



CNR-INO

ISTITUTO NAZIONALE DI OTTICA
CONSIGLIO NAZIONALE DELLE RICERCHE

Non-invasive optical techniques for artworks' analysis

HSG - Heritage Science Group

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WHY? WHAT? HOW?



WHAT?

Spectro-photometric characterization of coloured surfaces,
high-res 3D survey,
stratigraphy



HOW?

Non-invasive optical techniques



WHY?

Artworks are frail, delicate & precious objects

Vis-NIR multispectral scanner



0.25 mm (101.6 dpi)



Spectral range: 380–2550 nm
Spectral channels: 32 (16 VIS + 16 NIR)
Spectral res.: 20–30 nm (VIS), 50–100 nm (NIR)
Spatial sampling: 250 micron

Scanning area: 1 m²
Scanning time: 3 h/m²

Lighting system integral with the optical head

- uniform illumination
- painting heating is minimized

Single point detection:

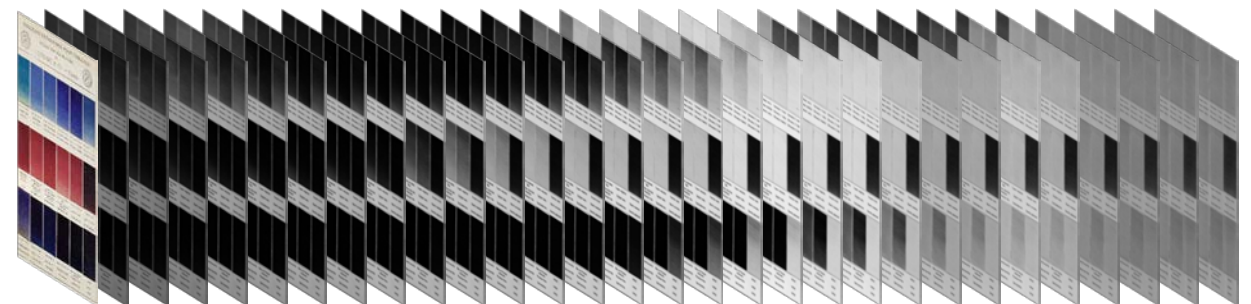
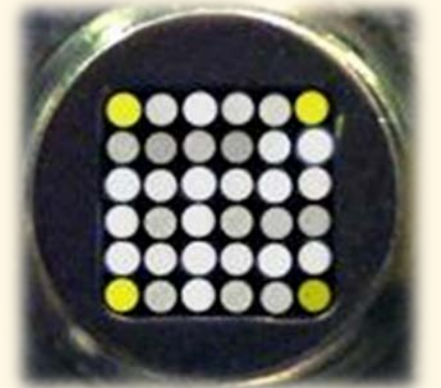
- negligible geometric aberration

