals containing water or OH- (mainly phyllosilicates and clays) as well as some sulfate and carbonate minerals can be observed in the short-wave infrared wavelength range due to their close proximity to the co-frequency and combined frequency of the chemical bond vibrations in mineral lattices.

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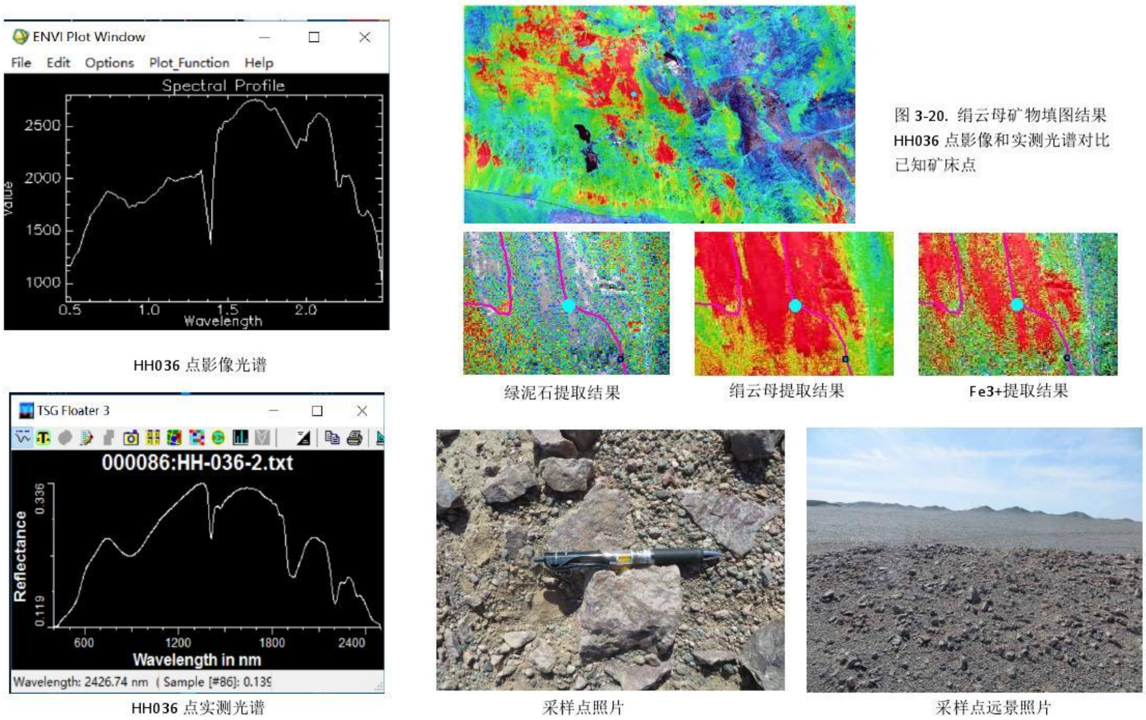

