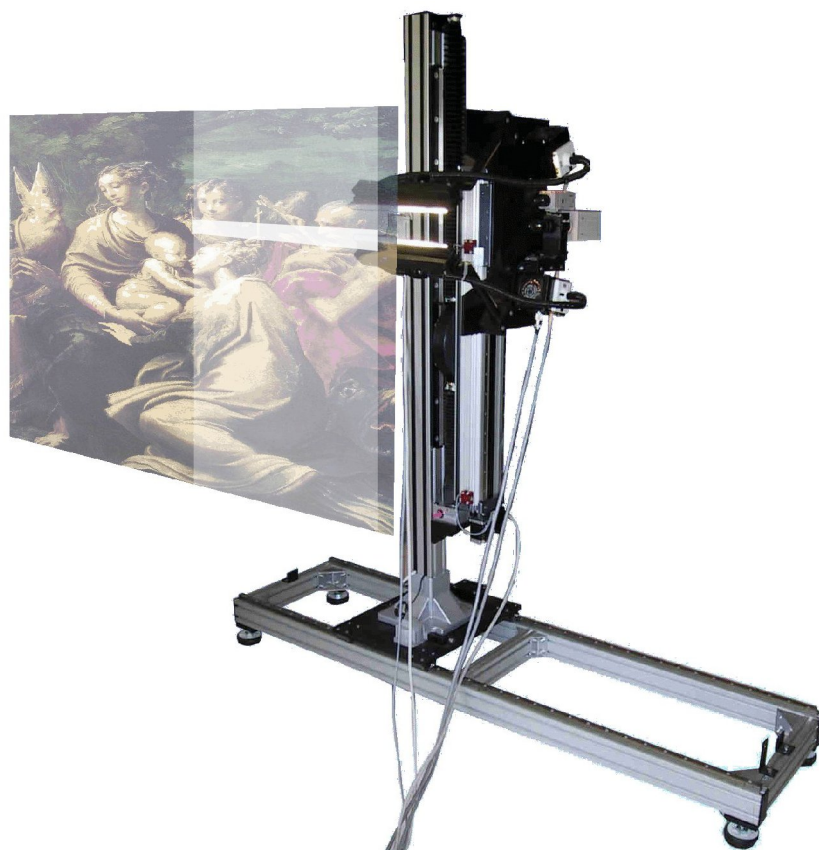


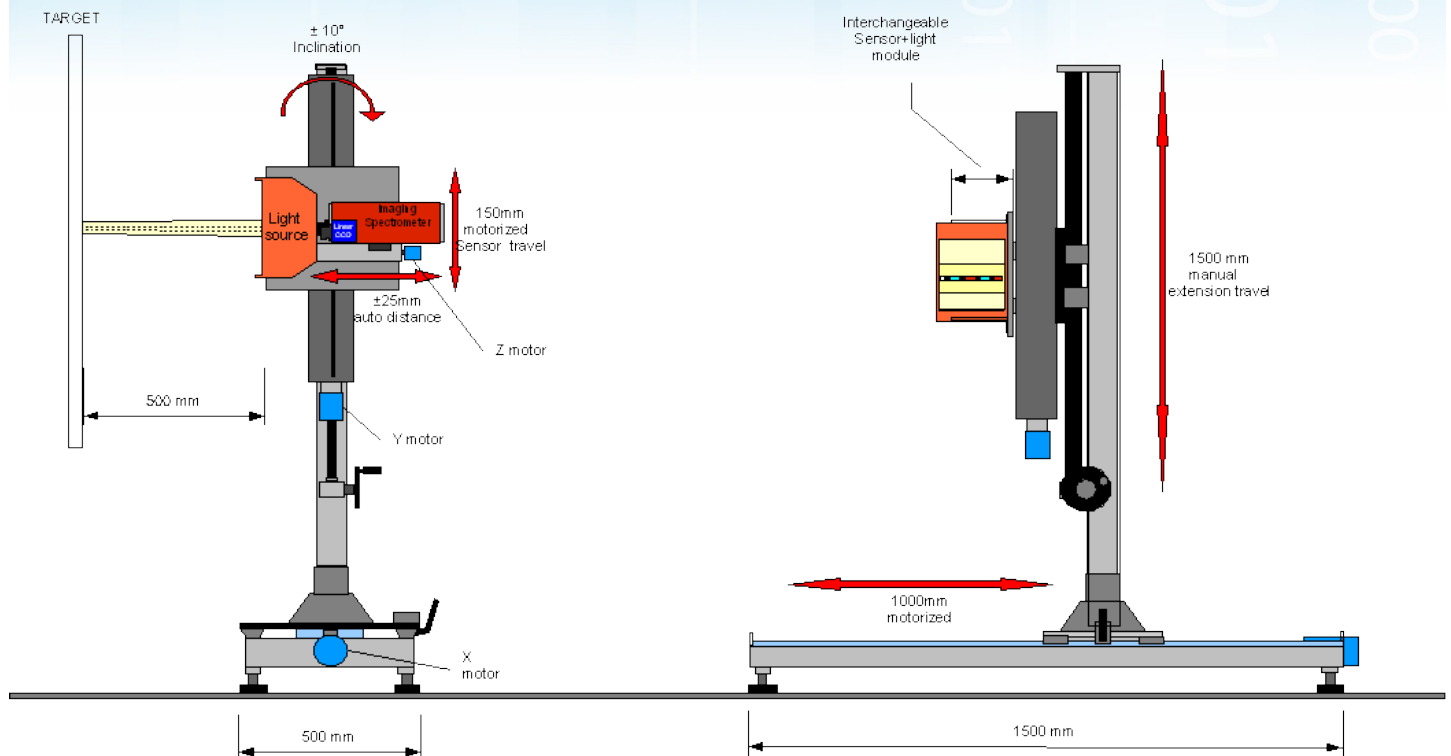
VERTICAL SPECTRAL SCANNER

for painting acquisition



The Vertical Spectral Scanner, produced on an original project of DV s.r.l., is an instrument to acquire with extreme simplicity the spectral distribution of the different wavelengths (spectral composition) of every single point of the inspected object. This represents a great advantage compared to traditional spectrophotometers which can perform the spectral analysis of only a single point at a time, or integrate the radiation from a whole area, losing the punctual localized information of the area.

The Vertical Spectral Scanner for painting can be used on-site for work of art spectral acquisition allowing an easy scan of 2D objects placed in vertical position. Acquisition can be performed in