Ormylia
Art Diagnosis
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Material mapping multispectral images acquired using Ultrasound (acoustic) Microscopy and Diffuse Reflectance Spectroscopy: Application to a Claude Monet painting and a wall-painting fragment

The technique

The proposed technique is based on the combination of two modalities; acoustic microscopy and diffuse reflectance spectroscopy and imaging from the ultraviolet up to the mid infrared area of the spectrum (UV/VIS/nIR/mIR), targeting to non-destructive stratigraphy identification of art objects (**fig. 1-2**). Using acoustic microscopy, the number and thickness of the stratified layers can be obtained using the information derived by the a-scan and c-scan. Using UV/VIS/nIR/mIR diffuse reflectance spectroscopy, the identification of the materials comprising each paint-layer can be achieved (**fig. 2**). The final result is material mapping images for both the upper layer and the existing under-layers.

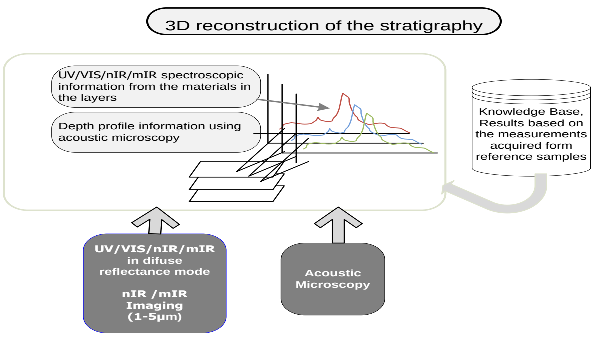


Figure 1 *The concept of the system*

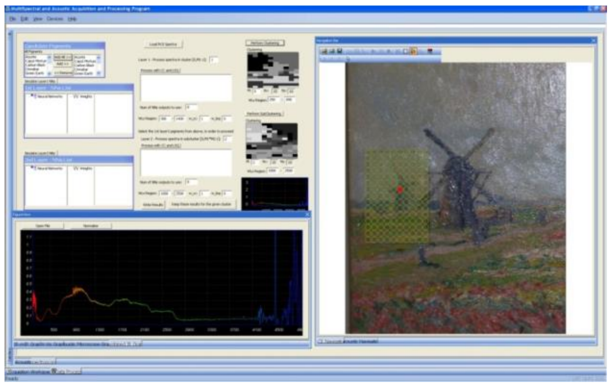


Figure 2 *The multispectral and acoustic acquisition and processing software*

Application

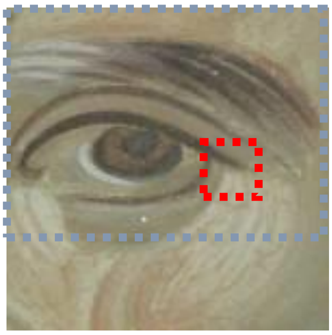
For each point of the artwork inside a specific Region-Of-Interest (ROI), the prototype device is able to scan and acquire diffuse reflectance spectra from 200nm up to 4500nm as well as echo graphs from the paint layers. From the same regions, images are acquired in the IR area of the spectrum from the 1000nm up to 5000nm (**fig. 1**).

Results

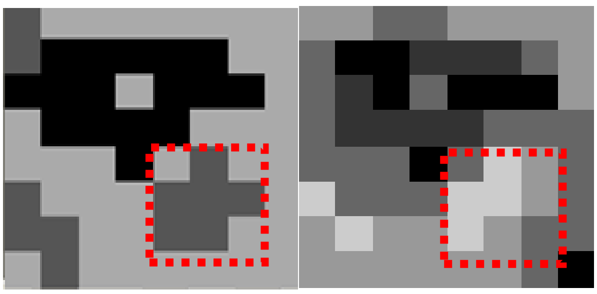
The system was tested on a wall painting fragment and a Claude Monet painting in order to be evaluated. In **fig. 3** the wall painting fragment and the corresponding infrared image from the 1500nm up to 5000nm is displayed respectively.

Fig. 4a shows the wall-painting ROI scanned with the spectrophotometer, while **4b** and **4c** display respectively the material mapping images which have been created based on the acquired spectra in the UV/VIS and the IR spectral area. These mapping images are in agreement with the materials of the painting as well as the IR reflectance image displayed in **fig. 3**. The region indicated with dashed line was also scanned with the acoustic microscope. In **fig. 5a** the a-scan acquired with the acoustic microscope from the area of brush strokes is shown and **fig. 5b** displays the wavelet transform of it, revealing three echoes. These echoes are generated by the successive interfaces that indeed exist in the stratigraphy.