图 3-20. 绢云母矿物填图结果
HH036 点影像和实测光谱对比
已知矿床点

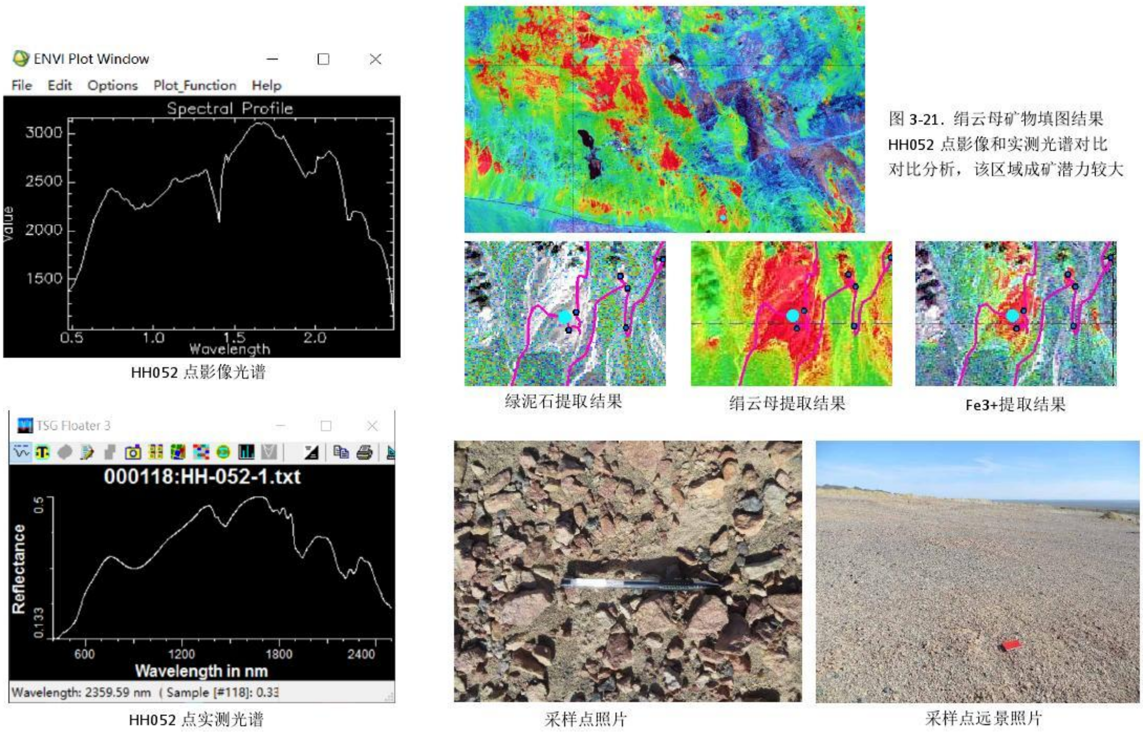

图 3-21. 绢云母矿物填图结果
HH052 点影像和实测光谱对比
对比分析，该区域成矿潜力较大

Application of hyperspectral imager in prospecting

Soil salinization is one of the important ecological and environmental problems in arid and semi-arid areas. Soil compaction, fertility decline, acid-base imbalance and land degradation caused by soil salinization seriously restrict the development of Chinese agriculture and affect the strategic situation of sustainable development. Remote sensing technology is characterized by large scale, wide range, strong timeliness and strong economy, which makes up for the deficiency of traditional

