Datasheet

Drone Hyperspectral Imaging System	ATH9500

Features:

- Spectral Range: 400-5300 (Customized)
- Max. Spatial Channels: 2048x2048 (Different by model)
- Max. Spectral Channels: 1088 (Different by model)
- Superior imaging performance
- Compatible with ENVI;
- Weight: <4kg (Different by model)
- Built-in smart calibration white version;
- High-definition VIS camera, capable of image fusion;

Application:

- Geological and mineral resources prospecting;
- Precision agriculture, crop growth and yield evaluation;
- Forest pest monitoring and fire prevention monitoring;
- Coastline and marine environment monitoring;
- Pasture productivity and pasture monitoring;
- Environmental monitoring of lakes and river basins;
- Remote sensing teaching and research;
- Meteorological research;
- Ecological environment protection and mine environment monitoring;
- Water quality testing, soil monitoring;
- Quality inspection of agricultural and livestock products; military, national defense and homeland security; disaster prevention and control;

Description:

ATH9500 is a series of small, light-weight Airborne miniature hyperspectral imaging system, consisting of a six-rotor high-stability UAV, high-stability gimbal, hyperspectral imager, large-capacity storage system, wireless imaging system,

GPS navigation system, ground receiving workstation, ground control system, etc.

The ATH9500 uses high-performance CCD imaging devices with clear imaging and low noise; the internal integration of an original high-compression ratio image compression algorithm greatly improves the storage life, which can reach more than 3 hours, which fully meets the needs of airborne.

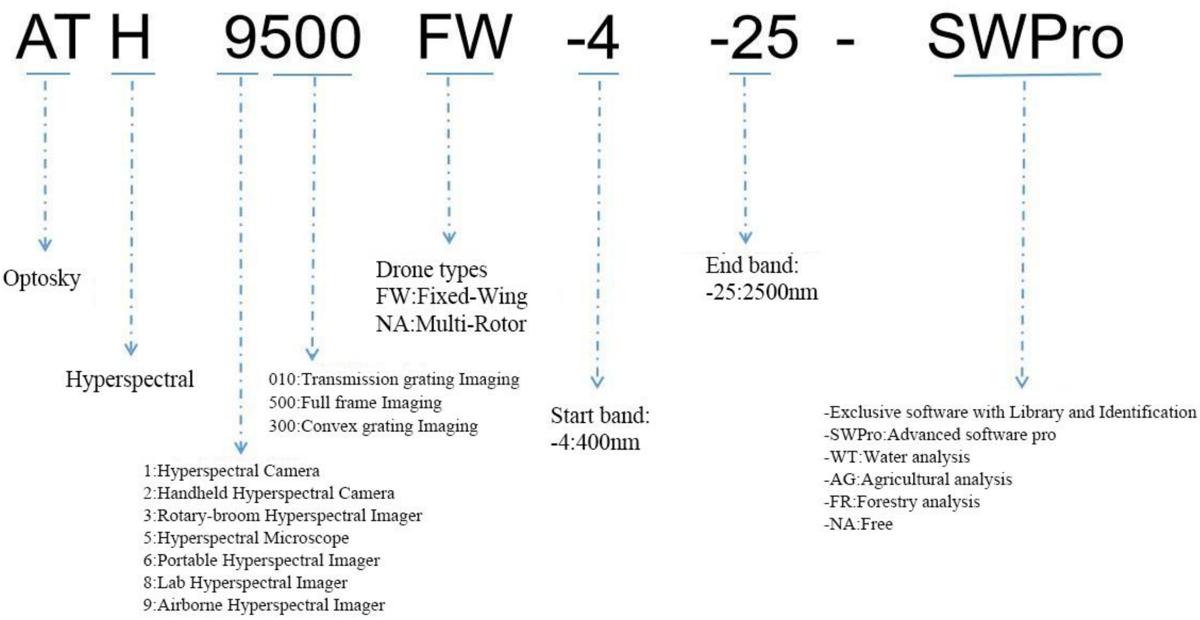
ATH9500 can be used to measure the spectral information of plants, water bodies, soil and other ground objects in real time, and obtain spectral images. By analyzing the spectral images, it can establish relationships with the physical and chemical properties of plants, etc., for plant classification and plant growth status research.

The entire system is compact in design, the mainframe of the imaging spectrometer has high spectral resolution, and at the same time, it adopts an external push-broom imaging method. It can form an independent measurement system with the field rotating platform and the indoor linear scanning platform. It can also be mounted on drones for aerial remote sensing operations.

1. Selection

ATH9500 Series	Feature	Application
ATH9500	Multi-Rotor 400-1000nm VIS-NIR hyperspectral imaging camera	Precision agriculture, agricultural and forestry diseases and pests, vegetation analysis, planting area evaluation, crop yield evaluation, water quality analysis, artwork scanning, cultural relic identification, pattern scanning, industrial sorting, oil pollution detection, etc.
ATH9500FW	Fixed-Wing 400-1000nm VIS-NIR hyperspectral imaging camera	Precision agriculture, agricultural and forestry diseases and pests, vegetation analysis, planting area evaluation, crop yield evaluation, water quality analysis, artwork scanning, cultural relic identification, pattern scanning, industrial sorting, oil pollution detection, etc.
ATH9500-17	1.0-1.7 um SWIR hyperspectral imaging camera	Semiconductor, industrial sorting, food sorting, construction waste sorting, meat sorting, plastic sorting, geological prospecting, mineral exploration, cultural relic identification, judicial identification, document inspection.
ATH9500-25	1.2-2,5 um SWIR hyperspectral imaging camera	Precision agriculture and food analysis, dark plastic sorting, geological prospecting, mineral exploration, national defense and military industry, cultural relic identification, judicial identification, document inspection, moisture content

		analysis, medicine and material sorting, mineral mapping, medical identification, waste recycling.
ATH9500-50	2.5-5.0 um MWIR hyperspectral imaging camera	Geological survey, national defense and military industry, camouflage investigation, mineral sorting.
ATH9500-12-50	1.2-5.0 um SWIR hyperspectral imaging camera	Geological survey, national defense and military industry, camouflage investigation, mineral sorting.
ATH9500-04-17	0.4-1.7 um VIS-NIR hyperspectral imaging camera	Precision agriculture, agricultural and forestry pests and diseases, artwork scanning, cultural relic identification, pattern scanning, industrial sorting, oil pollution detection, etc.
ATH9500-04-25	0.4-2.5 um VIS-NIR hyperspectral imaging camera	Precision agriculture, agricultural and forestry pests and diseases, artwork scanning, cultural relic identification, pattern scanning, industrial sorting, oil pollution detection, etc.



Drone types:

-FW: Fixed-Wing UAVs require much less energy in cruise mode as they capture data. This is thanks to their wings, which encourages a passive lift, so they cover more ground, faster.

-NA: Multi-Rotors use large amounts of energy just to stay aloft, so they move slower when capturing imagery and are unable to fly for long durations


ATH9500(Multi-Rotor) ATH9500(Fixed-Wing)

2. Principle

The ATH9500 Airborne hyperspectral imaging analysis system consists of a six-rotor high-stability UAV , a high-stability gimbal, a hyperspectral imager, a large-capacity storage system, a wireless imaging system, a GPS navigation system, Ground receiving workstation, ground control system, etc.

Figure 1 Airbrone hyperspectral imaging remote system function diagram

3. Specification

Items	Specification			
	ATH9500	**ATH9500-17**	**ATH9500-25**	**ATH9500-50**
Hyperspectral Imaging				
Spectral Range	400-1000nm	1000-1700nm	1.2-2.5um	2.5-5.0um
Detector	CCD	InGaAs SWIR Detector	Deep Cooling IR Detector	Deep Cooling IR Detector
Max. Spatial Channels	2048	640	640	640
Max. Spectra Channels	1088	512	512	512
Data Quantification Class	12bits	14bits	14bits	14bits

Max Frame Rate	330fps	240fps	80fps	80fps
Scan range	0-280mm	0-280mm	0-280mm	0-280mm
Reflectance calibration board	50%	50%	50%	50%
RAM	500GB, SD cord	500GB, SD cord	500GB, SD cord	500GB, SD cord
Power Supply Type	12V±10%, 5W			
Power support	4 hours			
Weight	400g	520g	1800g	1800g
Airborne System				
Flying Platform	M600			
Tripod Head	Dual axis single motor high stability tripod head			
GPS Accuracy	<0.3, RTK			
Wireless Image transmission	Yes			
Remotely Modify Imaging Parameters	Yes			
Real-time 3D Modeling	Yes			
Endurance Flight Time	>30 min			
Ground Station Working Distance	10 km			
Responsibility				
Working Temp.	-10-40 ℃			
Storage Temp.	-20-65 ℃			
Working Humidity	≤85% RH			
Software				
Basic	Flexible setting of exposure, gain, speed, dynamic display of real-time hyperspectral image and hyperspectral curve.			
Focus	Dynamic real-time display of hyperspectral images, scientific light and dark focusing, avoiding artificial visual focusing errors.			
System	Data acquisition software can dynamically display hyperspectral images and hyperspectral curves in real time; it can provide measurement modes such as transmission and reflection, and can flexibly set parameters such as exposure time and speed. It comes with a spectral library and a user-recorded library, which can realize image cutting, spectrogram recognition and other functions			

4. ATH9500-Attachment Lists

Standard Attachments	
1	ATH9500 hyperspectral camera *1
2	M600 pro UAVs（remote controller included） *1
3	UAVs battery *6 sets
4	Ipad *1
5	50cm, 95% Standard Board *1
6	Hyperspectral imaging system workstation (including operation controller and control software)*1
7	Objective lens and radiometric calibration*1
8	Sky control data acquisition and control software*1
Optional Attachments	
1	High-precision indoor scanning pan-tilt
2	High blue steady flow halogen lamp
3	Field calibration cloth imported from the original factory (1.2m×1.2m)
4	Tripod
5	Large-capacity lithium battery for outdoor use
6	Measurement darkroom
7	Field portable transport box

8	Push-broom device

5. Other Hyperspectral Imaging Products:

ATH1500 Series	Feature	Application
ATH1500	400-1000nm VIS-NIR hyperspectral imaging camera	Precision agriculture, agricultural and forestry diseases and pests, vegetation analysis, planting area evaluation, crop yield evaluation, water quality analysis, artwork scanning, cultural relic identification, pattern scanning, industrial sorting, oil pollution detection, etc.
ATH1500-17	1.0-1.7 um SWIR hyperspectral imaging camera	Semiconductor, industrial sorting, food sorting, construction waste sorting, meat sorting, plastic sorting, geological prospecting, mineral exploration, cultural relic identification, judicial identification, document inspection.
ATH1500-25	1.2-2,5 um SWIR hyperspectral imaging camera	Precision agriculture and food analysis, dark plastic sorting, geological prospecting, mineral exploration, national defense and military industry, cultural relic identification, judicial identification, document inspection, moisture content analysis, medicine and material sorting, mineral mapping, medical identification, waste recycling.
ATH1500-50	2.5-5.0 um MWIR hyperspectral imaging camera	Geological survey, national defense and military industry, gas analysis, VOCs inspection, water temperature detection, land cover type identification, camouflage investigation, mineral sorting.
ATH1500-12-50	1.2-5.0 um SWIR hyperspectral imaging camera	Geological survey, national defense and military industry, gas analysis, VOCs inspection, water temperature detection, land cover type identification, camouflage investigation, mineral sorting.
ATH1500-04-17	0.4-1.7 um VIS-NIR hyperspectral imaging camera	Precision agriculture, agricultural and forestry pests and diseases, vegetation analysis, planting area evaluation, crop yield evaluation, water quality analysis, artwork scanning, cultural relic identification, pattern scanning, industrial sorting, oil pollution detection, etc.