one or more pass depending on object size and spatial resolution wished. Spectral data is stored on a portable computer hard disk for following post processing. The main software application manage all acquisition parameters and make first elaboration for image stitching and reflectance calculation. A color linear camera can be mount together the spectral camera for high resolution acquisition.



The mechanical system is based on anodized aluminum profiles for optimal weight/rugged and to be transported for on-field acquisition. It consists of the following main blocks:

XYZ TRANSLATION AXIS

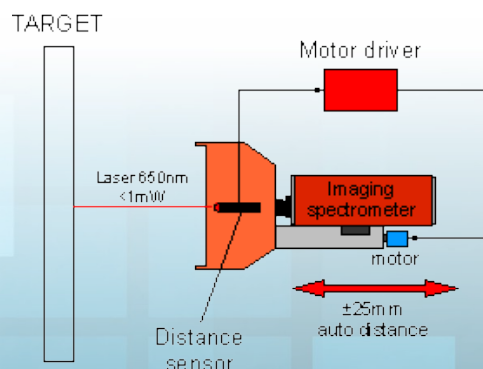
Motorized X axis: stroke 1000 mm Accuracy (rolling, pitching, yawing, parallelism) $50 \mu\text{m}$

Motorized Y axis: stroke 1500 mm Accuracy (rolling, pitching, yawing, parallelism) $50 \mu\text{m}$

