Use of Near- and Mid-IR hyperspectral imaging for paint identification, as an aid for artwork authentication

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In recent years various scientific practices have been adapted to the artwork analysis process and a set of techniques was found advantageous for conservation and restoration works [1]. Apart of these applications, art market also benefits from scientific testing of artwork. Although these services are already available to support determination of the authenticity of traded pieces, they are very expensive and time consuming and therefore serve only very limited range of transactions. As a response for requirements of growing market there is a need for rapid and non-destructive methods empowering art authentication [2].

Hyperspectral imaging combined with signal processing and classification techniques are proposed as a tool to enhance the identification of art forgeries. Using two hyperspectral imaging systems and a bespoke paintings designed for this work, a spectral library of selected pigments was established and the viability of training and the application of classification techniques based on this data was demonstrated.

Parallel to this work, a noise reduction approach was developed for the laser based Mid-IR hyperspectral imager. Illumination source in this system is a Q-switched laser, pumping an intracavity optical parametric oscillator. It is characterised by strong pulse-by-pulse jitter, manifesting itself as a noise in acquired images. Boxcar integrator based normalisation technique was employed to demonstrate the noise reduction capabilities for applications with such systems.

Developed techniques were used for the analysis of actual forged paintings held by the Berlin police, which comprised known and suspected forgeries from the infamous Beltracchi case [2, 3]. The analysis resulted in the identification of an anachronistic paint, confirming the falsity of the artwork.

This work demonstrates the ability of infrared hyperspectral imaging to identify various pigments and its applicability as an aid for artwork authentication.

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References:

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Figures

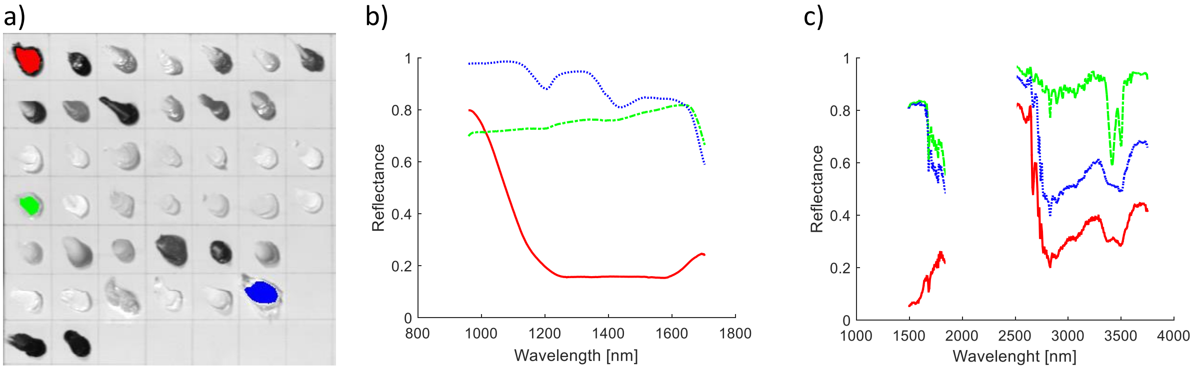

Fig. 1. Single band intensity image (at 1300nm) illustrating data extraction for three example paints from the bespoke paint grid canvas (a) and their corresponding average spectra acquired by passive, Near-IR (b) and active, Mid-IR (c) hyperspectral systems

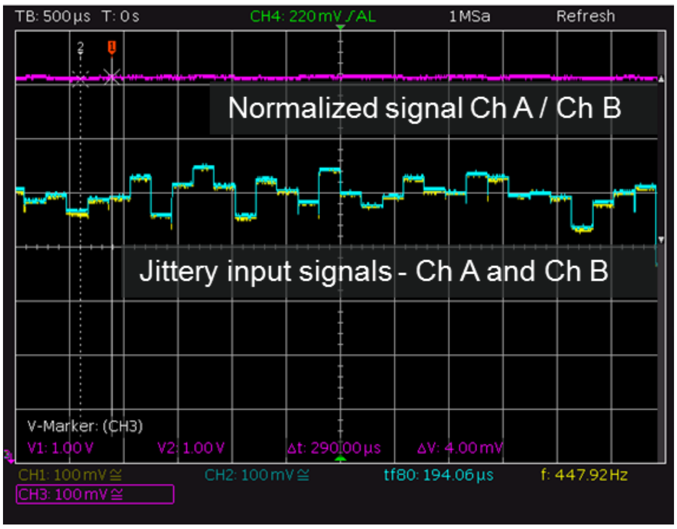

Fig. 2. Oscilloscope traces illustrating voltage representation of integrated laser pulses. The yellow (Channel A – test signal) and turquoise (Channel B – reference signal) traces, aligned to overlap each other, demonstrate the pulse-by-pulse jittery signals fed to the normalisation electronics while the magenta coloured trace demonstrate the resulting, normalised signal, with significantly reduced variation.

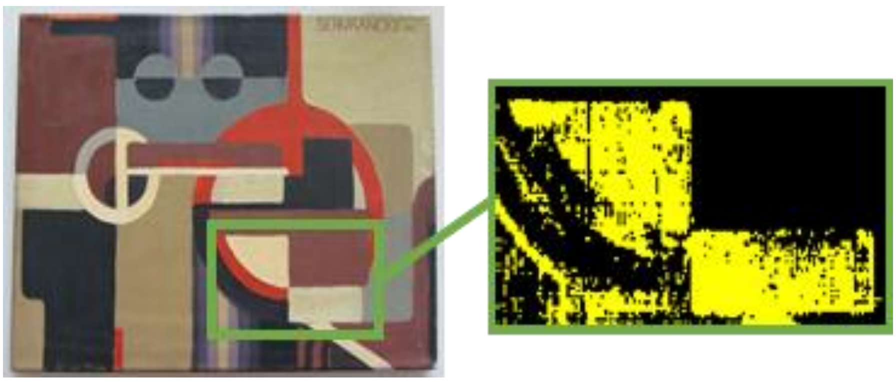

Fig. 3. Illustration of a Beltracchi forged painting, described as Sevranckx, with an indication of the analysis region and classification result of selected white/cream colour as an anachronistic paint - Titanium White.