6. Application

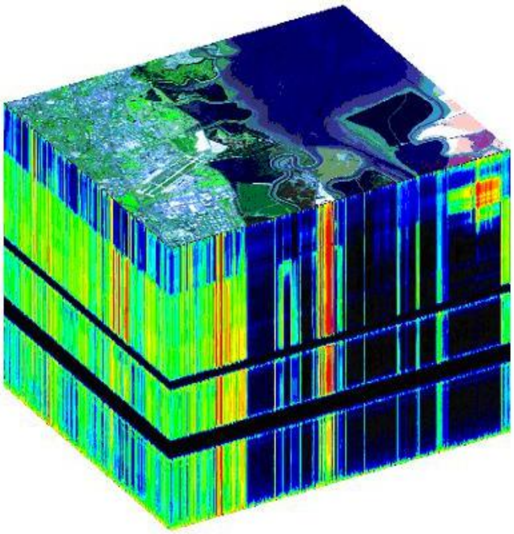


Figure 2 Data cube captured

Figure 3 Drone experiment

Figure 4 Outdoor experiment sceneI

Figure 5 Outdoor experiment sceneII

Figure 6 Outdoor experiment scene III

Figure 7 Outdoor experiment scene IV

Figure 8 Outdoor experiment sceneV

1. Industrial Sorting Application

With the development of NIR hyperspectral technology, such as Jiang tried to use near-infrared hyperspectral technology to detect impurities in cotton, especially the application of SWIR hyperspectral technology, which significantly improved the detection rate of plastic films compared with conventional methods.

Hyperspectral imaging technology is based on a very large number of narrow-band image data technology, which can obtain image information and spectral information of the sample while imaging the sample. Commonly used hyperspectral data processing methods include partial least squares (PLS), support vector machine (SVM) and artificial neural network (ANN).

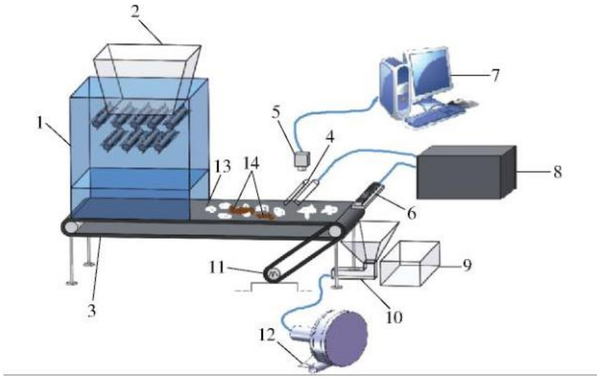


Fig. 2 Schematic of film sorting system of seed cotton

1.Cotton box 2.Cotton inlet 3.Conveyor belt 4.Dome halogen lamp 5.Hyperspectral camera 6.High speed spray valve 7.Industrial PC 8.Industrial PC 9.Seed cotton collection box 10. Waste collection box 11.Servo motor and encoder 12.Fan 13.Seed cotton 14.Film

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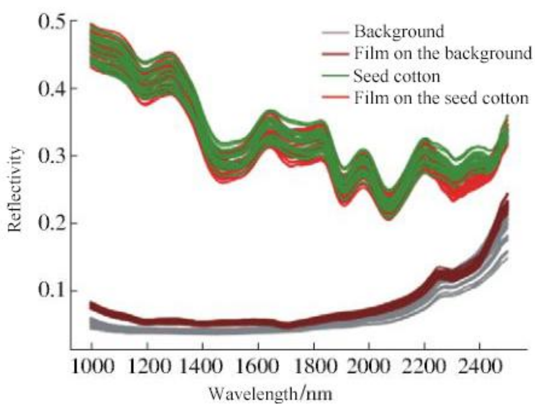


Figure 9 Seed cotton sorting application; (a) System functional composition; (b) Different substances reflectance spectrum

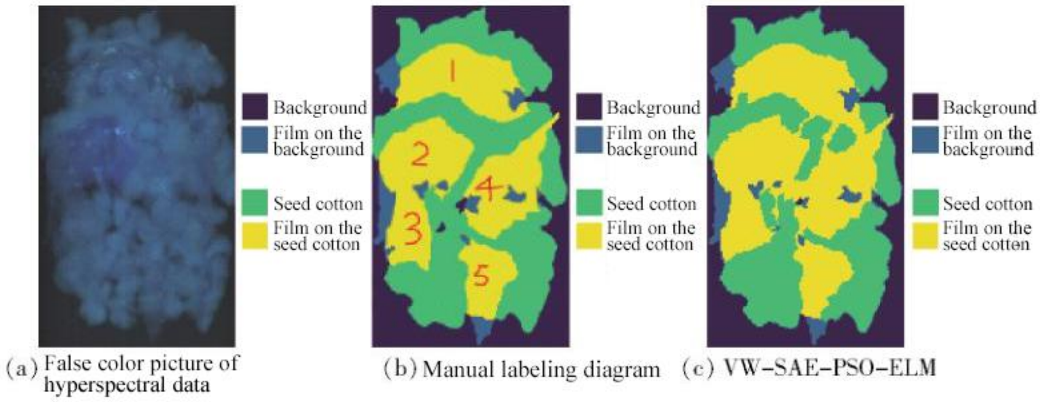


Figure 10 Seed cotton sorting application; (a) Artificial marking; (b) Recognition result

Apple’s external quality is the most intuitive quality feature of Apple, which directly affects Apple’s price and consumer preference. Aiming at the difficulties and key points of external inspection of apples, based on machine vision technology, hyperspectral imaging technology and multispectral imaging technology, integrated image processing technology, pattern recognition method, chemometric method and spectral analysis technology, the external physical quality of apple (shape and size) and detection methods for common defects on the surface.

The detection system and algorithm developed on the basis of the above research laid the foundation for my country's research and development of rapid online inspection and grading equipment for Apple's external quality based on machine vision technology and multi-spectral machine vision technology.

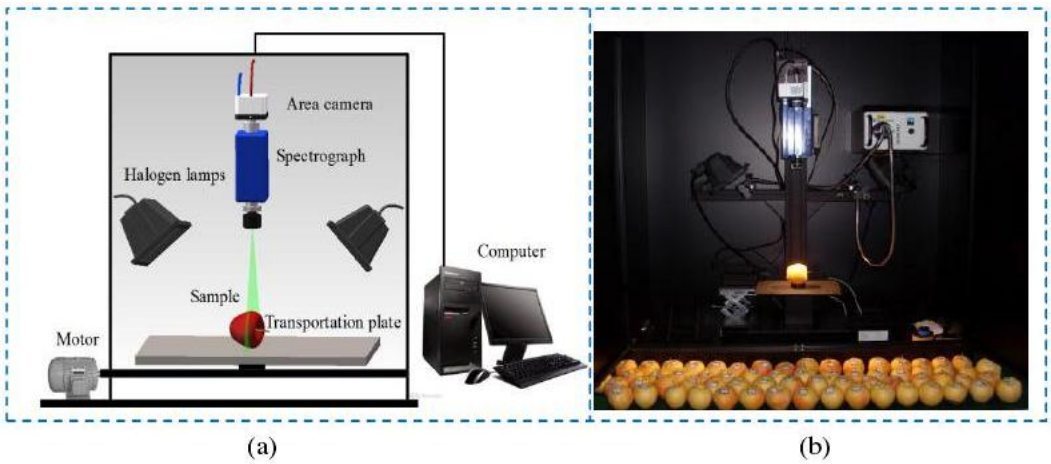


Figure 11 Schematic diagram and physical diagram developed by Dr. Zhang Baohua of Shanghai Jiaotong University; (a) Schematic diagram; (b) Physical diagram