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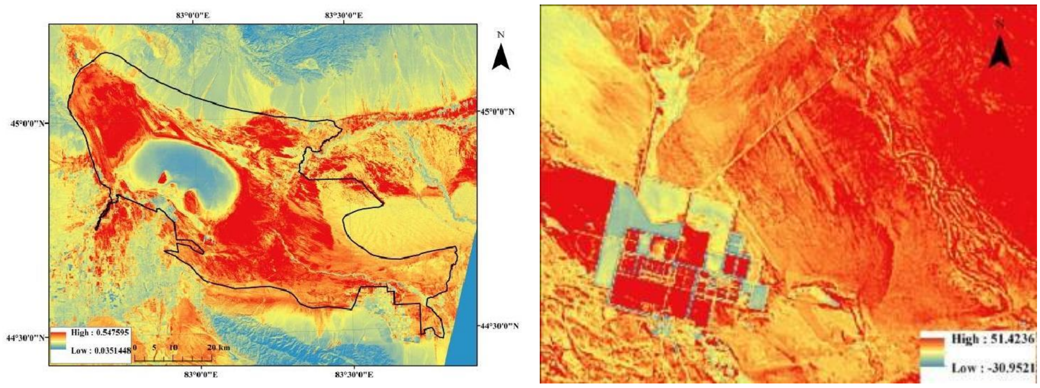
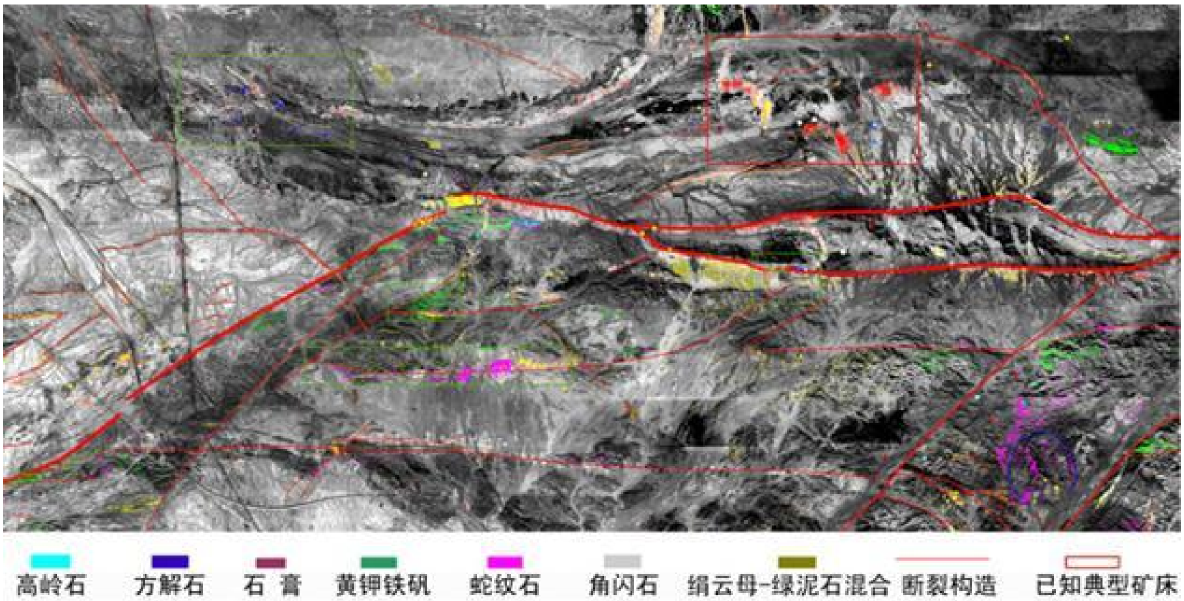
monitoring methods of salinization and provides a new way for quantitative monitoring of soil salinization



