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MULTITASKING APPLICATIONS OF HYPERSPECTRAL IMAGERS

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Abstract: *Spectral imaging provides both the capabilities of two powerful areas such as spectroscopy and digital images. Thus each pixel of the digital image is presented with a number of contiguous spectral bands. When this number of contiguous spectral bands is more than a hundred, then we are talking about hyperspectral instruments. In the work are presented several hyperspectral instruments with their characteristics. Emphasis is put on the wide range possibilities for applications which are illustrated with appropriate examples.*

МНОГОВАРИАНТНИ ПРИЛОЖЕНИЯ НА ХИПЕРСПЕКТРАЛНИ ПРИБОРИ

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Ключови думи: *Дистанционни изследвания, Хиперспектрални прибори, Приложения*

Резюме: *Спектралните прибори за получаване на изображения предоставят едновременно възможностите на две мощни направления, каквито са спектроскопията и цифровите изображения. По този начин всеки пиксел от цифровото изображение е представен с голям брой непрекъснати спектрални канали. При хиперспектралните такива става въпрос за повече от сто спектрални канали. В работата са представени няколко хиперспектрални прибори с техните характеристики. Акцентирано е на огромните им възможности за приложения, които са илюстрирани с подходящи примери.*

1. Introduction

Notwithstanding their young age, spectrometric measurements have about 30-year-long history, while Remote Sensing of the Earth from space occupies is of essential importance for the development of modern science and technology. The application area of remotely sensed spectral data is expanding continuously to incorporate new applications, such as ecologic monitoring of endangered areas, monitoring the global changes of natural resources and environment, climate changes etc.

2. Hyper Spectral Imaging Spectrometers

2.1 Imaging spectrometer with high spectral and high spatial resolution model for remote sensing applications

Project I-603/96 founded by National Found “Scientific Investigations”. (1997 – 2000) :“Investigations aimed to construction an imaging spectrometer with high spectral and high spatial resolution”.

The study has been carried out on the designing of a model of imaging spectrometer at Solar Terrestrial Influences Laboratory, Space Research and Technology Institute - Bulgarian Academy of Sciences (STIL - BAS).

The main instrument **characteristics** [1,2]:

Table 1
Spectral range – 400 – 800 nm;
Two spectral sub-ranges 400 - 600nm and 600 - 800nm;
Spectral channels 100, with 50 spectral channels each spectral sub-range;
Spectral resolution (FWHM-criterion) - 4nm;
Spatial resolution (IFOV) - 0.9 mrad.
Sensor – CCD area array 576X460 pixels.

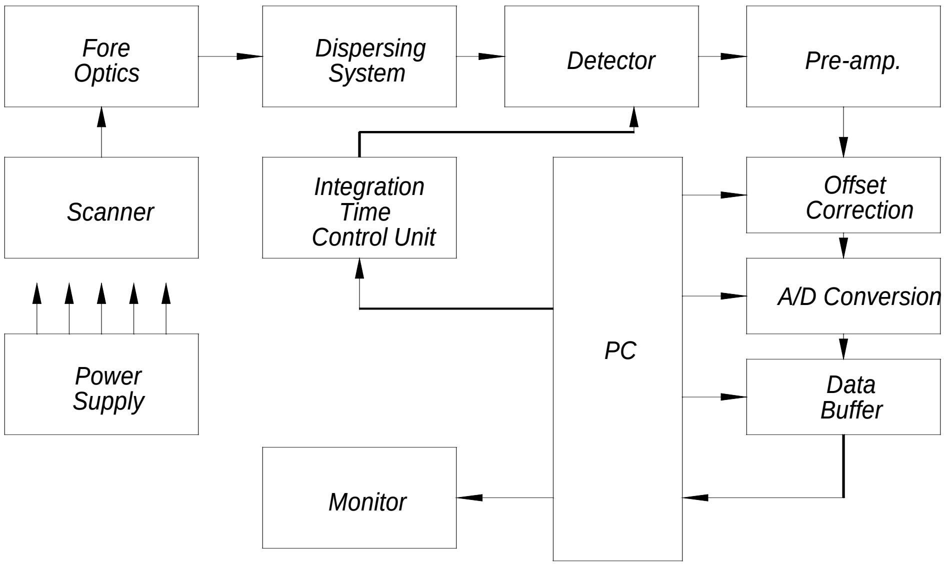

Fig. 1. Imaging Spectrometer Block Diagram

2.2 State-of-the art Hyper Spectrometers

Modern Hyper Spectral Imagers:

2.2.1 HySpex Sensor System (DLR) [3]:

Table 2. Spectral specifications of the HySpex sensors

Sensor	Spectral range	Number of channels	Sensor
VNIR-1600	416 – 992 nm	160	5 nm
SWIR-320m-e	968 – 2498 nm	256	6 nm

Table 3. Geometric specification of the HySpex sensors

	VNIR-1600	SWIR-320m-e
IFOV*	0.36 mrad across track	1.50 mrad across track
	0.72 mrad along track	1.50 mrad along track
FOV*	34 degrees (1600 pixels)	28 degree (320 pixels)
Swath*	1.6 km at 1 m IFOV (along track)	1.32 km at 2 m IFOV (along track)
	3.2 km at 2 m IFOV (along track)	2.64 km at 4 m IFOV (along track)

2.2.2 Hyperspec VNIR imaging sensor

Hyperspec VNIR
Table 4:
Wavelength Range (nm) - 400nm - 1000nm
Dispersion per pixel - 0.74 nm
Spectral Resolution (25μ slit) - 2-3 nm

Spectral Bands - 810
Spatial Bands – 1000

3. Applications of hyperspectral imagers

The spectral distributions shown below are an example of imaging spectrometer (SRTI, STIL – BAS) applications in the area of vegetation monitoring. When the vegetation is at a normal state, the value of NDVI is around 0.6, for rocks and deserts this value is close to zero (Kogan, 1994).