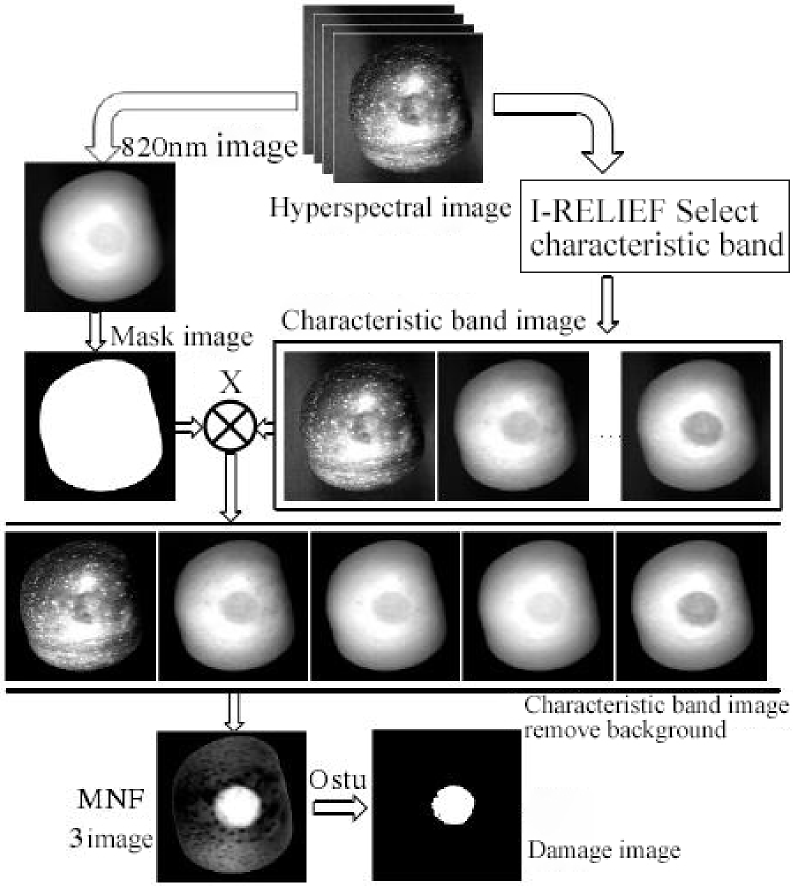


Figure 12: Flow chart of early damage detection algorithm for apple surface

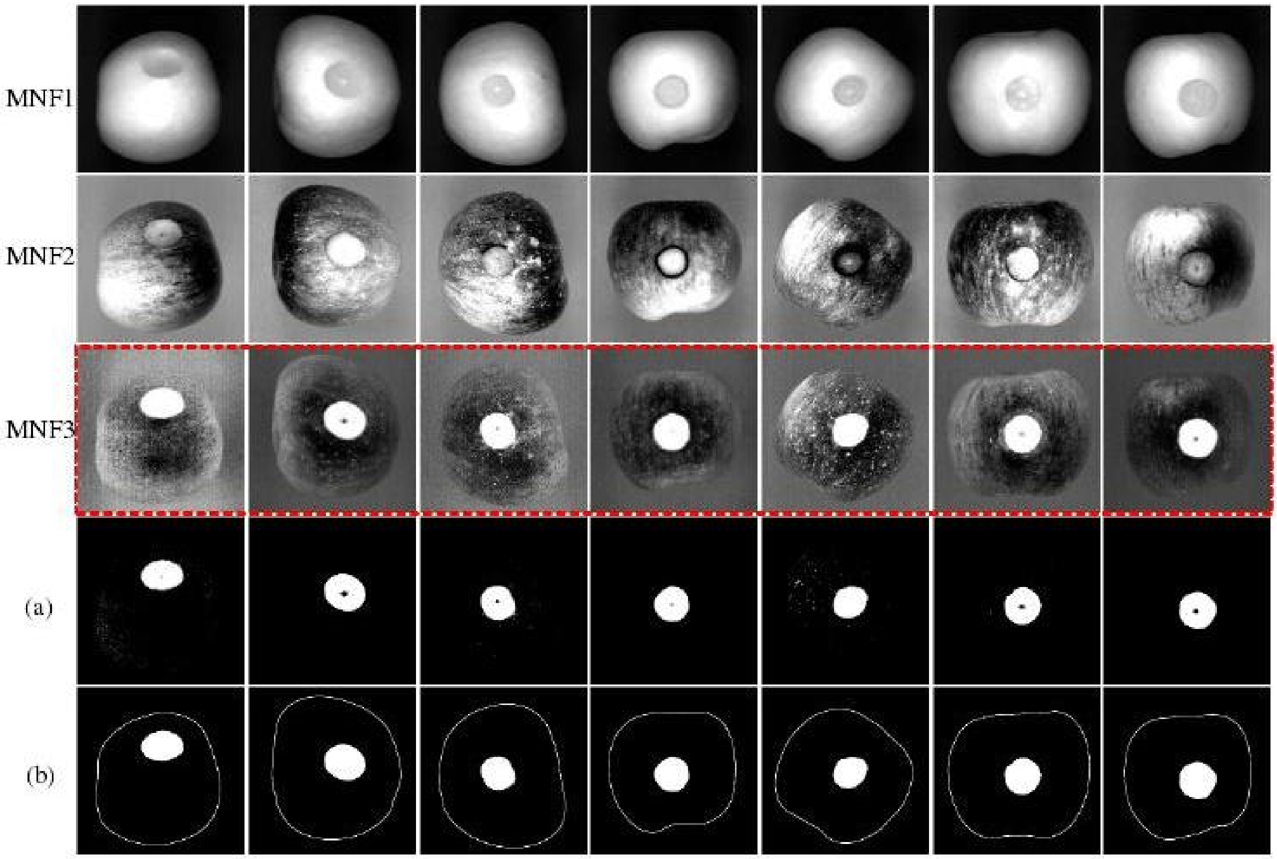


Figure 13 Recognition results of early decay of some apples and intermediate processing (a) rot segmentation results (b) final results

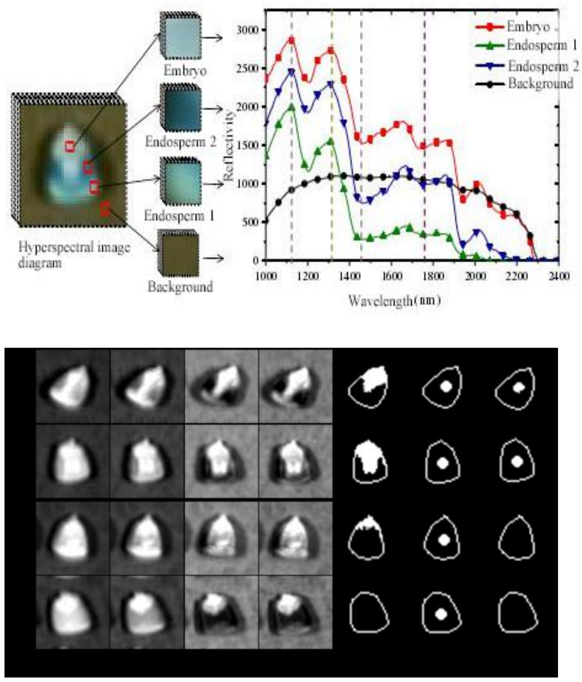


Figure 14 Corn seed sorting application (Dr. Chaopeng Wang, Northwest A&F University)

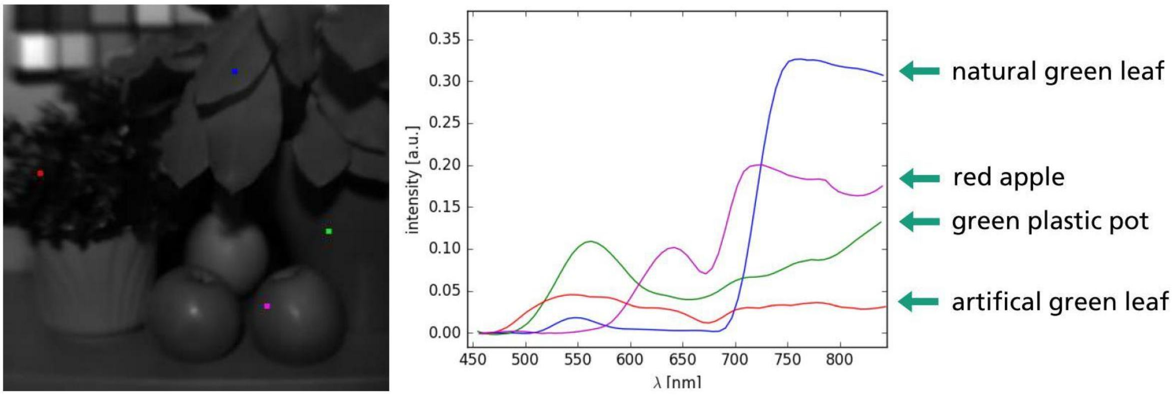


Figure 15 The spectrum of natural green plants, artificial green leaves, green plastic, and red apples

2. Precision Agriculture Application

Figure 16 Drone-borne hyperspectral imaging camera

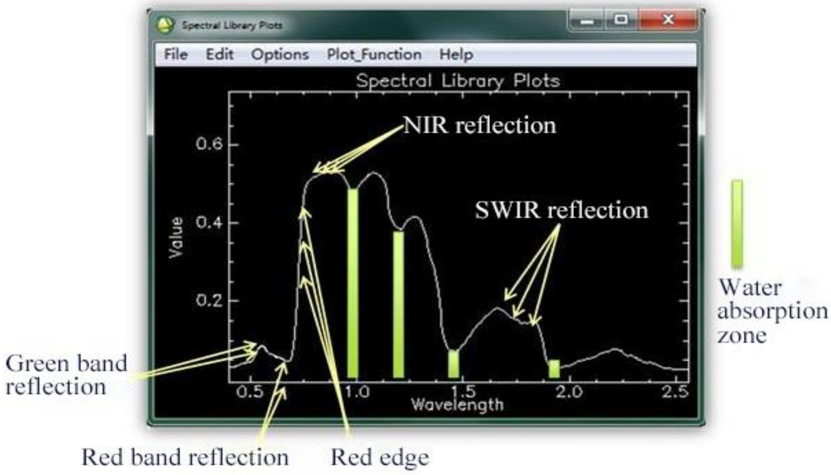


Figure 17 Green plants measured spectrum

1) **Crop growth monitoring and yield estimation:** Due to the different external factors of crops at each stage of their growth and development, there will be certain differences in their internal composition and external morphology. The most important difference is the leaf area index. Leaf area index is a comprehensive index reflecting the individual characteristics and group characteristics of crops.
2) **Crop pest control:** Remote sensing technology can monitor the effects of pests and diseases on the growth and development of crops, track the growth and development of crops, analyze and estimate disaster losses, and can monitor the distribution and activity of pests, thereby preventing the occurrence of pests.
3) **Drought monitoring of crops:** Remote sensing technology monitors crop drought conditions through crop vegetation index and canopy parameters.
4) **Monitoring of soil moisture content and distribution:** In the case of different thermal inertia conditions, the difference between remote sensing spectra is very obvious, so a mathematical model between thermal inertia and soil moisture content can be established, and remote sensing technology uses this model to analyze soil moisture content and distribution.
5) **Crop nutrient monitoring:** The accuracy of remote sensing technology to monitor the nitrogen content of crops is higher than that of other nutrient elements.

Normalized difference spectral index (NDSI), ratio spectral index (RSI) and simple spectral index (SSI) were constructed by using single band and any two bands in the range of 450 ~ 882 nm to calculate the correlation between CGI and spectral index and screen out spectral index with good correlation. Combined with partial least squares regression (PLSR), the inversion model was established.

Using CGI as the index, Airborne hyperspectral image was used to monitor the growth status of wheat in the multi-growth period in 2015. Unmanned aerial vehicle hyperspectral image inversion CGI has high precision, which can judge the difference of wheat overall growth, and can provide reference for wheat growth monitoring.

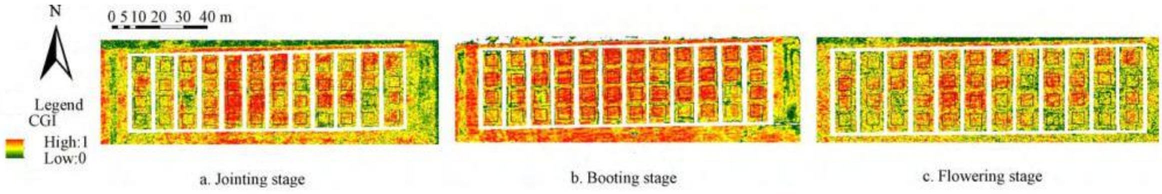


Figure 18 CGI inversion of wheat growth index

3. Forest Health Application

Used for pest monitoring and forest resource assessment.