The area around a salt farm



Survey drawing of a mine

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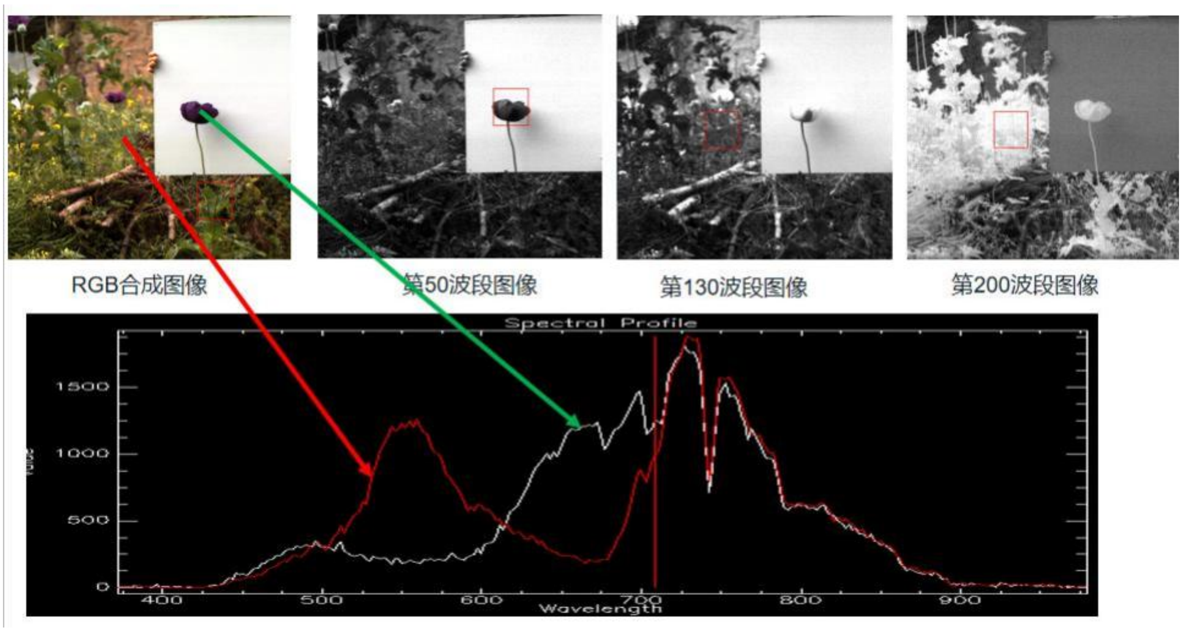
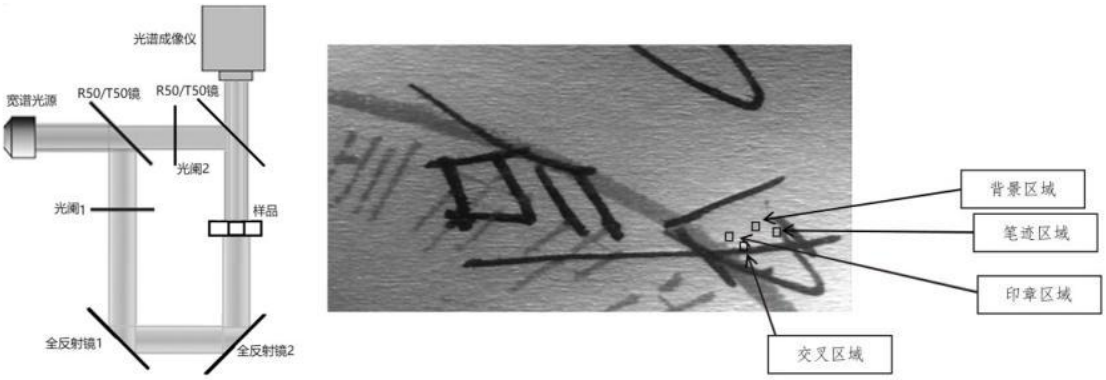
2.8. Hyperspectral applications to public safety



Application of hyperspectral imagers in the search for illicit poppy cultivation



The application of hyperspectral imager in textual information

2.9. Spectral applications for medical microscopic imaging

Application objective: Online detection and navigation in tumor surgery

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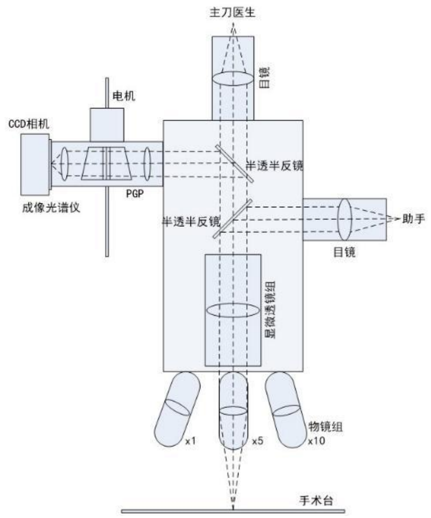

Schematic diagram of optical path of medical microscopic imaging spectrometer

The figure shows the schematic diagram of the medical microscopic imaging spectrometer. The target to be measured on the operating table is divided into three ways after passing through the objective lens and the microscopic lens group, one way for the surgeon to make visual observation, the other way for the assistant to assist visual observation, and the other way for the imaging spectrometer to detect and receive. The imaging spectrometer is driven by a motor to conduct spatial dimensional scanning of the target to obtain the imaging spectral information of the target to be measured. After data analysis and image processing, the monitor is displayed to the doctor.