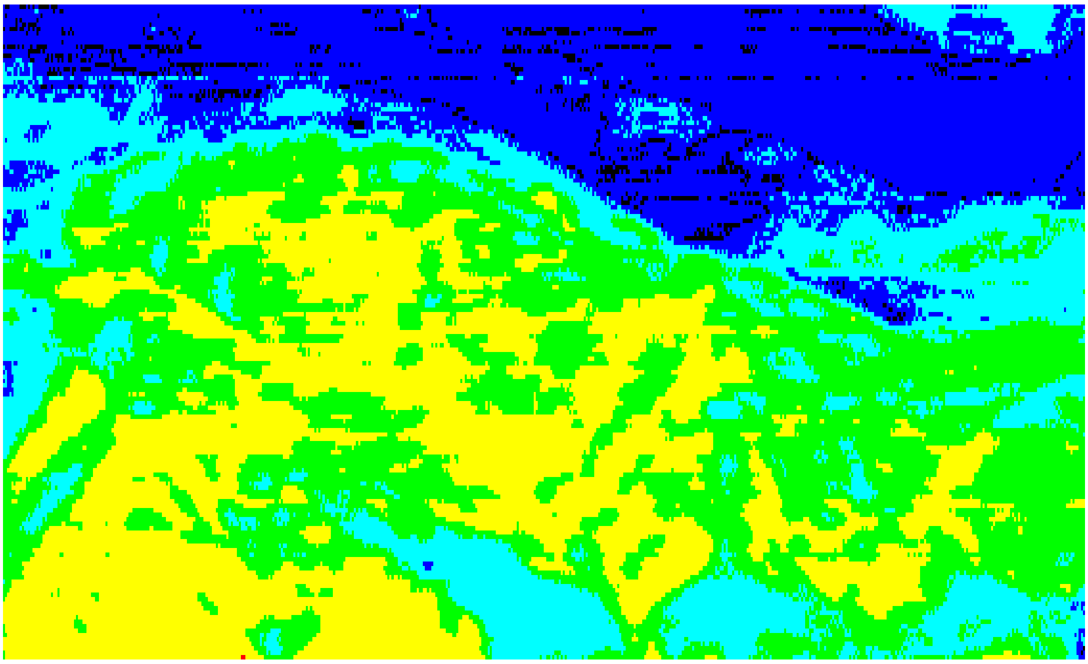

Fig. 2a

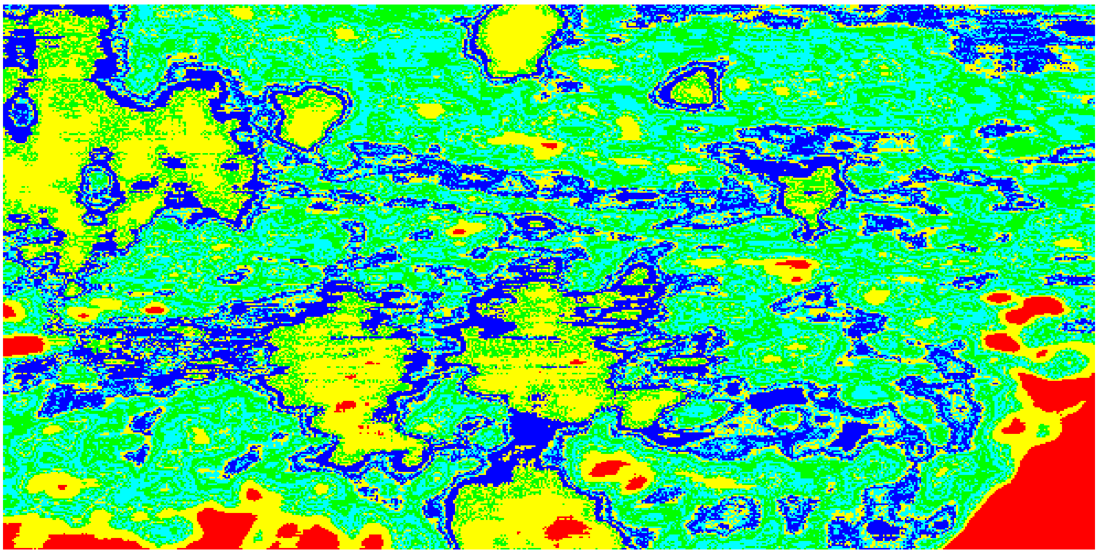

Fig. 2b

Fig. 2. Normalized Difference Vegetation Index (NDVI) images of two areas: a - Vitosha mountain, b - shrubs. Channel 1 wavelength - 550nm; channel 2 wavelength - 800nm; channel bandwidth - 6nm.

The spectral distributions shown above are an example of imaging spectrometer applications in the area of vegetation monitoring. When the vegetation is at a normal state, the value of NDVI is around 0.6, for rocks and deserts this value is close to zero (Kogan, 1994).