Catoptric lens

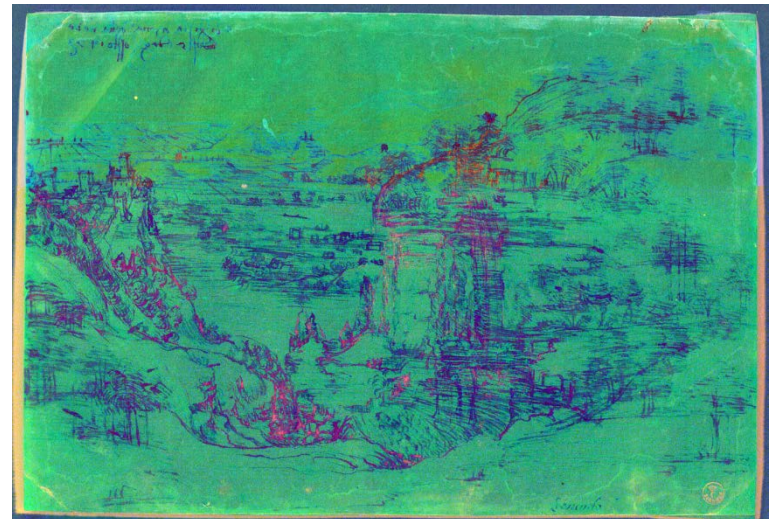
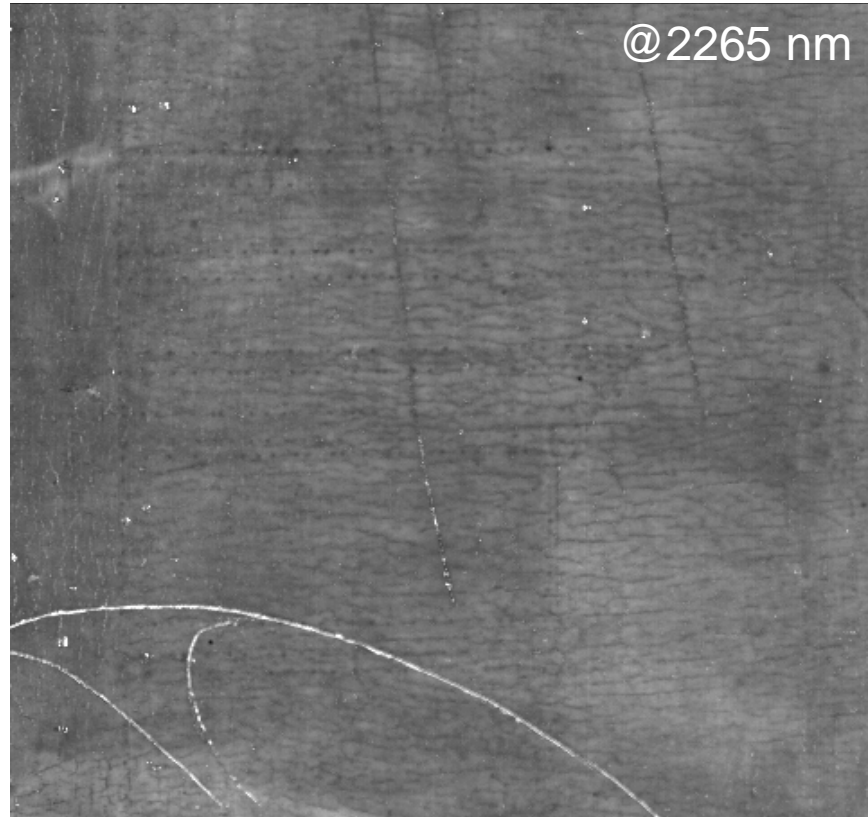
- no chromatic aberrations