Physical picture of medical microscopic imaging spectrometer

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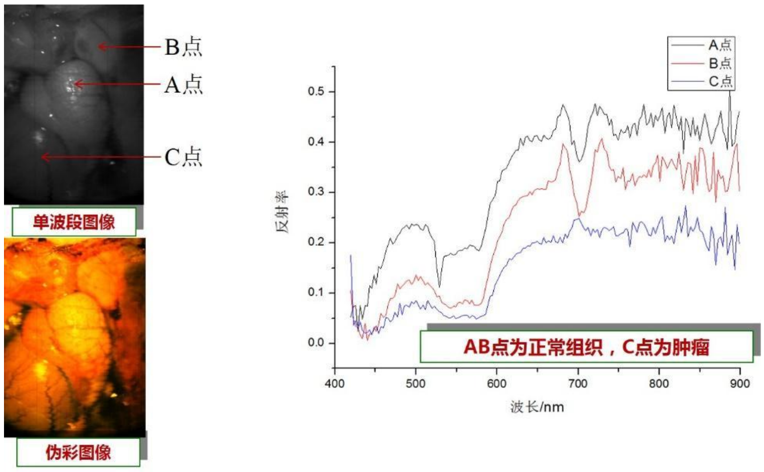


Medical microscopic imaging spectrometer data

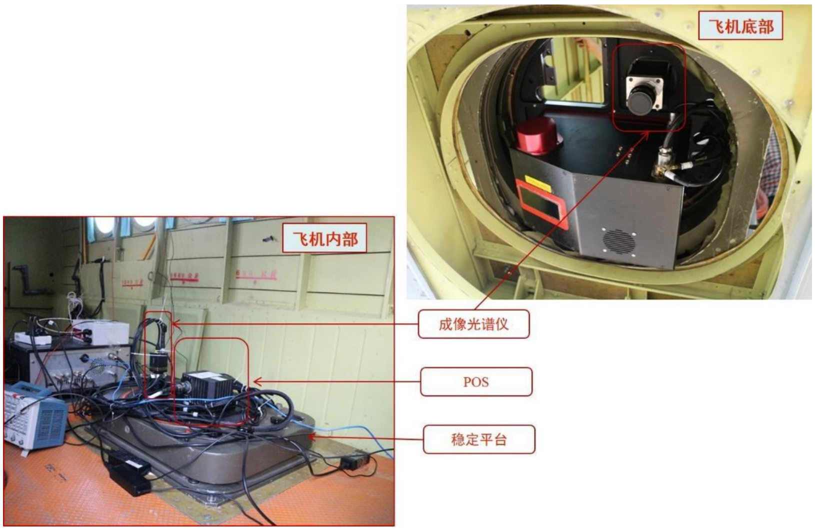
2.10. Airborne imaging spectral applications

Uav hyperspectral imaging system

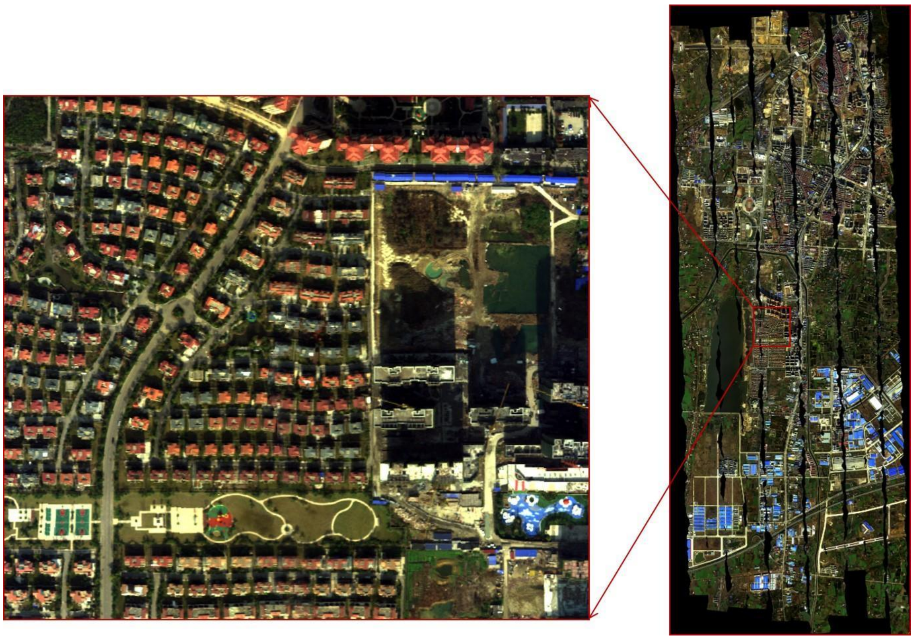
Application target: airborne remote sensing