Manual Y axis inclination: $\pm 10^\circ$

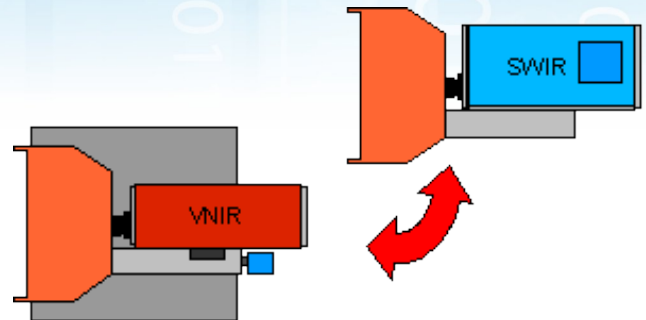
Manual extension Y axis: stroke 1500 mm

Motorized Z axis (optional): stroke 50 mm for constant distance from target. Motion controlled by optical sensor.



ACQUISITION AND LIGHT SOURCE MODULE

Spectral camera (imaging spectrometer + sensor) and illumination module can be easily mounted and unmounted to give place to different acquisition instruments.



HIPERSPECTRAL IMAGING SYSTEM VNIR [400-1000nm]

Imaging spectrometer

Spectral Range: 400-1000nm

Spectral resolution: 2.0nm

Input slit: 18μm x 14.2mm

Spectral Image dimension: spectral 6.15 mm spatial 14.2 mm

Numerical aperture: F/2.4

Dimension: max 60 x 60 x 175 mm

Weight: 1100g

Body: Anodized alluminium

Mount type: "C" mount

Environmental conditions: +5° / +40° not condensing



Sensor (CCD)

Resolution horizontal/vertical	2330 pixels x 1750 pixels
Interface	Gigabit Ethernet
Video Output Format	Mono 8, Mono 12, Mono 12 Packed,
Pixel Bit Depth	12 bits
Exposure Control	Programmable, external trigger
Housing Size (L x W x H) in mm	40.7 x 62 x 62
Housing Temperature	0 °C - 50 °C
Digital Input	2
Digital Output	4
Sensor Name	KAI-4050
Sensor Technology	Progressive Scan CCD, global shutter
Sensor Size (optical)	1 inch
Sensor Type	CCD
Sensor Size (mm)	12.85 mm x 9.64 mm



HIPERSPECTRAL IMAGING SYSTEM IR [1000-1700nm]

Imaging spectrometer:

Spectral Range: 900-1700nm

Spectral resolution: 5nm

Aberrations: Insignificant astigmatism, smile o keystone < 5 μ m

Entrance slit dim.: 30 μ m x 9.6mm

Image dim.: 9.6 mm x 7.2 mm

Numerical aperture: F/2.0

Total efficiency > 50%, independent of polarization

Stray light < 0.5% (halogen lamp, 1400 nm notch filter)

working temperature: +5 . +40 °C non-condensing

Sensor (InGaAs)

TE-cooled InGaAs photodiode array

Pixels: Full frame 320(spatial) x 256(spectral)

Data Interface USB: 12 bits

Frame rate: Up to 100 fps

Dynamic range: 68 dB (2400:1)

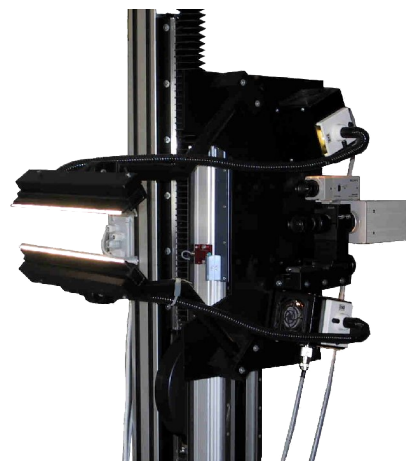


LIGHTLINE

Target is illuminated by two 150W Halogen lamps through two fiber optic bundles and two light lines to avoid damage of work of arts.

Input Voltage: 220V 50Hz

Power consumption: 300W



PORTABLE CONTROL UNIT

The control Unit contains all motor drivers and relative power supplies and light source power supply. X and Y Axis motors can be activated by buttons or joystick and all power line can be turned on or off.

