Ormylia
Art Diagnosis
Centre

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High Resolution Spectroscopic Mapping Imaging Applied In Situ to Multilayer Structures for Stratigraphic Identification of Painted Art Objects

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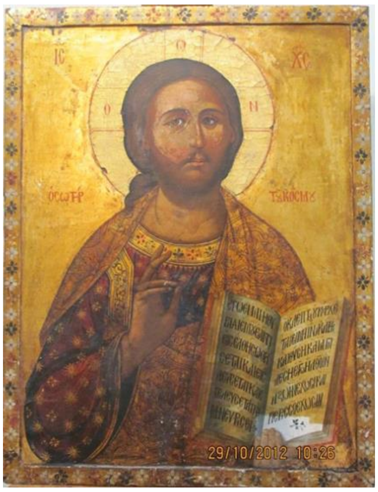
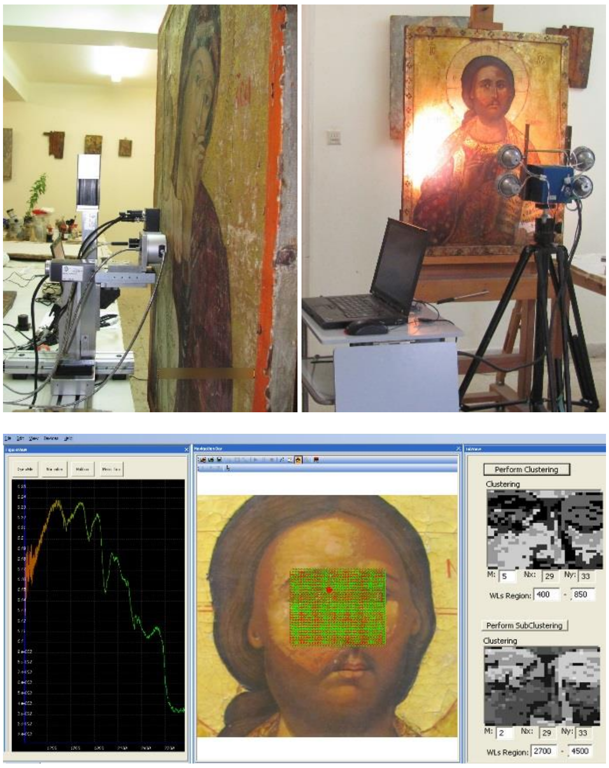
The development of non-destructive techniques is a reality in the field of conservation science. Still, these techniques are not usually as accurate as the analytical micro-sampling ones. Nevertheless, the proper development of soft-computing techniques can improve their accuracy. In this work, we propose a real-time fast acquisition spectroscopic mapping imaging system that operates from the ultraviolet to mid infrared (UV/Vis/nIR/mIR) area of the electromagnetic spectrum and it is supported by a set of soft-computing methods to identify the materials that exist in a stratigraphic structure of paint layers. Namely, the system acquires spectra in diffuse-reflectance mode, scanning in a Region-Of-Interest (ROI), and having wavelength range from 200 up to 5000 nm. Also, a fuzzy c-means clustering algorithm, i.e. the soft-computing algorithm, produces the mapping images.



Experimentation

The technique was applied to a byzantine painted icon from Cyprus. This holy icon of the Saviour is yet used permanently in the cult. It is dated at the late 17th century with levels of over paintings in different periods till the late 19th century. The main problem of this religious painting was the lacunae (partially arising as a result of mechanical cracks because of the sensible type of the materials in use) found at the face-front, which originally was cancelled especially the eyes. In this region of interest of the icon, a specially designed spectroscopic mapping software drives the hardware along a predefined set of raster arranged points.

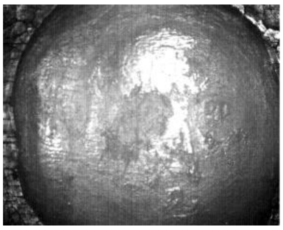


The icon was scanned in situ in the conservation laboratory of the Holy Archbishopric of Cyprus using the prototype spectroscopic and the InSb 640x512 FPA XENICS imaging devices.

Results

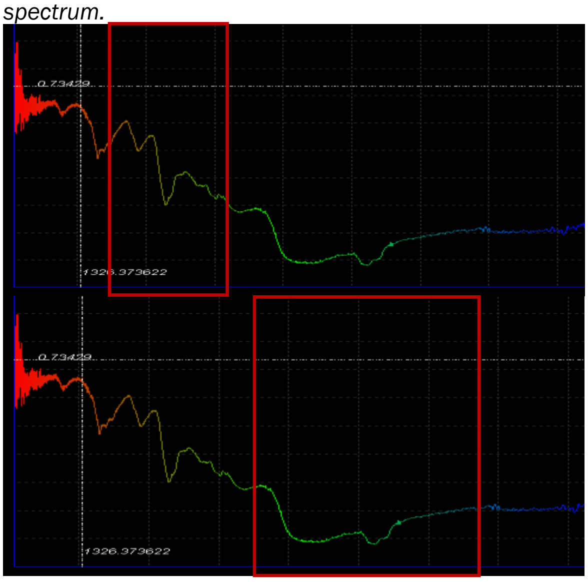
Infrared images acquired at 1800nm and in the spectral area from 2785 up to 5000nm

5000nm>λ>2785nm



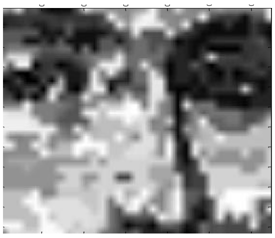
1800nm

Infrared spectroscopic mapping images acquired at the spectral area between 300nm and 850nm , in the area near 1800nm and between 2700 and 4800nm each gray level correspond to different diffuse reflectance spectrum.



4800nm>λ>2785nm

1800nm



Conclusions

In this work, we have presented an in-house built prototype device, operating in diffuse reflectance mode from 200 nm up to 5000 nm, appropriate for the non-destructive documentation of artworks. The spectroscopic technique is accompanied by a soft-computing technique in order to enhance the overall detection accuracy. By exploiting the acquired UV/VIS/nIR/mIR spectral information, the proposed technique identifies the materials that exist in the surface, as well as in the hidden paint layers of an art object, as observed by experimenting on this byzantine painted icon. The experiment evidently shows, via stratigraphic analysis, the kind of maintenance the icon has been subjected to over the centuries. The results of the mapping images presented in the wavelength area between 2700–4800 nm provide the possibility to acquire information from the whole stratigraphy of the icon, up to the preparation or the substrate layers.