Application description: The picture shows an airborne imaging spectrometer, which consists of a hyperspectral imager, a stabilization platform and a POS module.

The figure shown is the pseudo-color image after geometric correction, band splicing and radiation correction of acquired data



Airborne remote sensing application



Airborne application data - false-color images

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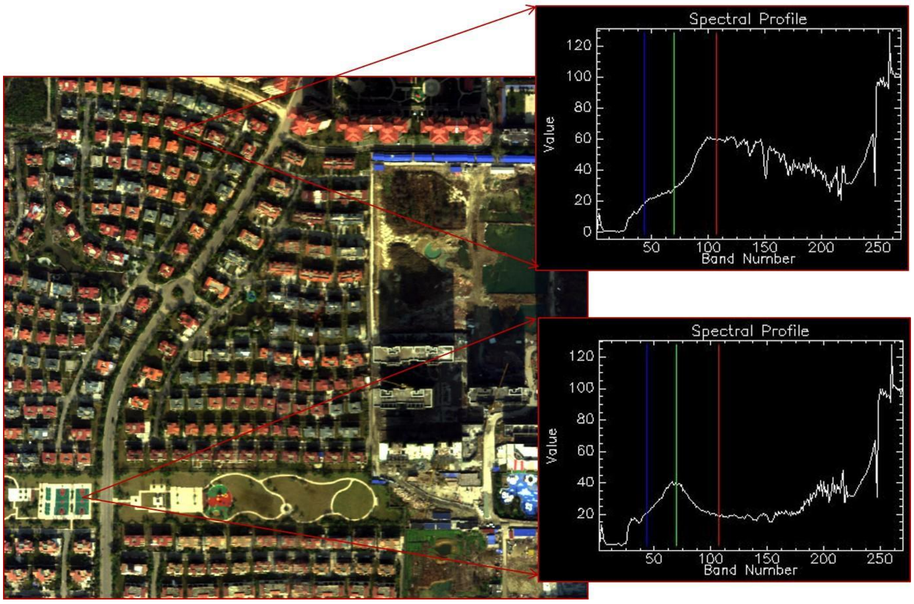
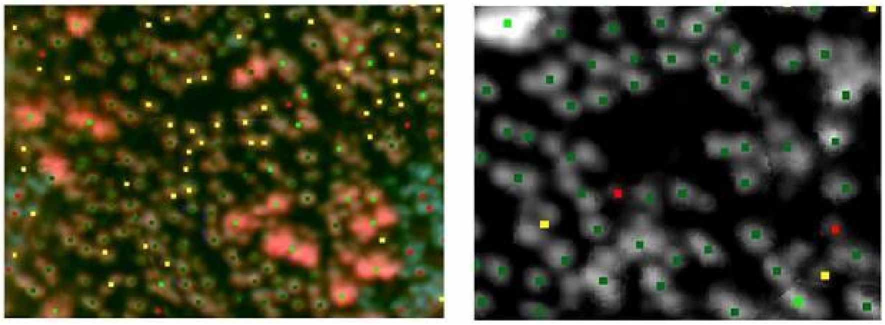