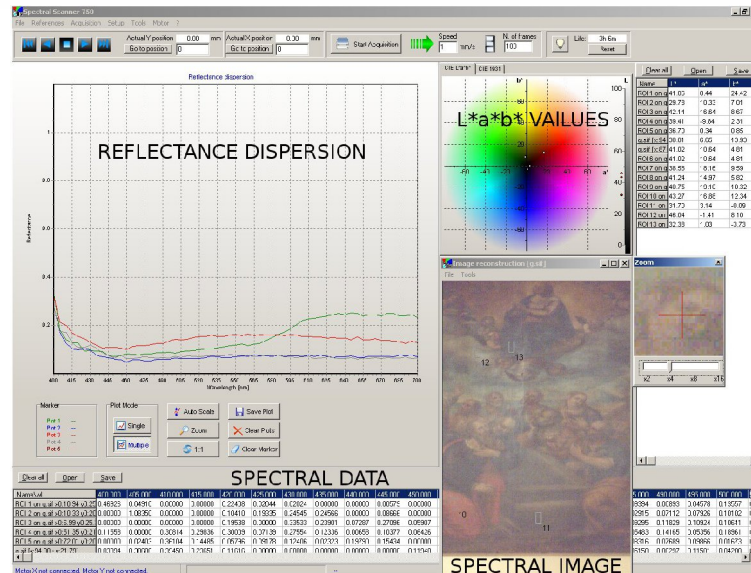
Input Voltage: 220V 50Hz

Power consumption: 500W



SOFTWARE

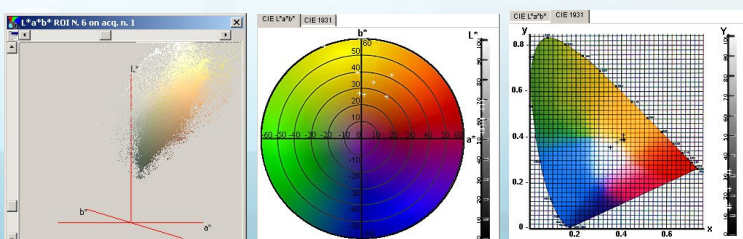
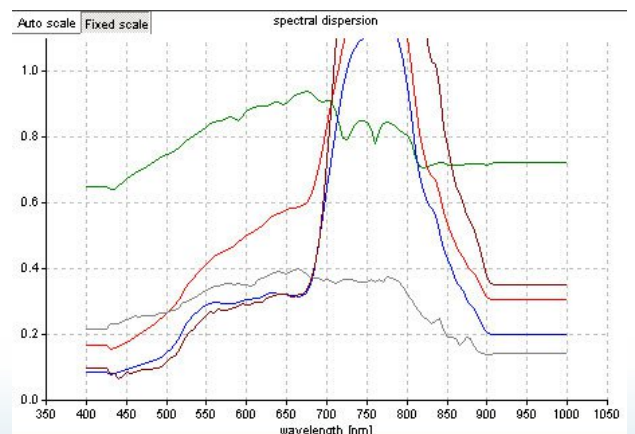
Spectral Scanner is a software compatible with Microsoft Windows XP/7. Its libraries and calculation tools make it ideal for research purposes and spectral imaging applications.



Many spectral imaging applications, like color measurement, require to determinate the absolute reflectance of the sample; *Spectral Scanner* calculates reflectance for every acquired pixel, evaluating the acquired signal ratio with a white reference sample. The mouse movement on the rendered image gives access to the spectral profiles of the selected pixels, instantly evaluates the colorimetric parameters and with one click lets you immediately save the data in various formats. Software filters allow narrow band analysis (up to 2nm) of the images. In the same way *Spectral Scanner* can render an image in transmittance mode for applications that require it.

