IMAGE DATA FUSION APPLIED TO THE RECOGNITION OF PICTORIAL LAYERS

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Painting materials were investigated through two hyperspectral cameras adopting a data fusion approach, allowing to identify and characterize the pigment materials in a rapid, non-invasive and reliable way.
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1. Introduction

Hyper-Spectral Imaging (HSI) as a diagnostic tool in the field of cultural heritage is gaining an increasing interest and this technique has been largely used in the last decade tanks to its ability to obtain both spatial and spectral information from a sample [1]. Furthermore, for a more comprehensive characterization of the sample of interest, it is a consolidated practice to acquire multiple imaging data coming from different devices covering different spectral ranges. In the present study, we present an analytical approach based on data fusion strategies to perform an evaluation of imaging data, related to point layers of the different pigments, acquired in two spectral ranges, visible near infrared (Vis-NIR: 400-1000 nm) and short infrared wavelength (SWIR: 1000-2500 nm), using two imaging devices. The aim of the study was to verify and validate, according to the information acquired in the investigated wavelength regions, the advantage of using collected spectral signatures in different spectral ranges from 400 to 2500 performing a "data fusion" in respect to utilize them separately and then comparing/integrating the results separately achieved for the two ranges.

2. Experimental

A conspicuous group of painting layers were investigated in the visible VIS-NIR (400–1000nm) and SWIR (1000-2500 nm) range. HSI measurements in the VIS-NIR region was performed using a hyperspectral scanner based on an ImSpector™ V10E (SPECIM Ltd, Finland) with a spectral resolution of 2,8 nm, dispersion of 97,5 nm/mm, numerical aperture F/2.4 and slit width of 30μm, equipped with a 25 mm lens. Pixel resolution was 12 bits. This spectrograph is connected to a CCD camera (Blaser A312f) equipped with a higher sensitivity sensor (Sony ICX 415AL/AQ, 782x580 pixels). The number of the acquired spectral band in the VIS-NIR range was 121. HSI measurements in the SWIR (1000–2500nm) region was performed using Specim SISUChema XL™, embedding an ImSpector™ N25E (Specim Ltd, Finland) acting in the range from 1000 to 2500 nm, with a spectral sampling/pixel of 6.3 nm, coupled with an MCT camera (320x240 pixels). The number of the acquired spectral band in the SWIR range (1000-2500 nm) was 240. The Spectral sampling/ pixel was 6.3nm. Before each scan the scan-light is verified by a certified standard target of diffuse reflectance (Spectralon). Data were processed adopting a chemometric approach [2], in accordance with implemented methodologies in previous works [3].

3. Results

An example of the prediction map obtained of the different paint layer investigated is shown in Fig. 1.

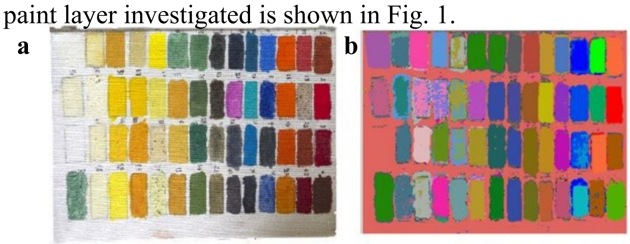

Fig. 1 Reconstructed RGB map of the pictorial layers (a) and prediction results (b).

Based on classification result, we have detected all paint layers and background.

4. Conclusion

The results showed the great advantages in terms of prediction performances offered by the proposed approach. New scenarios can thus be envisaged when different spectral units, characterized by different wavelength sensing features are utilized to perform analyses finalized to the characterization, the conservation and the monitoring of paintings following a "one shot" analytical approach able to handle larger spectral ranges deriving from different sensing units.

References

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