Airborne application data - Spectral curves



Forest remote sensing, airborne hyperspectral observation of forest pests and diseases

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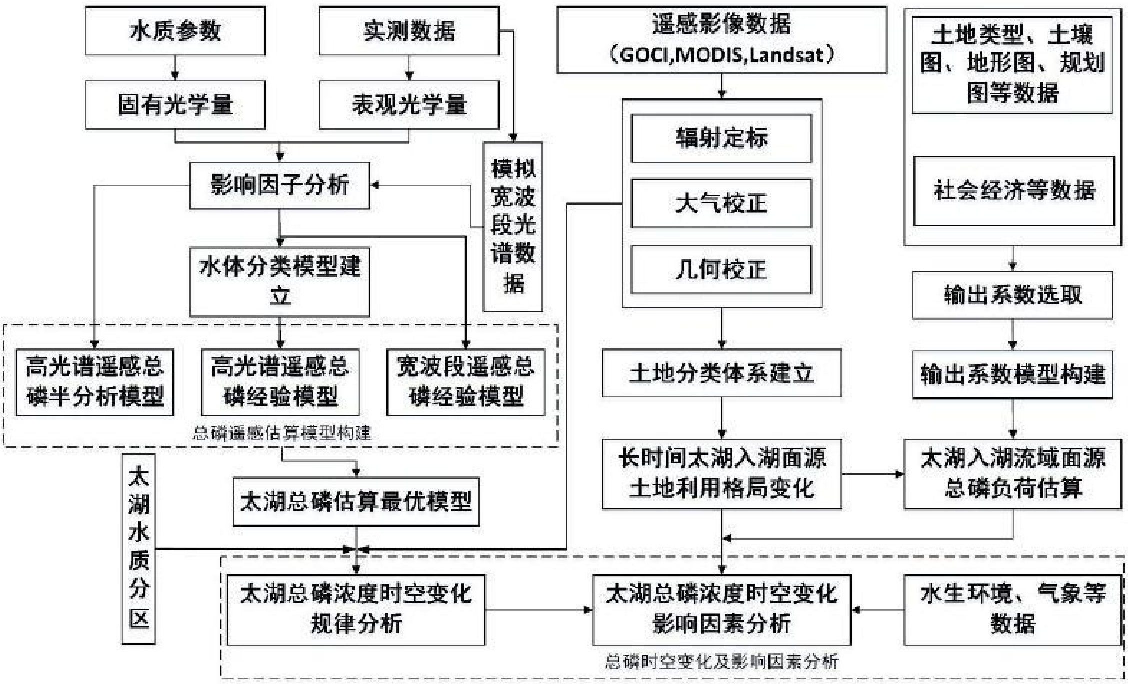
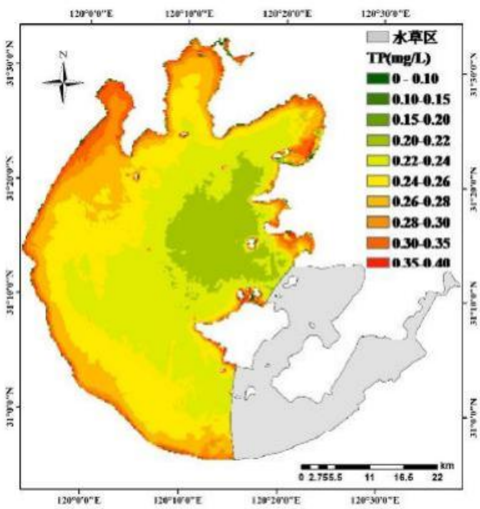
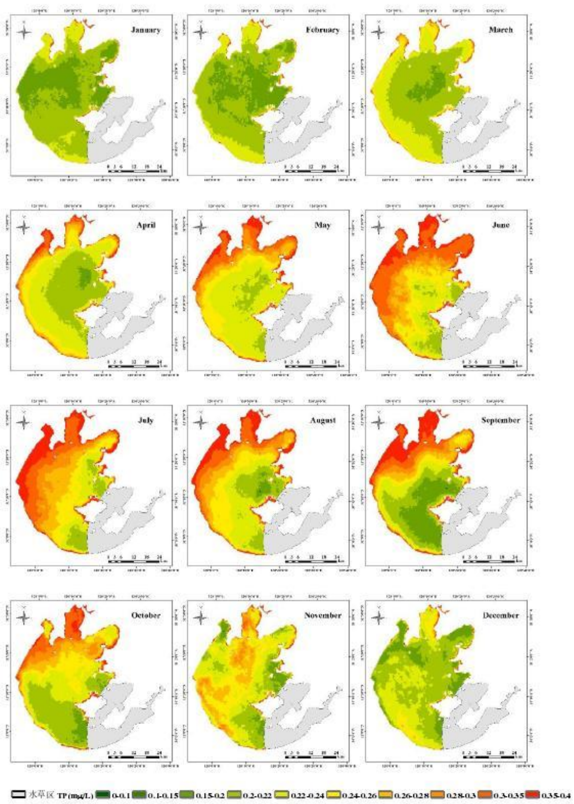
2.11. Application of hyperspectral imager in water quality and environmental protection