High precision scanning system

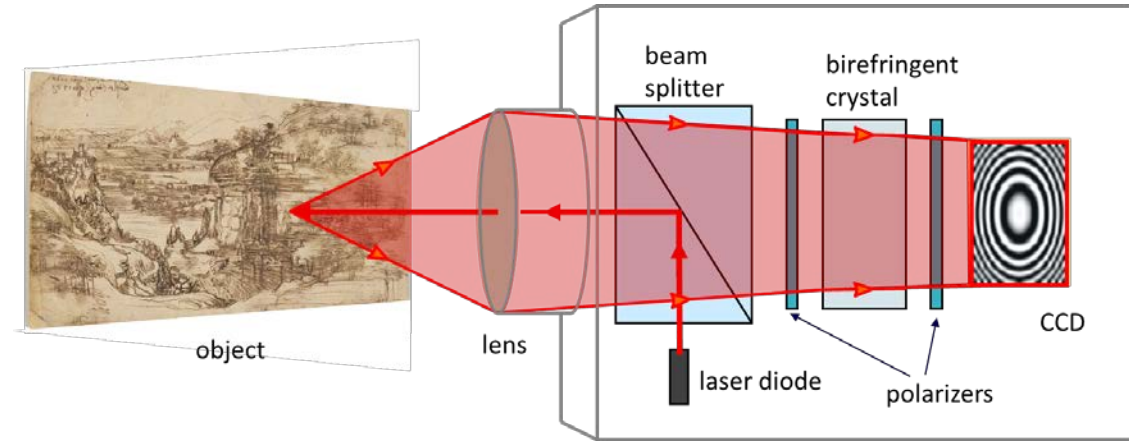
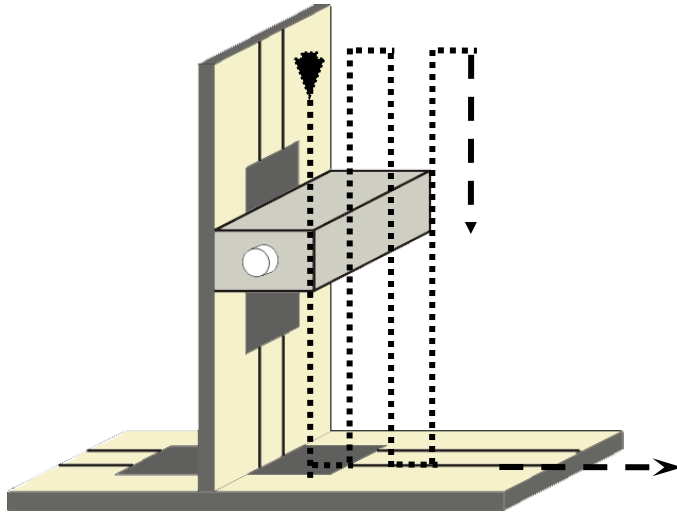
- metrically correct images



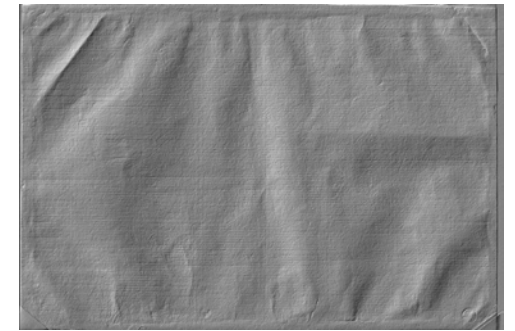
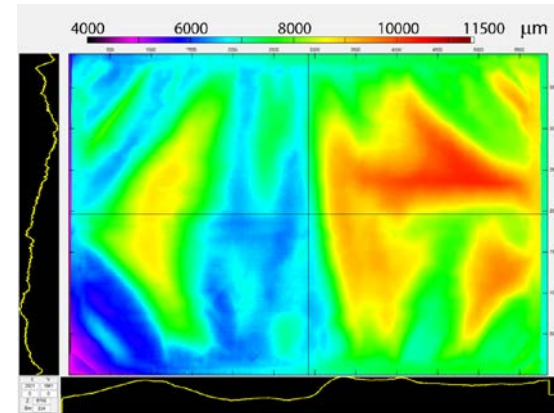
Vis-NIR multispectral analysis: examples



