



STSM Report

Hyperspectral imaging of historical manuscripts and natural scenes

REFERENCE: Short Term Scientific Mission, COST TD1201

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Host: Prof. Sérgio M. C. Nascimento, University of Minho, Portugal

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Purpose of the STSM

In order to establish a better method to represent 'natural colours' and art conservation, it is essential to achieve precise estimation of spectral properties in historical artefacts and natural scenes; to evaluate their relationship to human vision computationally and psychophysically.

The present report aimed particularly to explore effective representations of art images by gaining a better understanding of natural spectra and technical limits. To accomplish these, the hyperspectral imaging was performed at the host (University of Minho) and home (University of Manchester) institutions with different methodology and post image processing over the same artefacts. With the resulting image data, psychophysical experiment was performed to explore how human observers appreciate colours in art paintings, namely colour preference.

Hyperspectral imaging

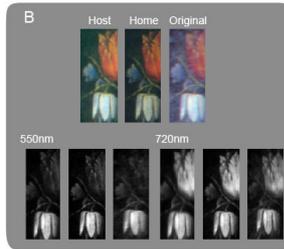
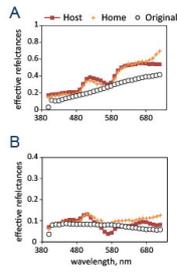
Hyperspectral imaging was performed with reproductions of art paintings (Renaissance époque paintings) at each of the host and home institutions. The system consisted of a low-noise Peltier-cooled monochromatic digital-camera and a fast tunable liquid-crystal filter, ranged 400-720 nm in 10 nm step. The image acquisition procedure and data processing differ between the institutions in the following points: selection of exposure times; the number of repetitions in image acquisitions; with/without on-chip camera gain; dark noise processing; with/without image registration over the repetition and over spectrum (removal of chromatic aberration and noise by vibration and other environmental factors). Despite these differences, good agreements were observed in resulting spectral profiles. To establish best procedure, characteristics of optical lens and of dark-noise are to be evaluated.

Psychophysics

Colour reproduction of art paintings tends to have higher saturation. This may well be based on observers' colour preference. To test how human observers appreciate the colours of the paintings, colour adjustment experiment was performed. Observer adjusted hue so that art paintings appeared to be 'natural' (i.e. as if they are appreciated at museum). The hyperspectral imaging data of the Renaissance époque and the 20 c modern paintings were used. The results suggested that observers can adjust colours as sensitive as to colour errors in natural scenes.



Hyperspectral imaging



Psychophysics

Adjustment of 'natural' hue