Inversion algorithm flow of hyperspectral data





Product data information is current as of publication data. Products conform to specifications per the terms of Optosky Standard warranty.

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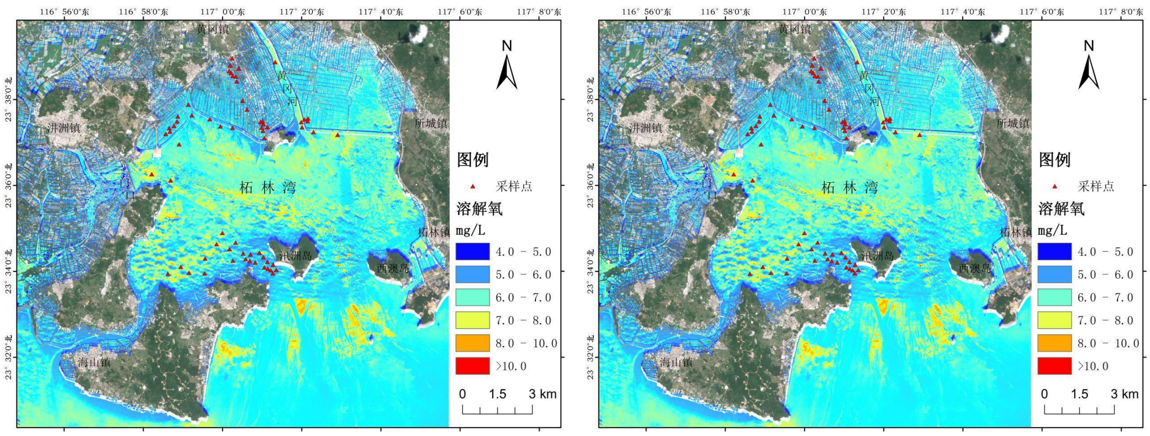
FIG. 44 (a) Spatial distribution of total phosphorus concentration in Taihu Lake. The spatial difference of total phosphorus concentration was obvious, with the highest value being 0.38mg/L and the lowest value being 0.06mg/L. (b) The monthly variation pattern of total phosphorus concentration in different lake areas, and the lake areas basically reached the maximum total phosphorus concentration between June and September. The total P concentration in Zhushan Bay, Meilang Bay and the west bank of Taihu Lake was higher than the average of the whole lake from March to October, and was significantly higher than that in the rest of Taihu Lake. The total P concentration in Gonghu Bay was higher than that in the whole lake only in June, while the total P concentration in the south bank of Taihu Lake and Great Taihu Lake was relatively low throughout the year



Hyperspectral image of dissolved oxygen and chlorophyll concentration distribution in Zhelin Bay, eastern Guangdong