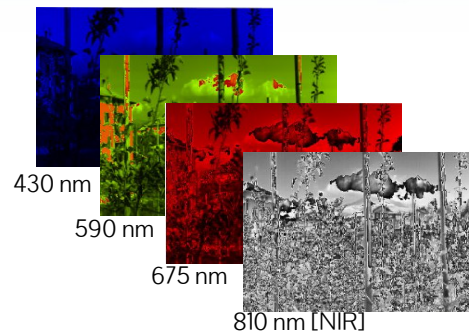
Spectral Scanner performs absolute and relative color measurements using the CIE $L^*a^*b^*$ standard colorimetric coordinates. Such parameters and the DE parameter can be evaluated for the single pixel, for a selectable part of the image or for the whole image, making *Spectral Scanner* very versatile in spatial resolution.

CIE 1931 or CIE 1964 standards can be selected with D65 or A illuminants.



CIE $L^*a^*b^*$ (3D and 2D dispersion) and CIE 1931

Spectral Scanner allows the selection of single bands with defined wavelengths and the visualization to screen of the rendered filtered images.



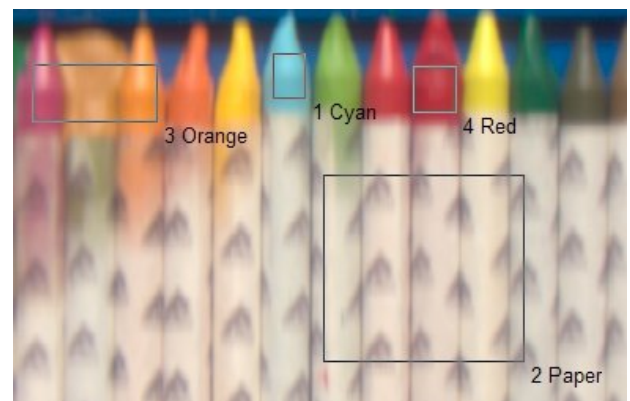
All the spectral reflectance data and colorimetric calculated values can be quickly exported for further elaborations with other mathematical applications and tools. ENVI file format is supported.

	400.000	405.000	410.000	415.000	420.000	425.000	430.000	435.000	440.000	445.000	450.000	455.000	460.000
A1.tif [x:38.19 - y:17.61]	0.00889	0.01285	0.01581	0.01581	0.02075	0.02372	0.02767	0.03554	0.04249	0.05429	0.06324	0.07016	0.08202
A1.tif [x:43.75 - y:13.81]	0.00593	0.00692	0.01086	0.01382	0.01678	0.01974	0.02468	0.02863	0.03949	0.04837	0.05923	0.06910	0.07700
A1.tif [x:10.42 - y:17.01]	0.00692	0.00988	0.01087	0.01285	0.01482	0.01383	0.01976	0.02273	0.02668	0.03557	0.04447	0.04941	0.05435
A1.tif [x:130.21 - y:23.42]	0.00297	0.00396	0.00297	0.00791	0.00988	0.01285	0.01680	0.02075	0.02866	0.03656	0.04545	0.05435	0.06324
ROI 1 on A1.tif [x:51.74 - y:0.0]	0.00591	0.00735	0.00897	0.01078	0.01262	0.01434	0.01613	0.01912	0.02247	0.02623	0.03024	0.03392	0.03777
panoramic.tif [x:7.97 - y:35.0]	0.12418	0.12418	0.12418	0.12418	0.12418	0.11243	0.11795	0.11842	0.11765	0.12703	0.12911	0.13443	
ROI 2 on panoramic.tif [x:0.0]	0.13001	0.13001	0.13001	0.13001	0.13001	0.13001	0.12222	0.12308	0.12789	0.13420	0.14041	0.14609	0.15224

Spectral Scanner provides many tools for thorough comparative analysis of the acquired spectral images, useful when a high grade of colorimetric conformity with a sample reference is demanded.

It's possible to save in a file the regions of interest of an acquired spectral image and then reutilize them for further acquisitions. Useful for analyze the same zones of various samples.

The use of the file containing the positional data of the regions can be automated: all the acquisitions will have the same regions selected and analyzed; copy-and-paste of the regions is allowed also between two spectral images.



Multiple strips can be stitched manually or using internal algorithm to obtain single image and datafile.