Principle: The health of vegetation is related to greenness index, leaf area index, leaf moisture content and light use efficiency;

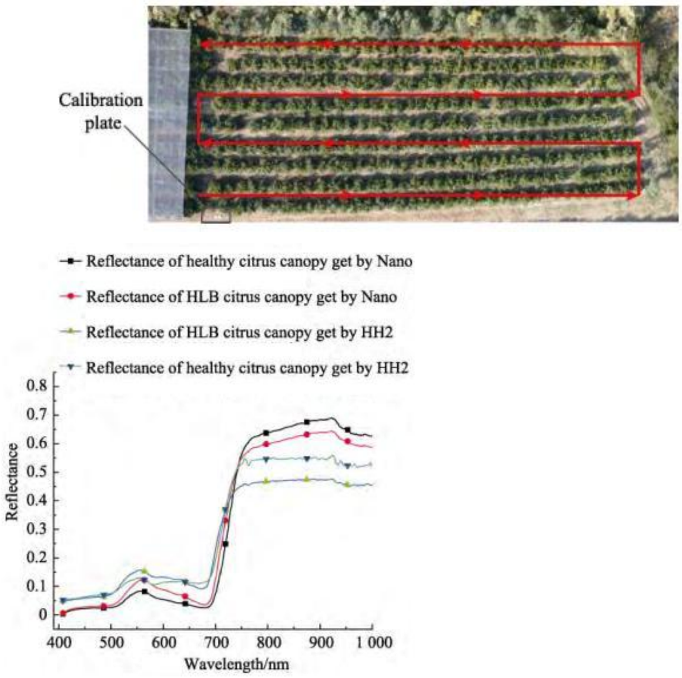


Figure 19 Monitoring and classification of citrus yellow dragon disease plants based on drone-borne hyperspectral imaging camera (designed by Lan Yubin et al., South China Agricultural University)

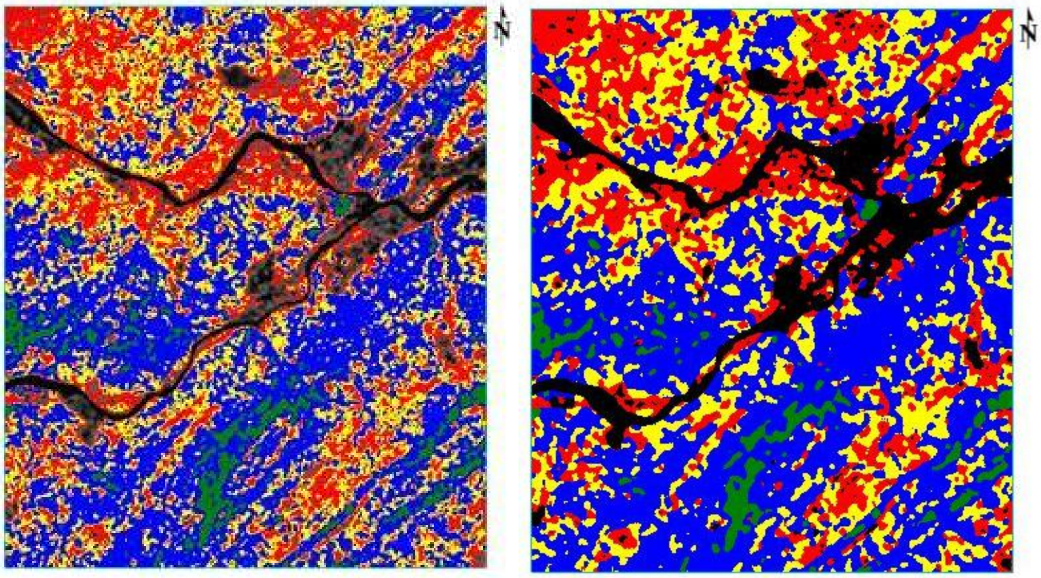
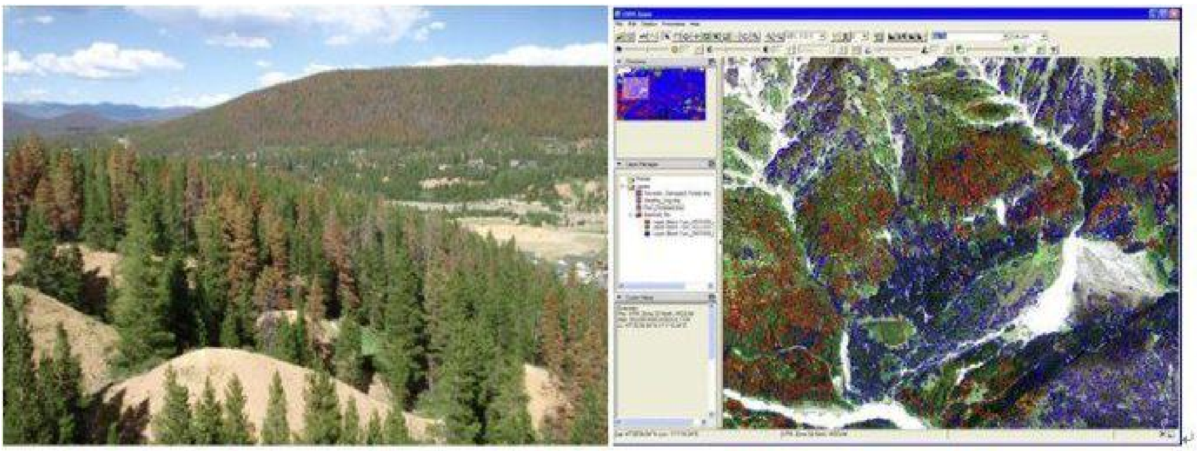


Figure 20 Distribution map of masson pine health degree studied by Wang Shuang of the University of Electronic Science and Technology of China with a hyperspectral camera



4. Geological Prospecting Application

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 atlas integration, hyperspectral remote sensing technology has the ability of fine detection and analysis of surface rock mineral composition on a large scale. It can not only provide a macro image of the ground, but also determine the type and abundance of minerals in the geological body, and even the chemical composition of some minerals at pixel level details (Wang Runsheng et al., 2010).

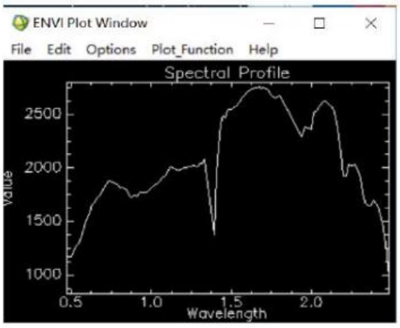
In recent years, with the continuous development of hardware, data processing methods and software related to imaging spectrometer, the application of hyperspectral remote sensing technology in the field of geological survey has been accelerated.

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 mineralization anomalies from large metallogenic areas to medium-scale ore fields (e.g. Bierwirth et al., 2002; Company Changyun 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).

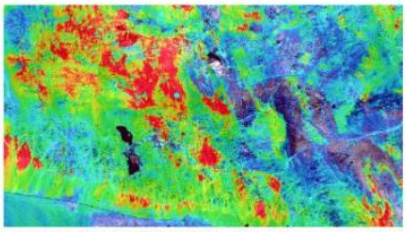
With the theory of metallogenic system (Wyborn et al., 1994) becoming the guiding principle of prospecting practice, thematic mineral mapping on the scale of large ore concentration areas and metallogenic belts will provide key regional material composition information for predictive prospecting and exploration.

The spectral wavelength ranges used for mineral mapping include visible light (400-700nm), NIR (700-1000nm), SWIR (1000-2500nm), and thermal IR (7000-15000nm). At present, the most widely used in mining is the short-wave infrared region (1000-2500nm).

Because the frequency is close to the cofrequency and combined frequency of the chemical bond vibration in the mineral lattice, the mineral containing water or OH- (mainly layered silicate and clay) as well as some sulfate and carbonate minerals can be observed in the range of short-wave infrared wavelength.

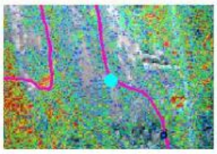


HH036 point image spectrum

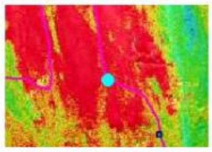


Sericite Filling Results

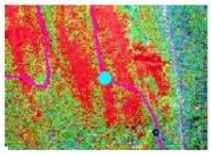
Comparison of known deposit points between HH036 and measured



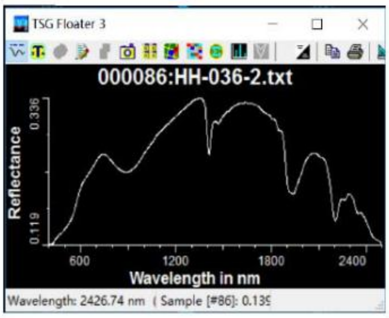
Chlorite extraction results



Sericite extraction results



Feb3+ extraction result



HH036 point measurede spectrum

Sampling point photos

Long-range photos of sampling points

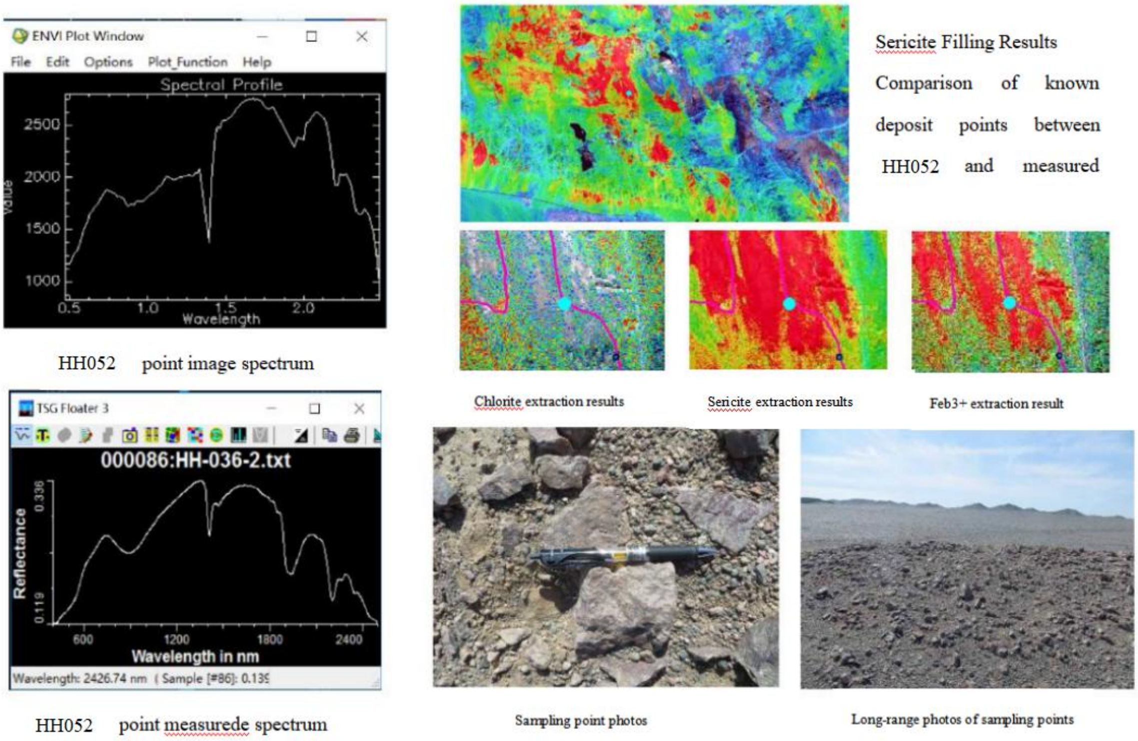


Figure 21 Application of hyperspectral imager in prospecting

Soil salinization is one of the important ecological and environmental problems in arid and semi-arid areas. Soil salinization causes soil hardening, fertility decline, acid-base imbalance, land degradation and other consequences, which seriously restricts agricultural development in China and affects the strategic situation of sustainable development in China at present.Remote sensing technology, with its characteristics of large scale, wide range, strong timeliness and economy, makes up for the deficiency of traditional methods for monitoring salinization phenomenon, and provides a new way for quantitative monitoring of soil salinization phenomenon.

