

# HYPERSPECTRAL SCANNER FOR IMAGE SPECTROSCOPY OF WORKS OF ART

Image reflectance spectroscopy has been utilized for extracting spectral information over an extended painted surface. Scanner system is developed by IFAC Image Spectroscopy Laboratory (Italy). Utilized technology: SPECIM's V10 imaging spectrograph combined with high accuracy CCD camera and fiber optic light line illumination.

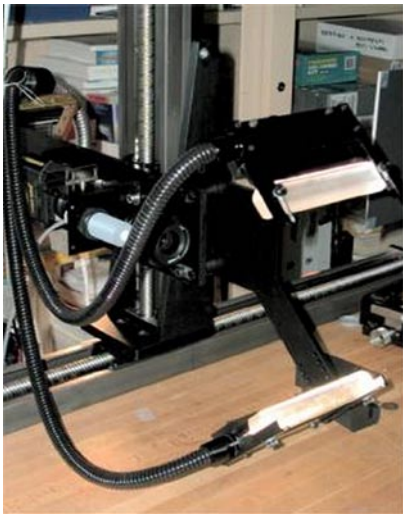


Figure. 1 - Hyperspectral scanner: detail of the head and illumination fibre optics bundles

A typical approach, which was followed previously in order to obtain extensive spectral information for diagnostic purposes involving works of art, consists of acquiring a sequence of narrow band images taken at different wavelengths. However, such a band-sequential approach has a limited spectral resolution.

In order to overcome these limitations, a special hyperspectral scanner offering high performances both in spatial and spectral resolution has been designed and developed at the IFAC Image Spectroscopy Laboratory.

A spectrographic head moved along two orthogonal axes of a vertical plane mounts an in-line dispersive optics that is based on a prism-grating-prism ensemble (ImSpector[™] mod. V10). The lighting system, which is realised by means of two fibre optics bundles terminating in cylindrical lenses, projects a "light strip" onto the object plane. It moves together with the spectrographic head, to guarantee uniform lighting conditions and limited light exposure (Fig. 1).

Figure 2 shows the scanning of the "Madonna of the Yarnwinder", within the framework of the Universal Leonardo Project.

## Hyperspectral scanner

SCANNER FEATURES	
Spectrograph	ImSpector [™] mod. V10
Digital Camera	Hamamatsu Orca ER
Spectral range	400-900 nm
Spectral sampling	1 nm
Scanned area	1 m x 1 m
Spatial sampling	0.1 mm (254 ppi)
Spatial resolution	~2 lines/mm
Acquired file (max)	~128 GByte



Figure. 2 - Scanning a painting on a wooden panel

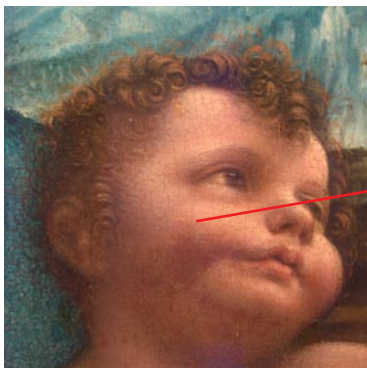


Madonna of the Yarnwinder

## SOFTWARE

Suitable software has been developed to manage cube files of hyperspectral high resolution images up to 128 Gbytes and to extract the spectra immediately, simply by pointing the cursor at any point of the painting image. The demo of such software is available at <http://www.ifac.cnr.it/webcubview/demo/>. An example of the results achieved by using the demo software can be seen below.

To help in the identification of pictorial materials, a reference data base of reflectance spectra for several kinds of pigments and pictorial layers has been set up at IFAC, and is available at <http://fors.ifac.cnr.it>. This research has been partially funded by the Italian CNR "Cultural Heritage" Project and by the Opificio delle Pietre Dure of Florence.



Detail



Reflectance spectrum from hyper-spectral image cube