Ultra-high resolution, full-field, time domain OCT in the visible range and multi-spectral camera. Crosschecking and complementarity of the images

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In order to increase the knowledge on works of art for restorers and art historians, we present two instruments allowing non-destructive measurements and whose results are complementary. We begin by a short description of both devices, already developed since four years[1, 2]. We shall here insist on the new improvements of each method. Images on an oil painting, a portrait of the Austrian painter Franz Schrotzberg (1811-1889), with several restorations, will be presented and compared [3, 4].

The OCT instrument built at INSP works in the visible range in order to obtain a micrometric accuracy in the three directions. The system is based on a Linnik interferometer, which allows full-field recording, without lateral sweeping. Both arms are then gathered in a Mirau interferometric objective leading to record in-face images 200µmx 200 µm each 40 nm in depth. Recent improvements deal with the instrument and the signal processing:

- A new Mirau with four different beam-splitters allows increasing the contrast of the interferograms.
- The signal processing has been modified in order to increase the signal to noise ratio: the Larkin algorithm used initially has been replaced by a first band-pass filter followed by the demodulation of the interference career and at last by a second band-pass filter.

The OCT results thus lead to quantitative information with ultra-high resolution, in lateral or transverse 2D images or 3D reconstructions. Surprising images of Schrotzberg's portrait will be presented.

The multi-spectral camera built by Lumière and Technology [5] contains 13 interferential filters from 440 to 900 nm, a CCD of 12 000 pixels on each line and 20 000 lines. So that 240 millions of pixels are recorded for each wavelength and allows spectra reconstruction. The Schrotzberg's portrait was recorded with 354 dpi, the size of the digital painting was 4323 x 5370 pixels with a pixel lying around 70 µm^2. The following new developments are listed here:

- Compatibility between the reflectance spectra recorded with the camera and those belonging to our spectra date-bases of pigment and dye references. Pigment, dye and pigment mixture can then be identified 6, 7.
- Virtual unvarnishing of the painting
- Visualization of touching-up thanks to the difference of images at different wavelengths, using different algorithms such as numerical derivate, minimum of entropy or weighting of images.

The multispectral camera leads to qualitative information that can be crosschecked to OCT results, such as the network of micro-cracks and the depth of each crack.

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