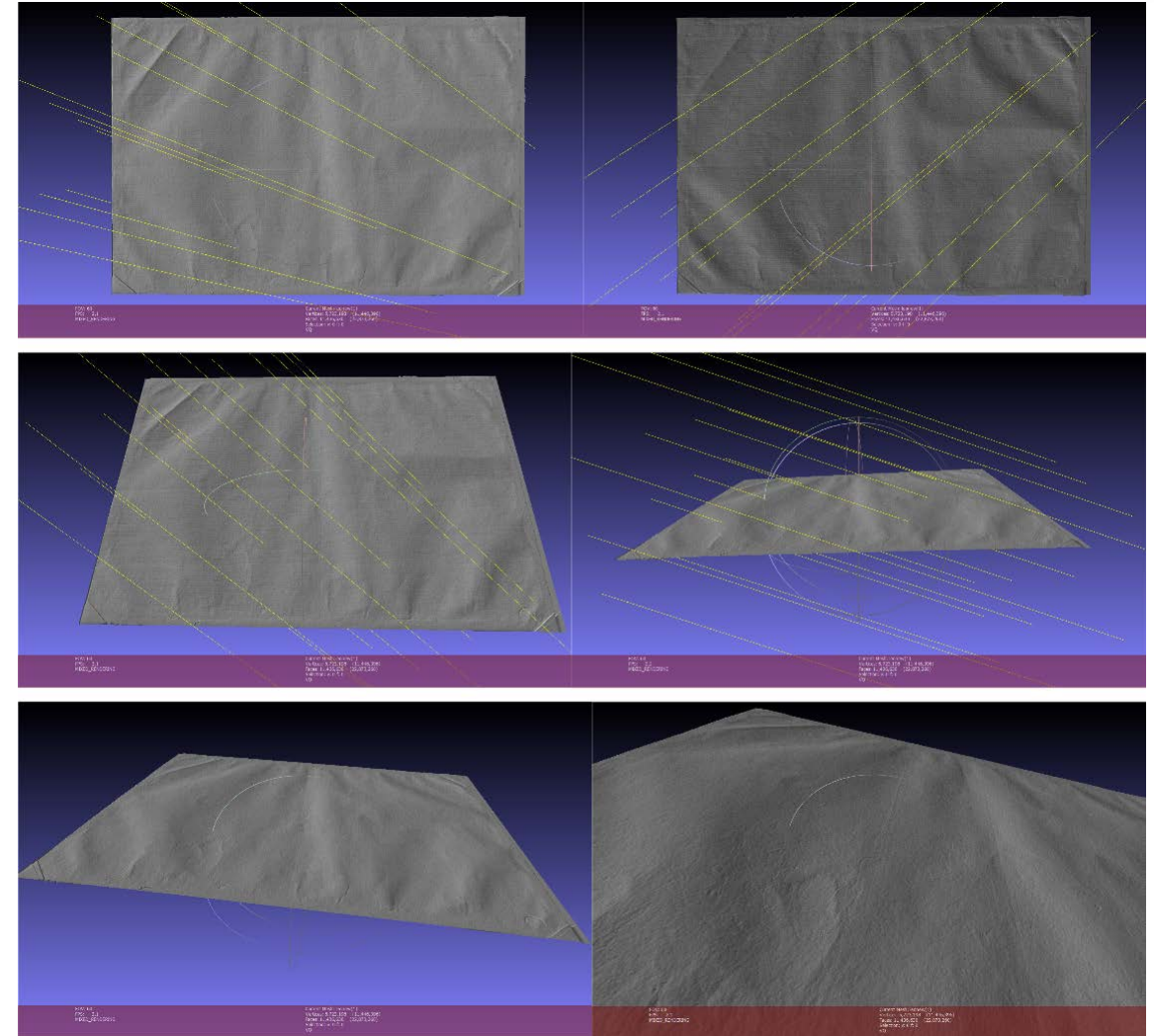
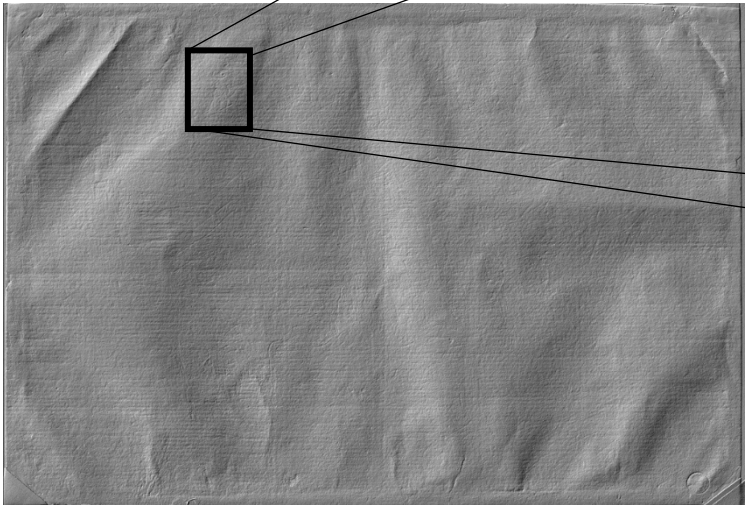
Microprofilometer