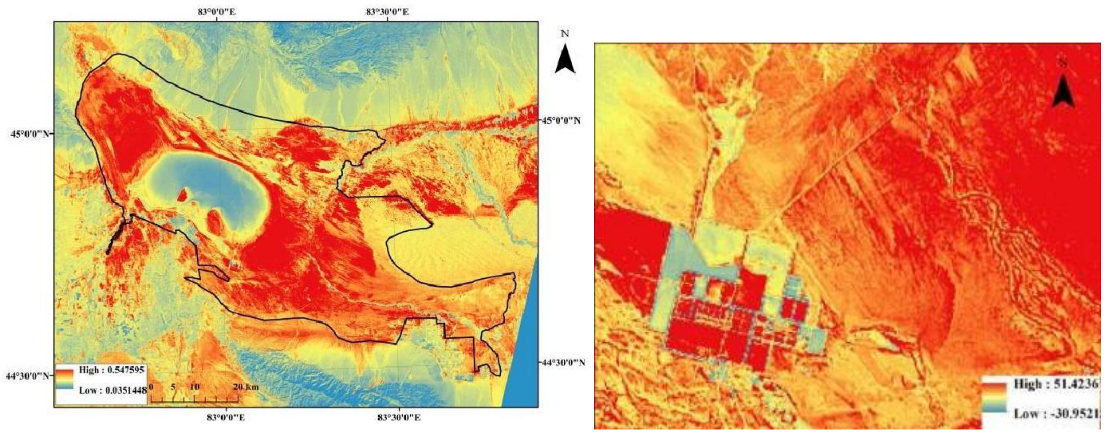
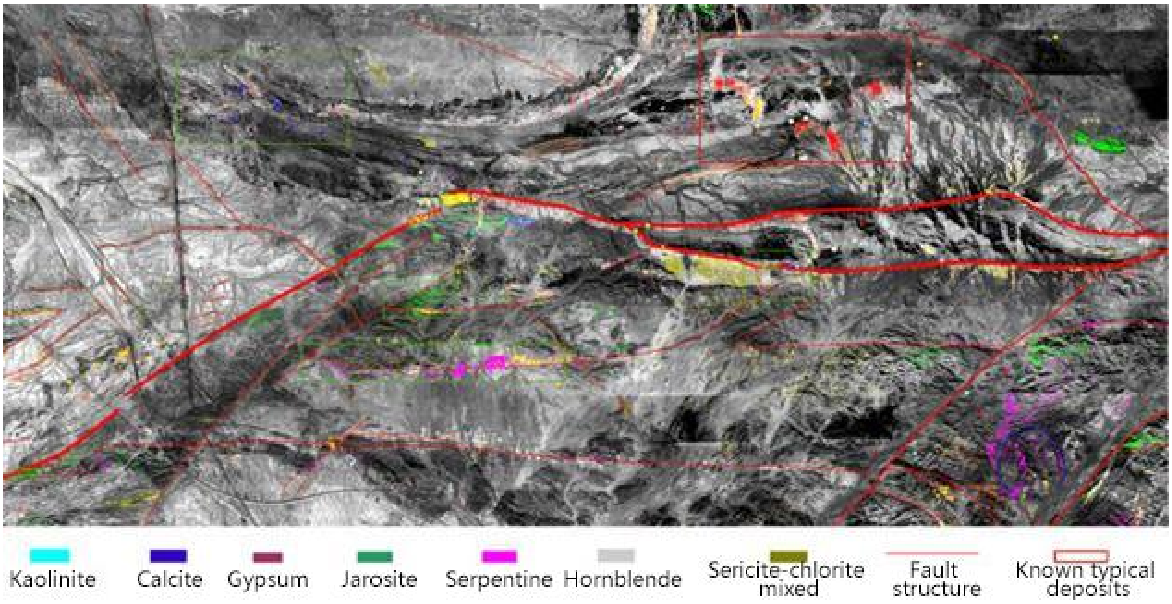


Figure 22 The surrounding area of a salt field



5. Public Safety Application

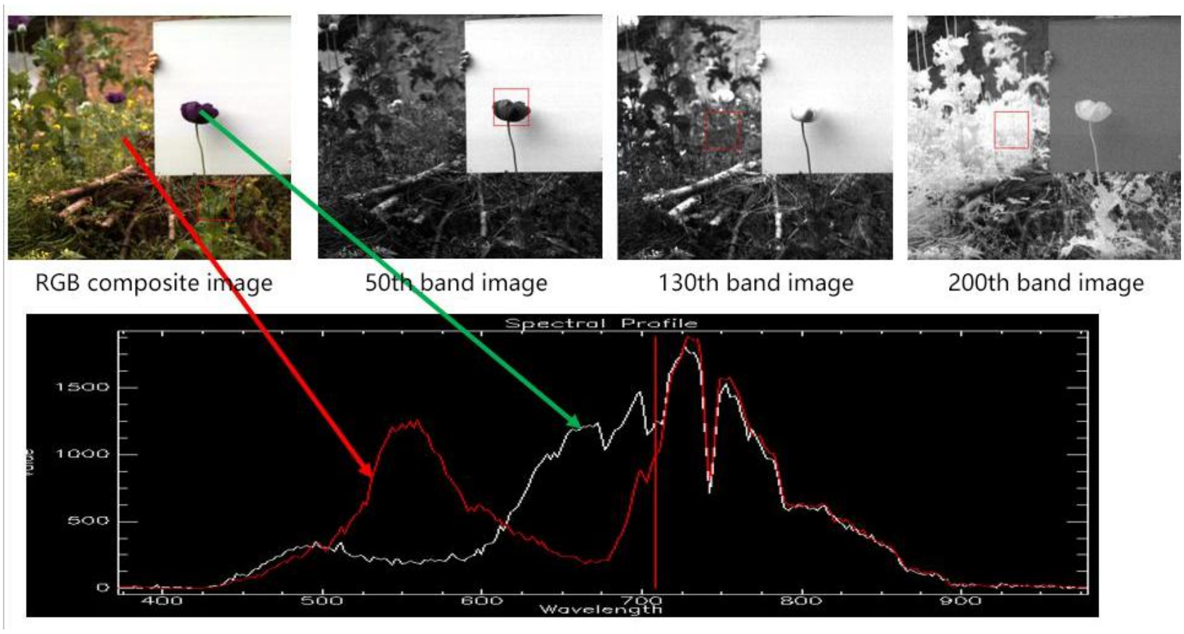
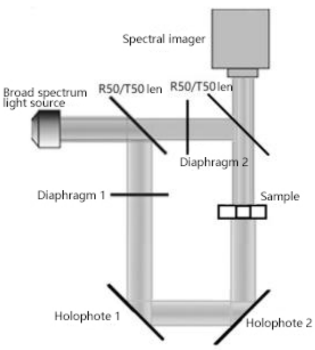


Figure 23 The searching for illegal poppy cultivation application



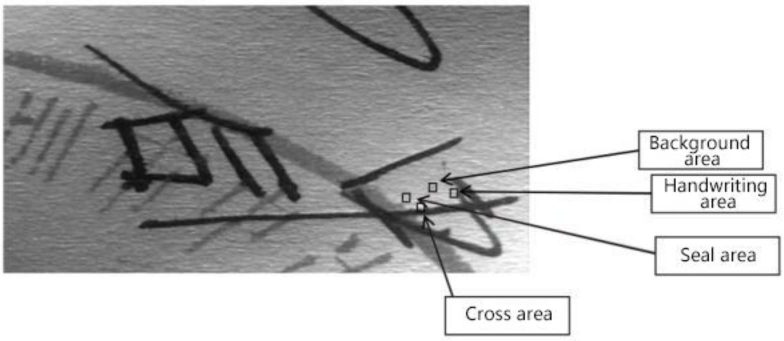


Figure 24 Document inspection application

6. Medical Microscopic Imaging Application

Objective: online detection and navigation positioning during tumor surgery

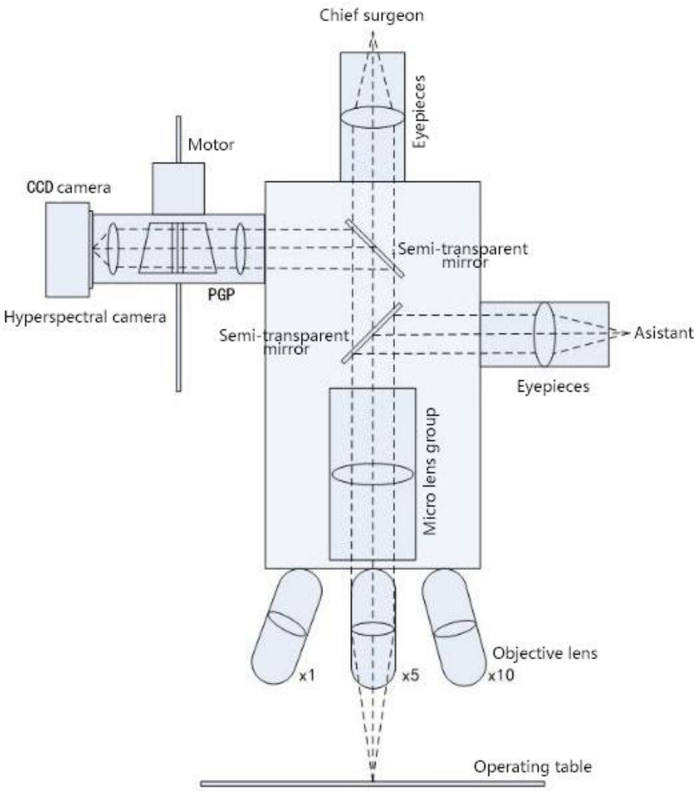


Figure 25 Medical microscope imager optical path schematic diagram

Is shown in the figure of medical microscopic imaging spectrometer principle diagram, the operating table for the target after the objective lens, microscope lens group is divided into three road, visual observation for the surgeon, all the way all the way for the assistant auxiliary visual observation, a routing imaging spectrometer detection, driven by a motor to imaging spectrometer measuring target space d scanning, imaging spectral information of the target under test, then through data analysis, image processing, through the display to the doctor.