Fig. 3. Spectral image (RGB format) (**Hyperspec VNIR)**

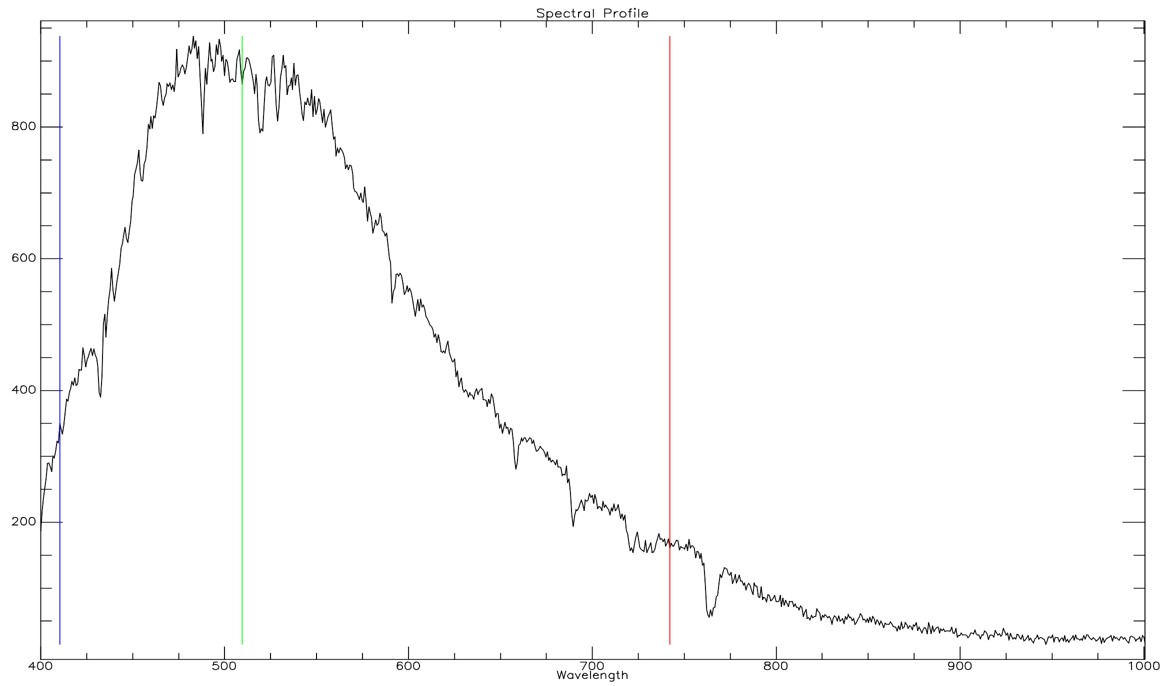

Fig. 3a. Sky spectral diagram

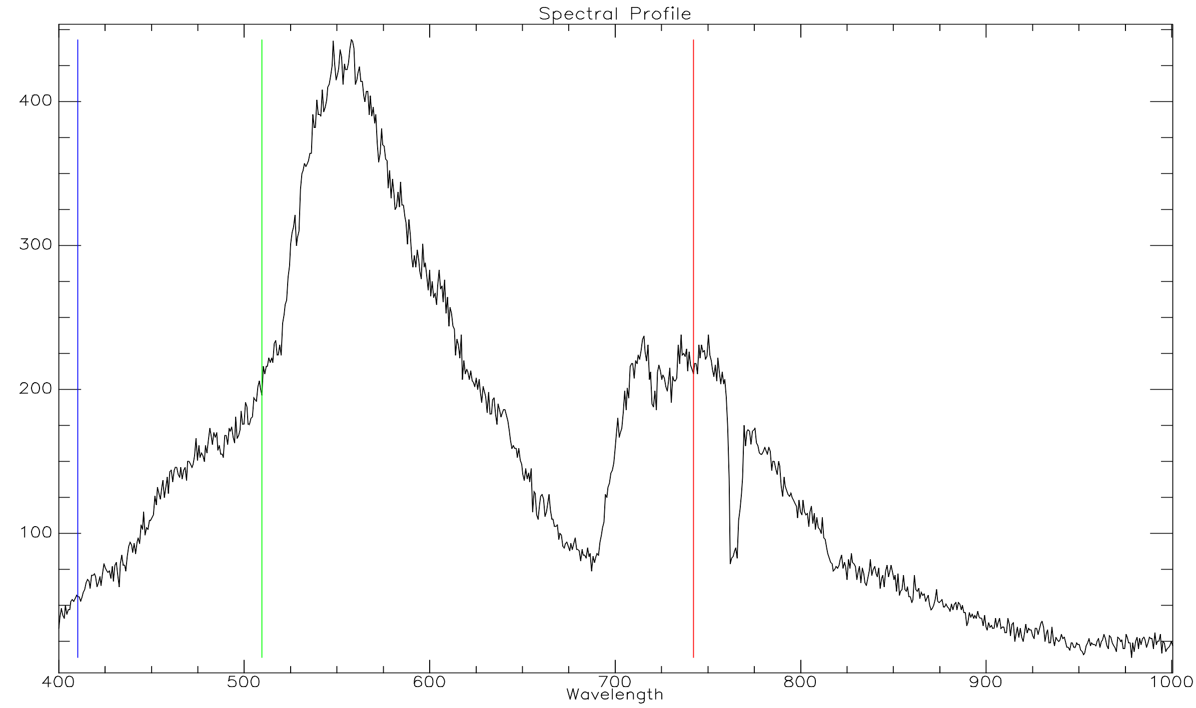

Fig. 3b. Vegetation spectral diagram

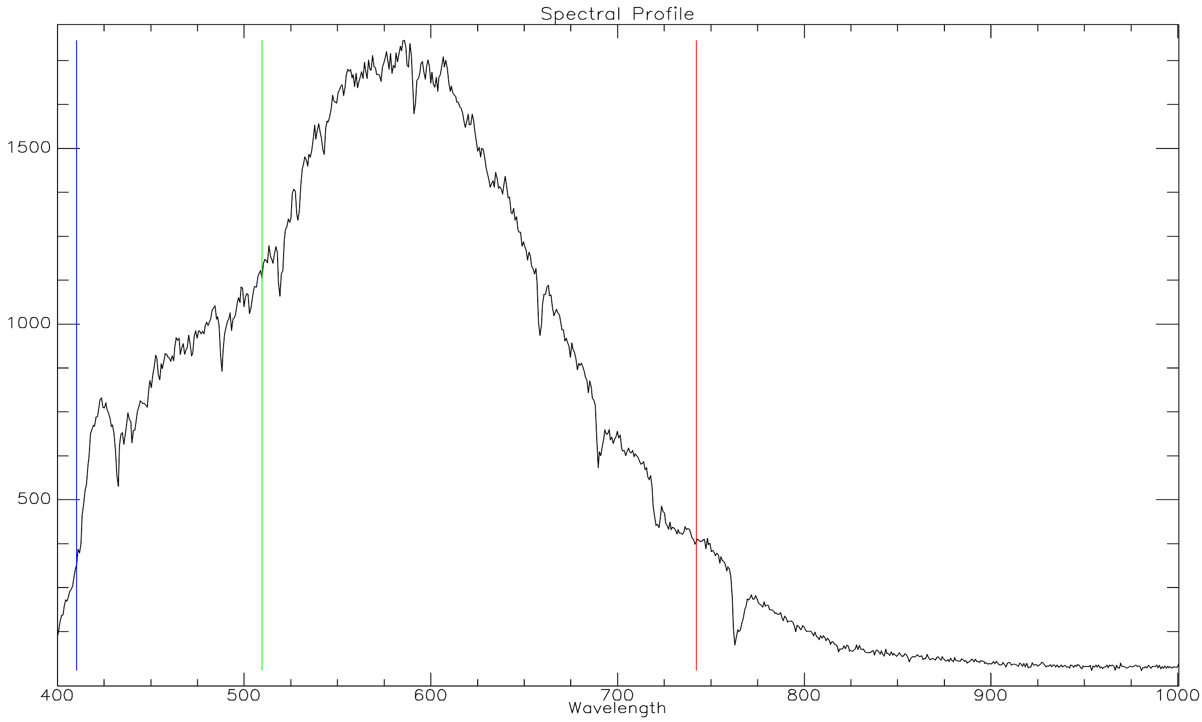

Fig. 3c. House spectral diagram

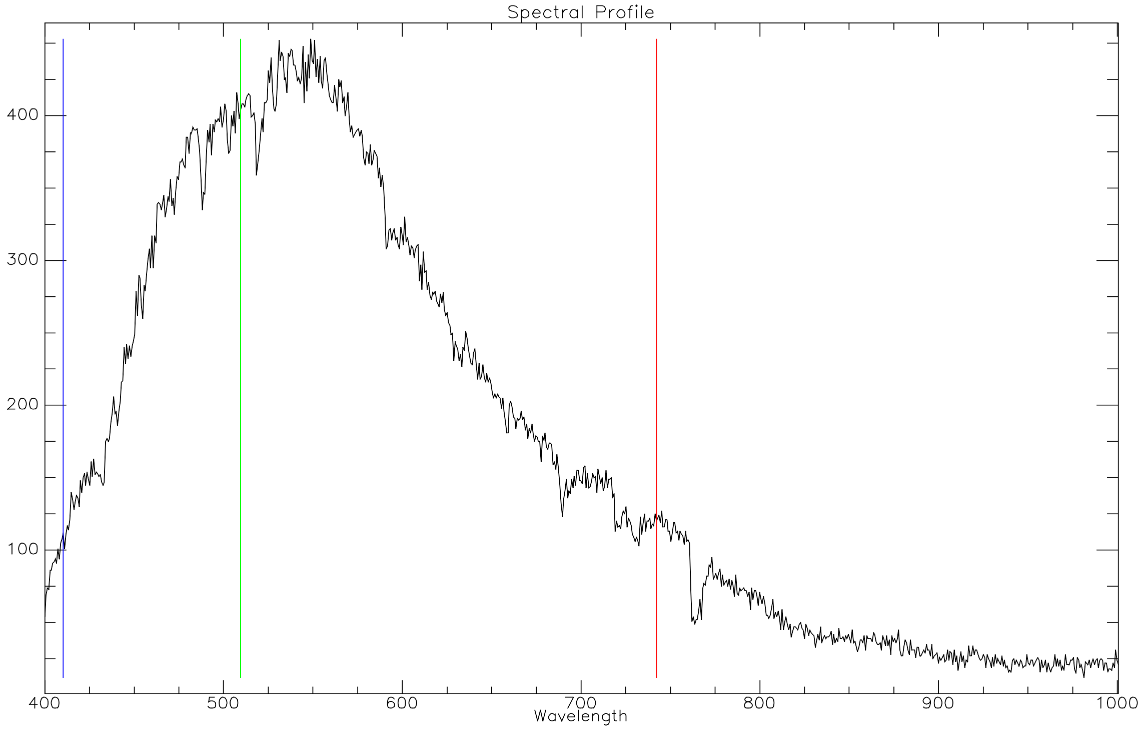

Fig. 3d. White body spectral diagram

4. Conclusion

The conclusion can be drawn that **hyper spectral images** make it possible to map biophysical and biochemical changes of the Earth's surface and the state of atmosphere with unprecedented accuracy. The observed tendencies show that we need better observation and understanding of the basic lines for sustainable development of our resources and the preservation of the environment.

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