Axial resolution: 1 μm
Lateral resolution: 20 μm
Dynamic range: 8 mm
Working distance: 4 cm
Max scanning area: 28 x 28 cm^2



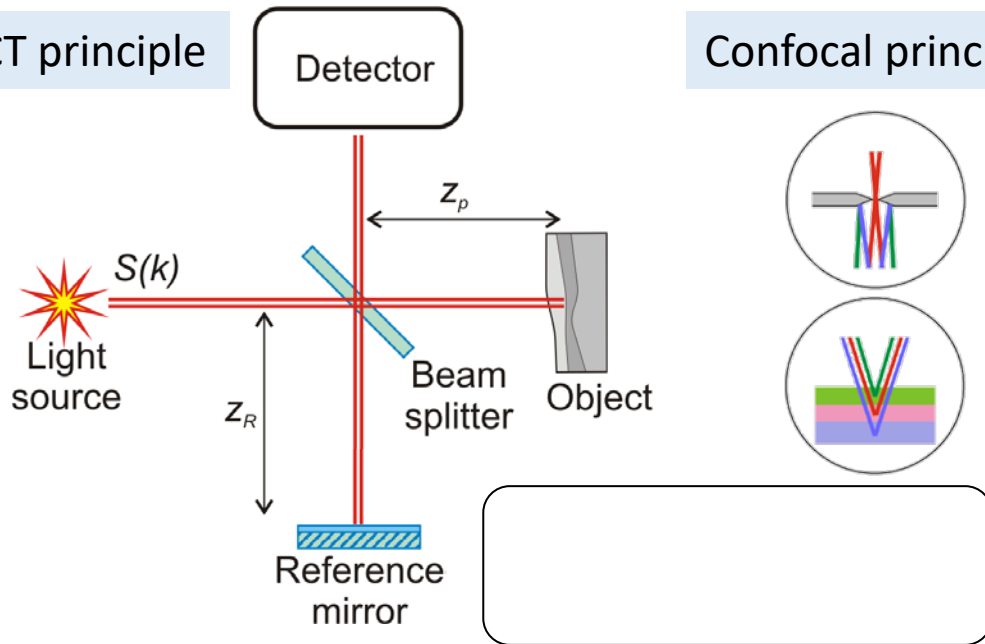
Micro-profilometry: an example



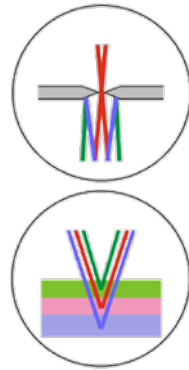
Confocal Time-Domain OCT device



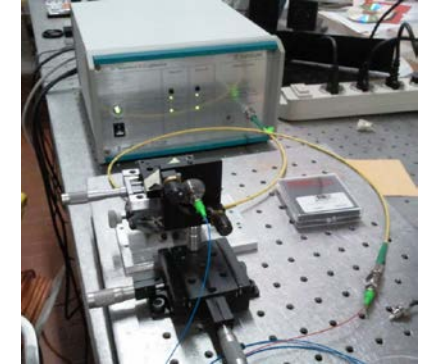
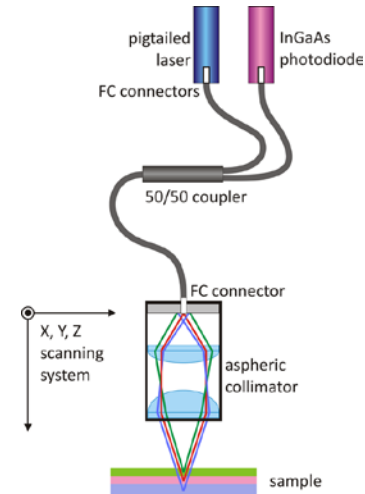
OCT principle