Figure 26 Medical microscope imager figure

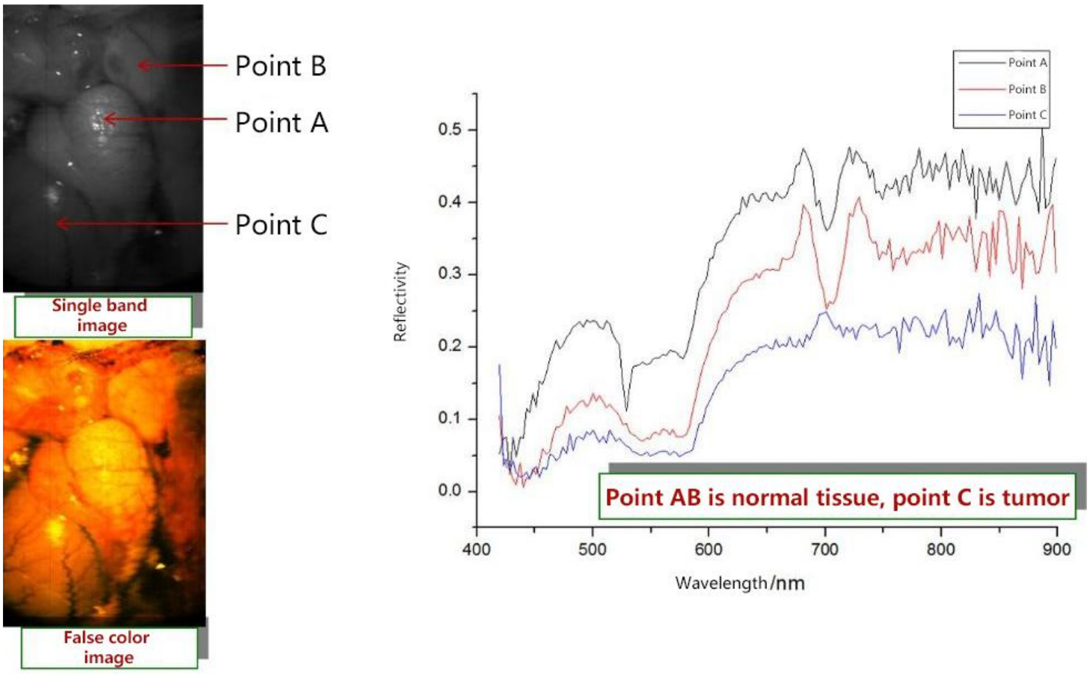


Figure 27 Data collect by medical microscopic imager

7. Airborne Imaging Spectroscopy Application

Figure 28 Optosky Airborne Imaging Camera

Objective: Airborne remote sensing

Application: Figure shows airborne imager consists of SpecVIEW-VIS, stable platform and POS modules. Figure 30 and Figure 31 show data was collecte. Figure 7 shows pseudo color image processed through geometric correction, flight strip spice and radiatation correction. Figure 31 shows typical geology spectral curve.

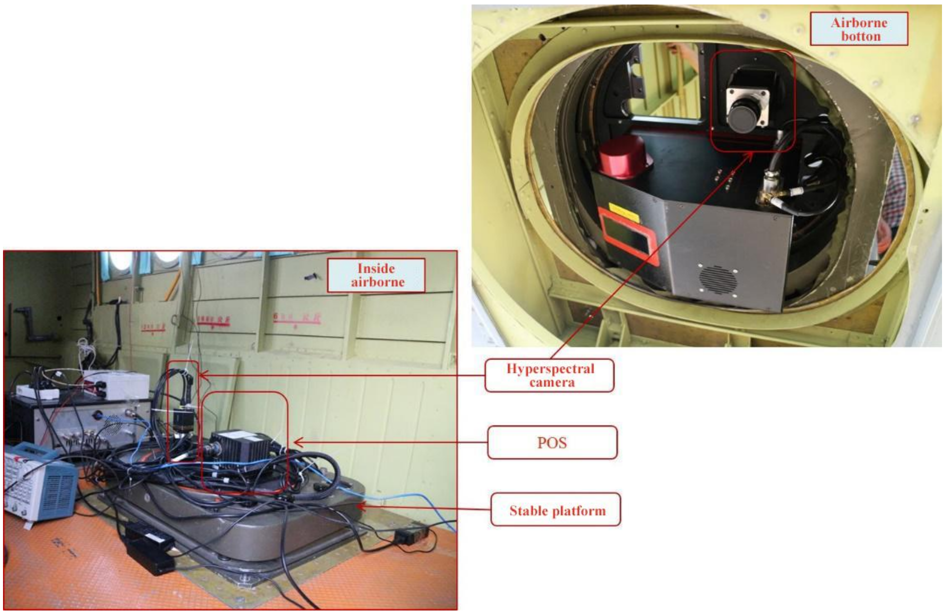


Figure 29 Airborne remote sensing application

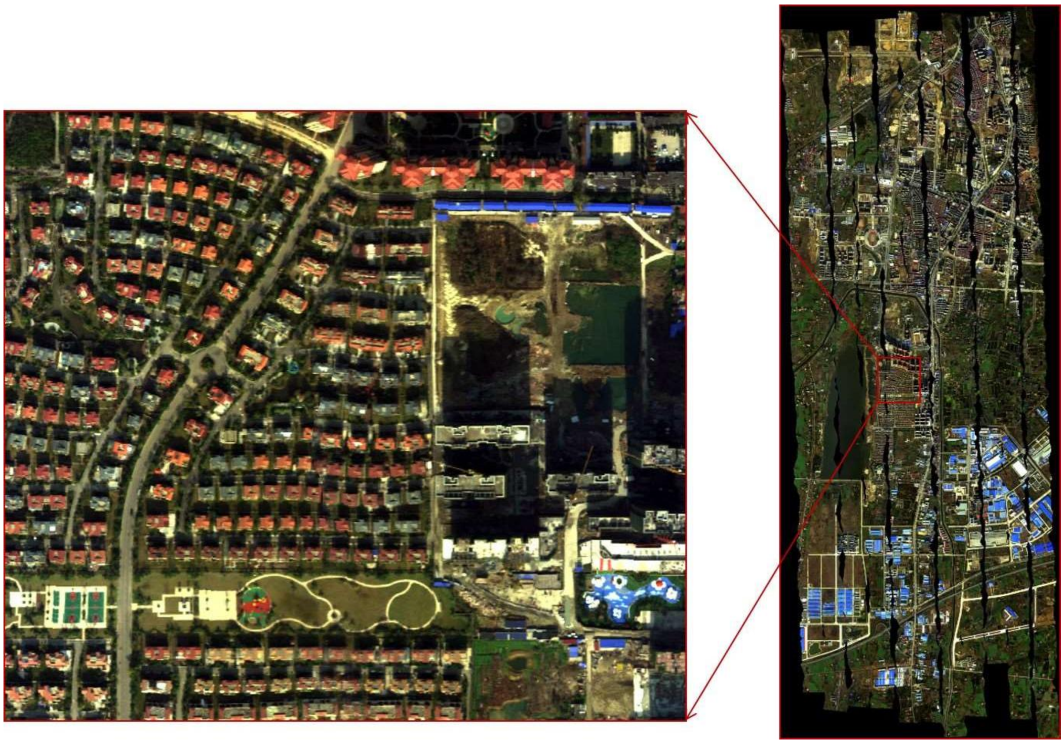


Figure 30 Airborne application data-pseudocolor image

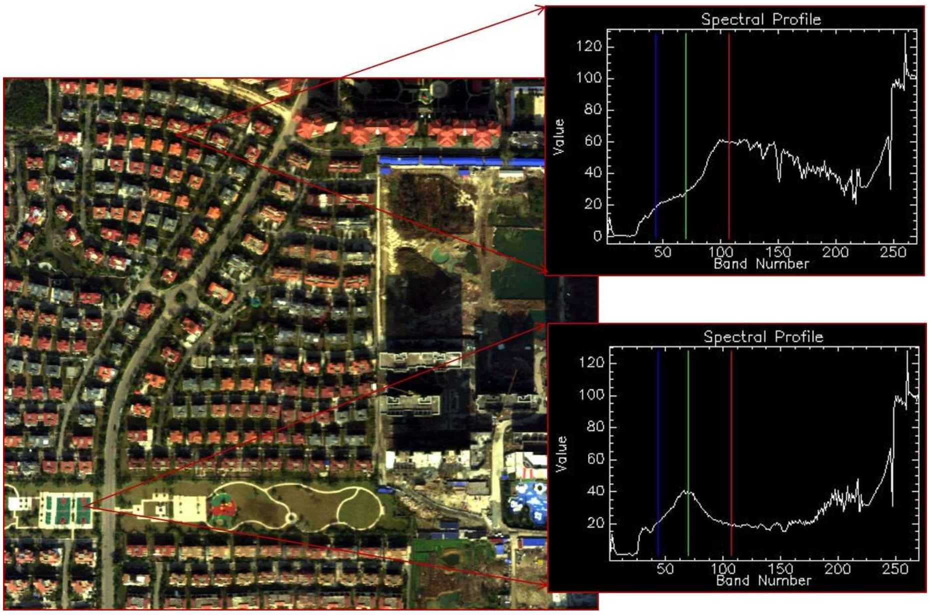


Figure 31 Airborne application data-spectral curve

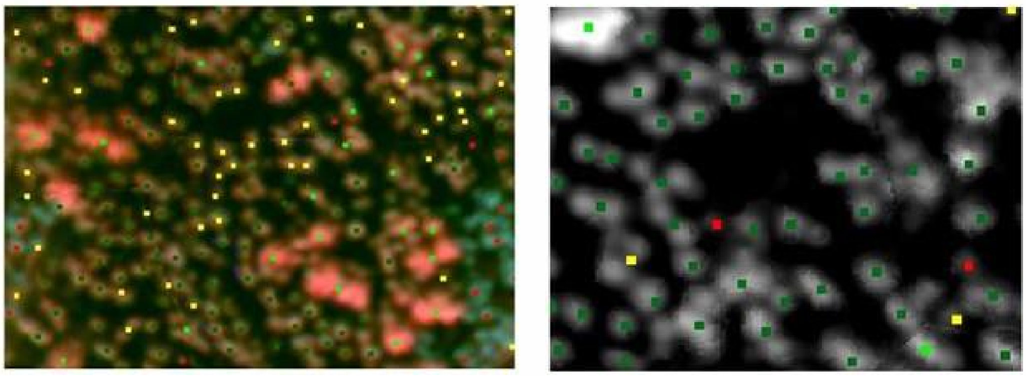


Figure 32 Forest remote sensing, Airbone hyperspectral monitor forest disease and pest