***Figure 3** The wall-painting fragment and the corresponding IR reflectance image*

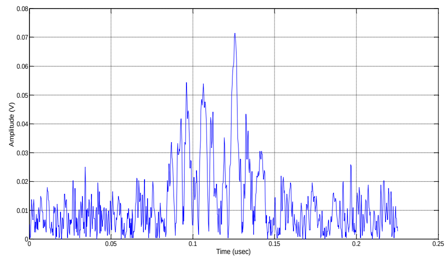


(a)

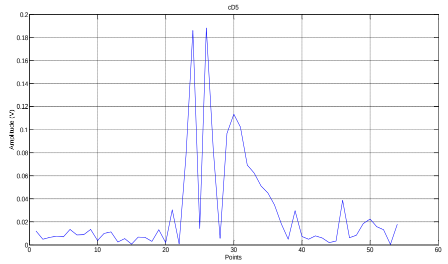


(b) (c)

***Figure 1:** Image of the wall-painting ROI in the visible spectrum and the corresponding mapping images*



(a)



(b)

***Figure 5** Wall-painting: The a-scan acquired from the area of brushstrokes (a) and the wavelet transform of it (b). The x axis is representing time and the y axis is representing voltage*

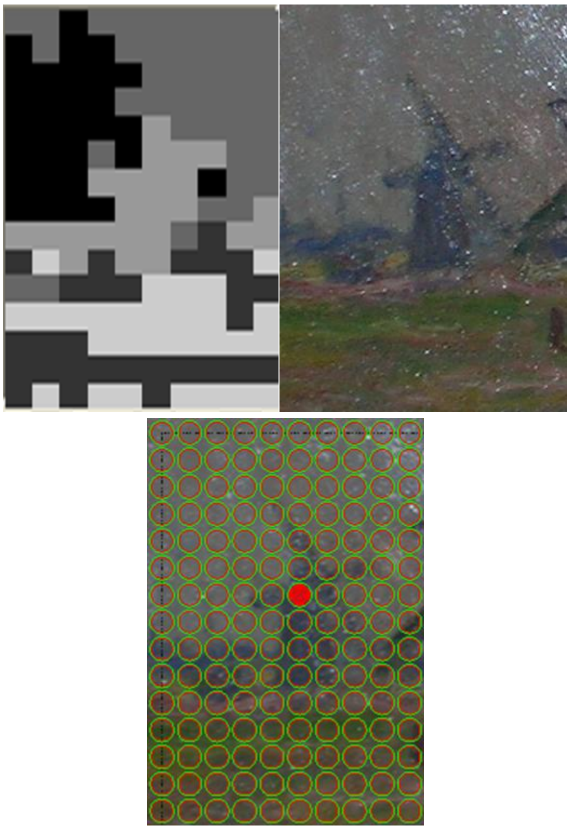


***Figure 6** Monet painting: Clustering of the materials on the surface as well as in the paint layers of the painting in a specific scanned Region of Interest*

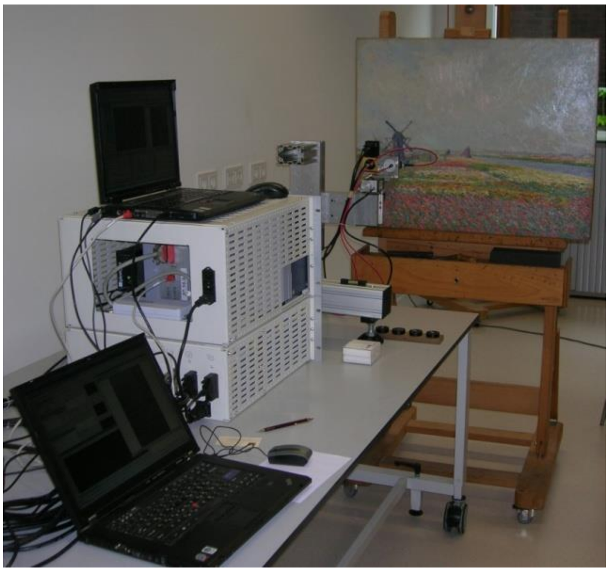


Figure 7 *The instrumentation that was used for the in situ scanning of the MONET painting*

References

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