8. Water Quality and Environmental Protection Appication

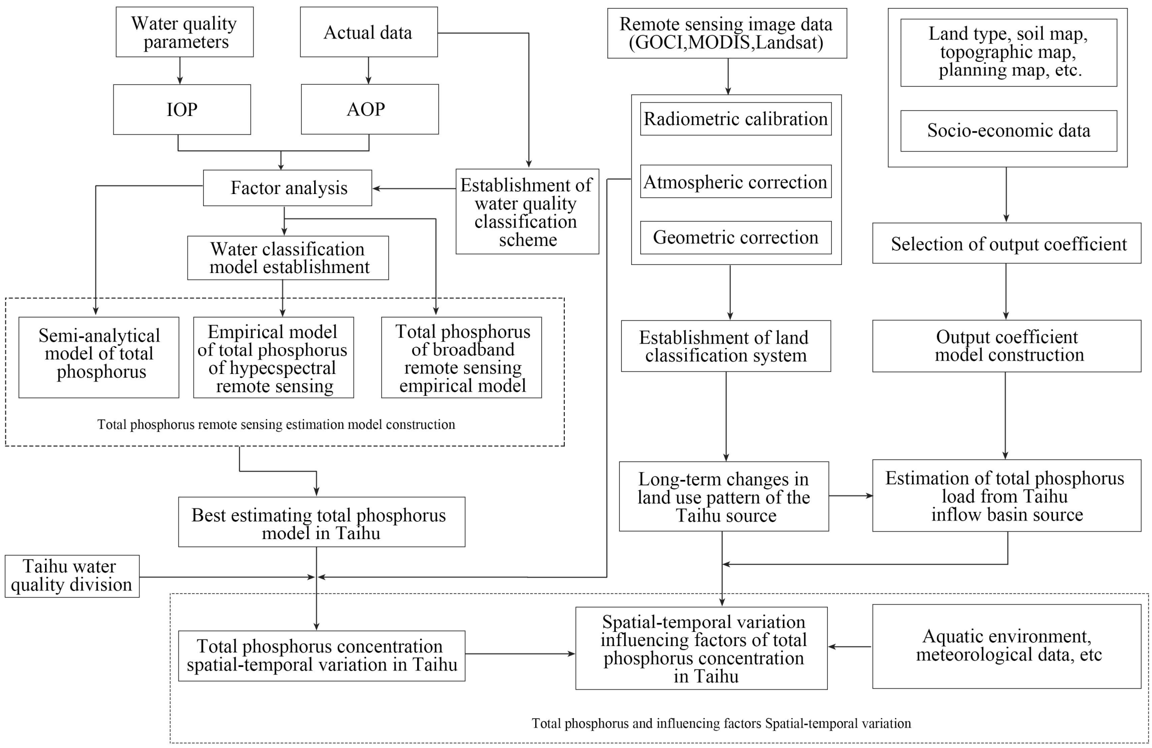


Figure 33 Inversion algorithm flow of hyperspectral data

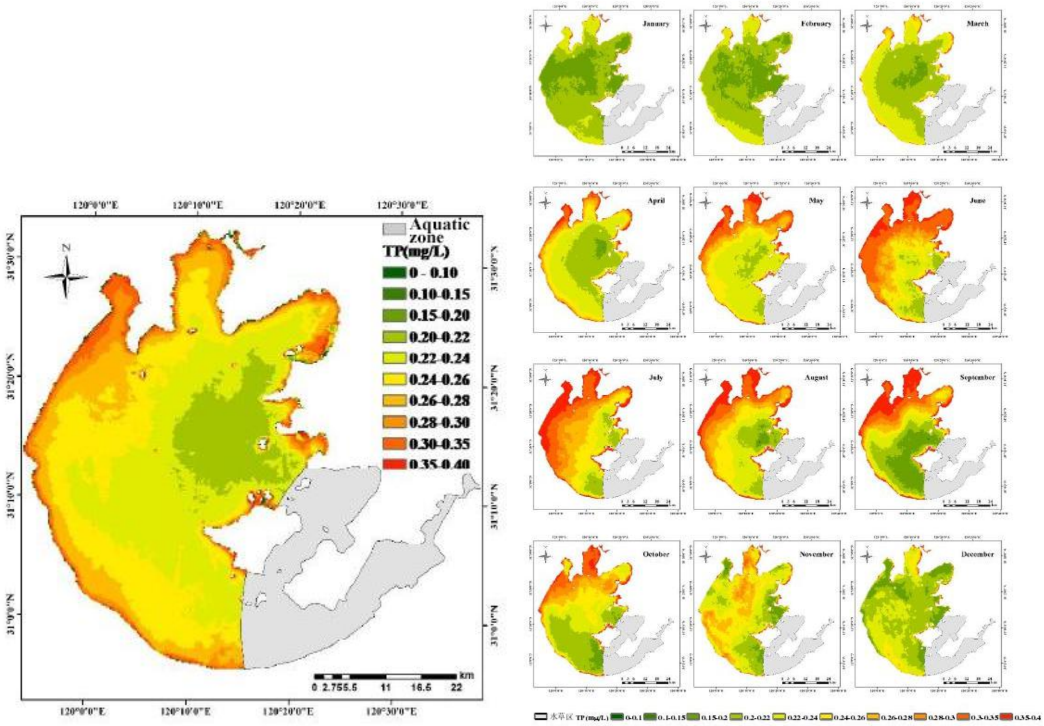


Fig. 34 (a) Spatial distribution of total phosphorus concentration in Taihu Lake. The spatial difference of total phosphorus concentration was obvious, with the highest value of 0.38mg/L and the lowest value of 0.06mg/L. (b) Monthly variation of total phosphorus concentration in different lakes.

The lake area also generally reaches its maximum phosphorus concentration between June and September. The total phosphorus concentration in Zhushan Bay, Meiliang Bay and the west bank of Taihu Lake was higher than the mean value of the whole lake from March to October of the year, and was significantly higher than that in the rest of Taihu Lake. The total phosphorus concentration in Gonghu Bay was higher than that in the whole lake only in June, and the total phosphorus concentration in the south bank of Taihu Lake and Great Taihu Lake was relatively low throughout the year.

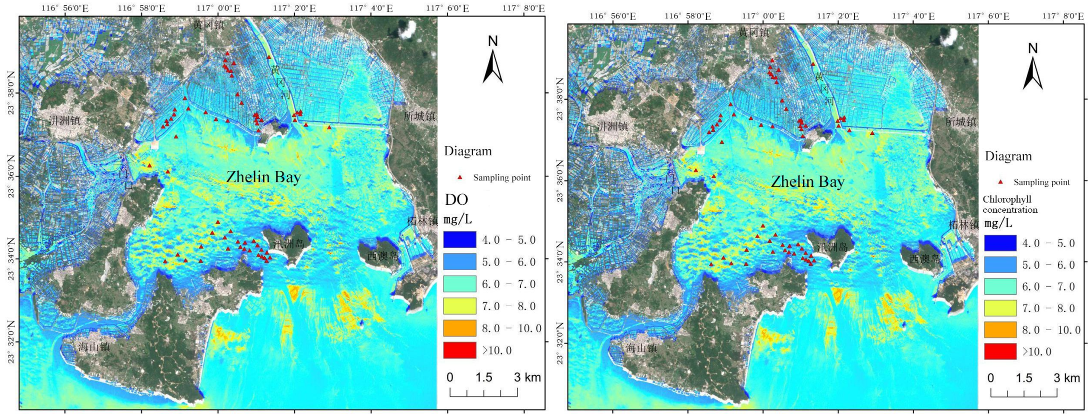


Figure 35 The distribution of dissolved oxygen and chlorophyll concentration in Zhelin Bay, eastern Guangdong, taken by hyperspectral

7. Company Profile

Optosky company is an first-class spectroscopy solution provider, with the headquarter locates in the 7th floor of the research institute of the Chinese Academic of Science at an area of 2500 square meter in Xiamen city where successfully held the international 9th BRICK summit in 2017.The subsidiary company locates in Wuhu city with an area of 2035 square meter.

The company founder Dr.Hongfei,Liu graduated Docter degree from Chinese Academic of Science and postdoctral degree from Xiamen University, by integrating both of top Universities' spectroscopy technology background into Optosky company aiming at developing the leading spectroscopy equipment in the world.

The company bases on unique technologies of Optomechatronics, Spectroscopy Analysis, Process Weak Optical and Electrical Signals, Cloud Computing, and have been developed wide products line of the competitive Raman spectroscopy instruments, micro spectrometer, hyperspectral imager, field spectroradiometer, fluorescence spectroscopy, LIBS etc. Driven by advanced technologies and products, Optosky brand has been well-known to customers all over the world.

Optosky company base on technologies innovation, market driven direction, customer first, provides first-class products and services, and one-stop solutions to many fortune 500 companies in many industries. The company received praise from different industries companies, as well as many innovative intellectual property, software copyright, qualification certification, and winner awards over hundred numbers.

Optosky receives top class A introduced high-tech company to international Xiamen city, the national high-tech and new innovative technology company award. The founder Dr.Hongfei Liu receives the innovation talent award by ministry of science and technology.

The company is currently conducting the exclusive project of major industrialization national oceanic administration with a total fund of five million us dollar. The company in charge of drafting national industry standard of VNIR and SWNIR Field Spectroradiometer, and six national standard drafter, including China National Standard Drafter for Hazmat detector based on Raman spectroscopy, China National Standard Drafter for Buoy-type Monitor eco-environment, China National Standard Drafter for water quality monitor in unmanned boat, China National Standards drafter for online water quality monitor by spectroscopy, China National Standard Drafter for UV-absorbent measure fabrics.

The company has over 70 IPs and over 20 innovative patents.

The company received ISO9001:2015 certification, CE certification, Police Administration Certification, FDA approval compliant, IQOQPQ compliant.

Figure 1 Optosky (Xiamen) Photonics Inc. Company Headquarter

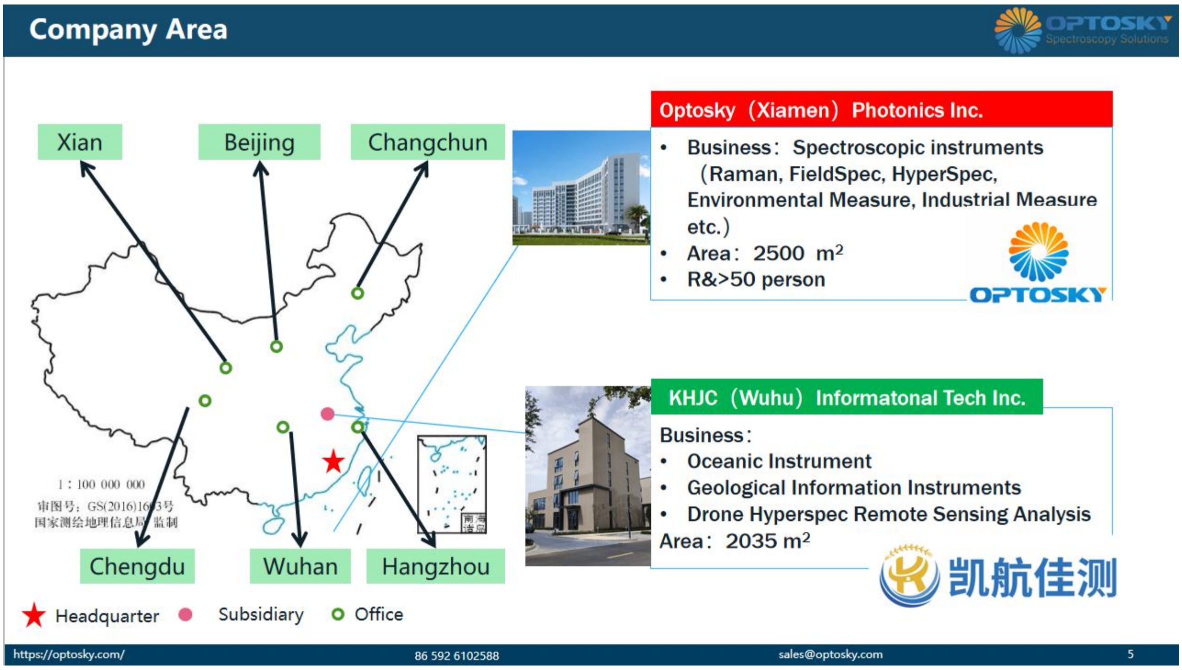


Figure 2 Optosky Company Area

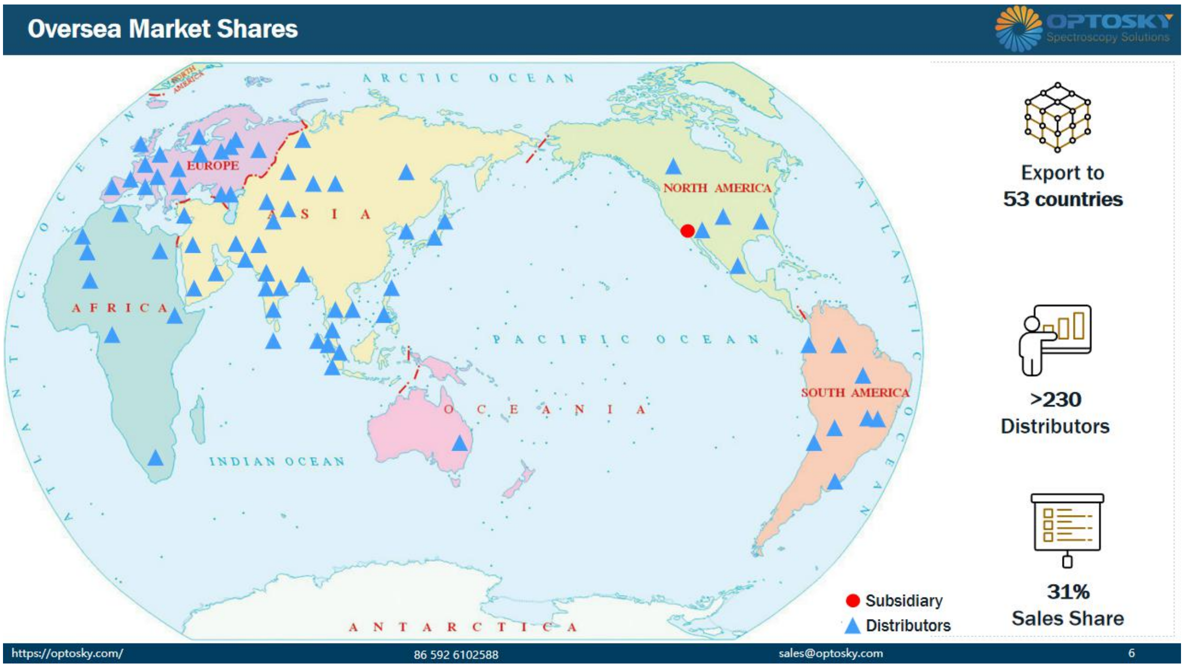


Figure 3 Oversea Market Shares

Figure 4 Optosky Chair and Draft National Standards Lists.

Figure 5 Qualification

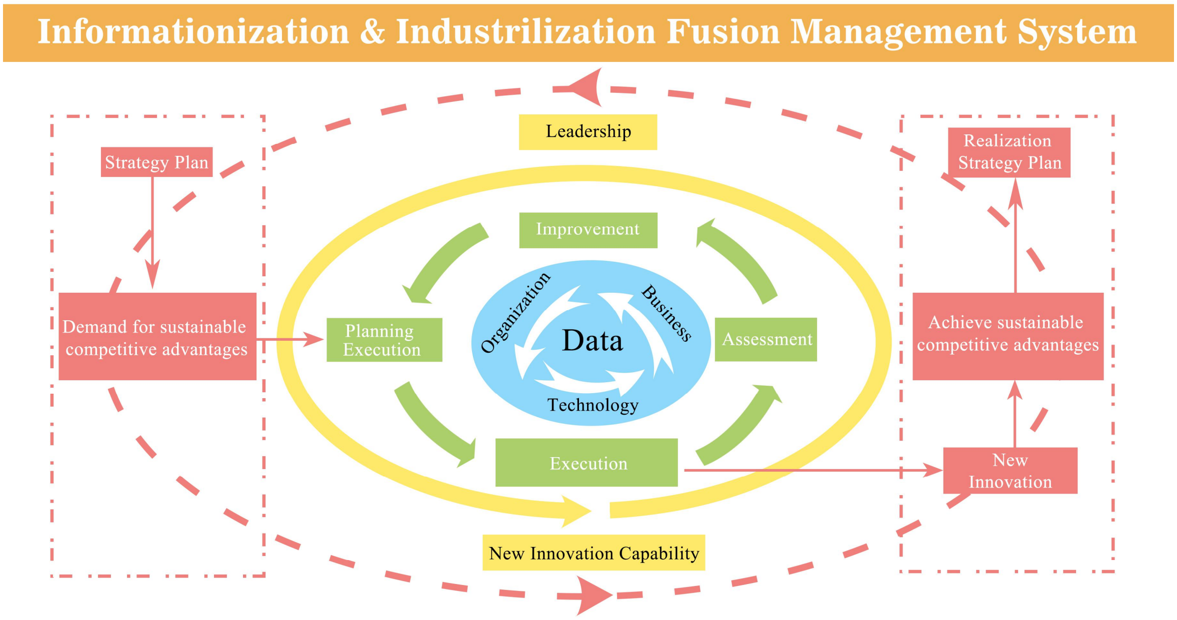


Figure 6 GB/T 23001_Informationization & Industrilization Fusion Management System

Figure 7 Optosky's Co-founder_Dr. Hongfei Liu

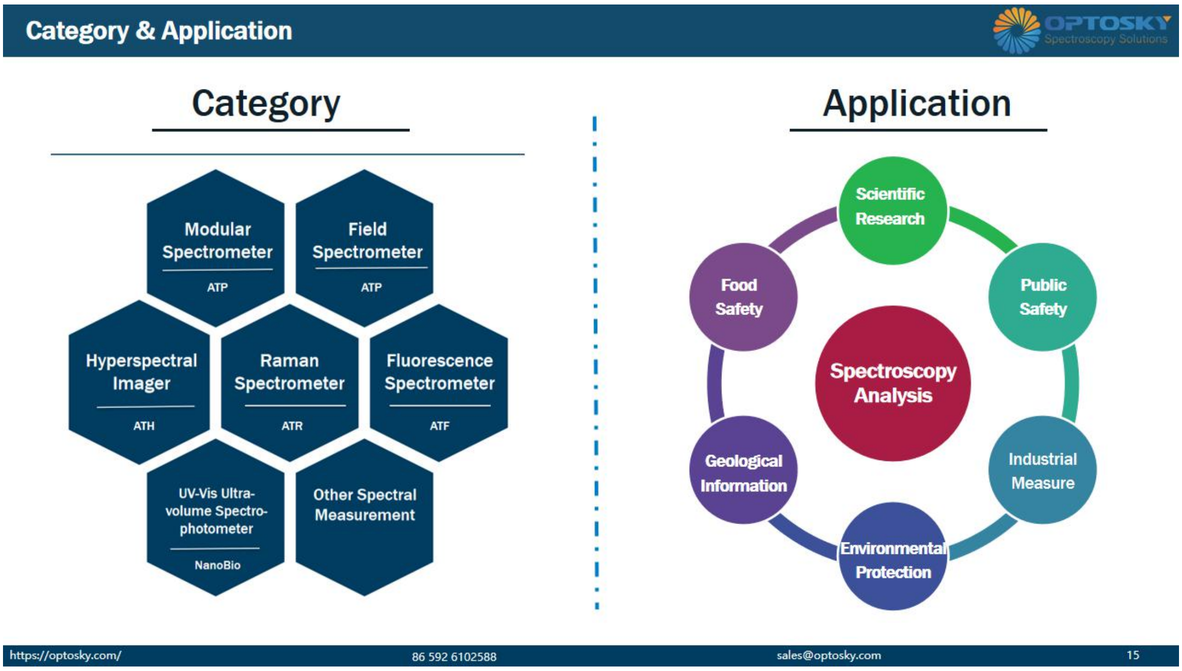


Figure 8 Category & Application

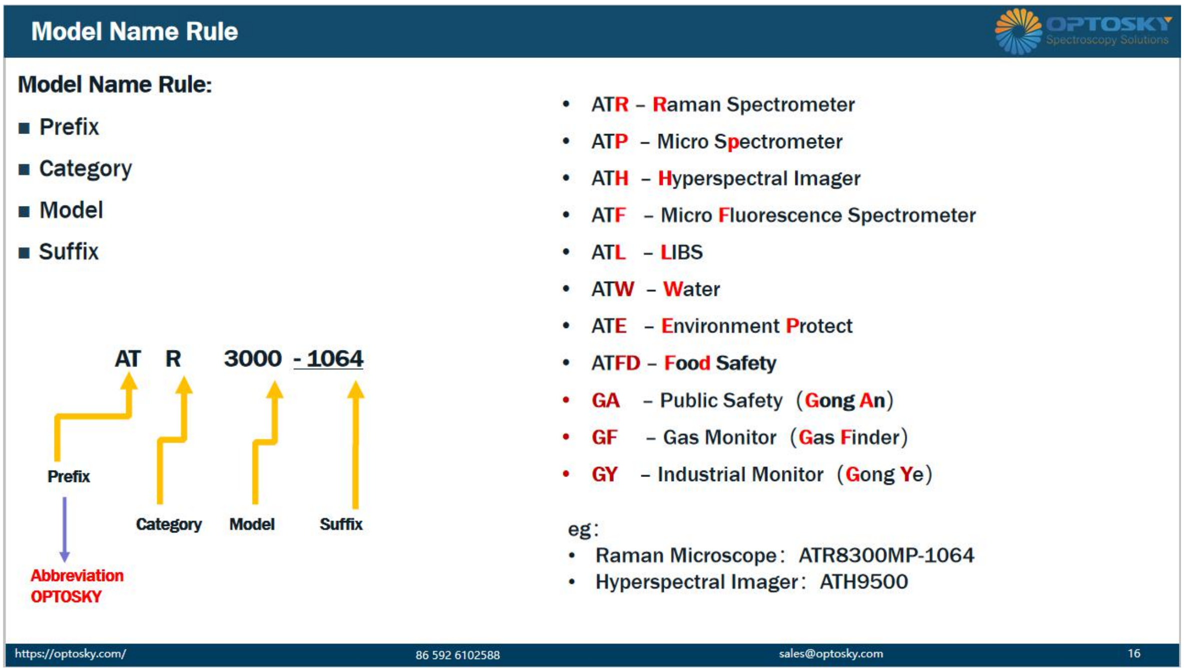


Figure 9 Model Name Rule