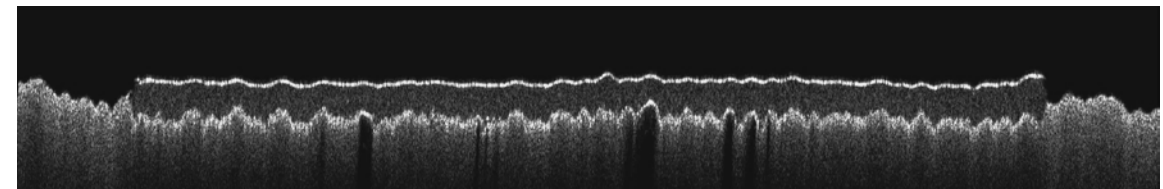
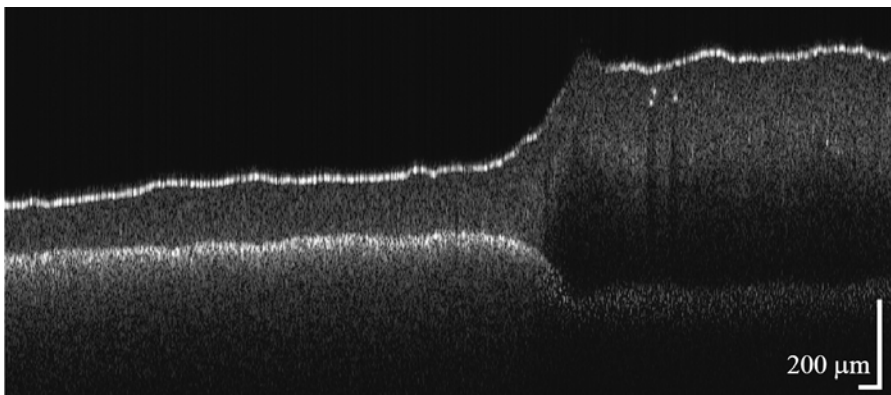
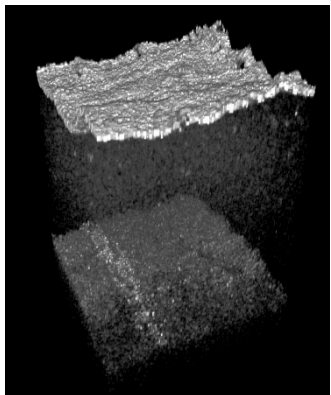
Confocal principle



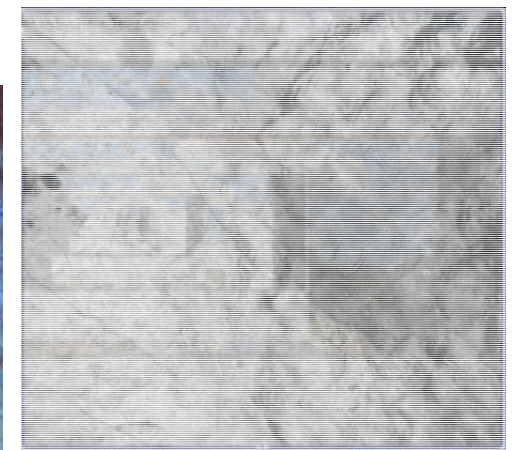
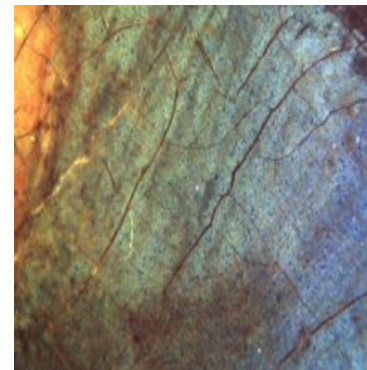
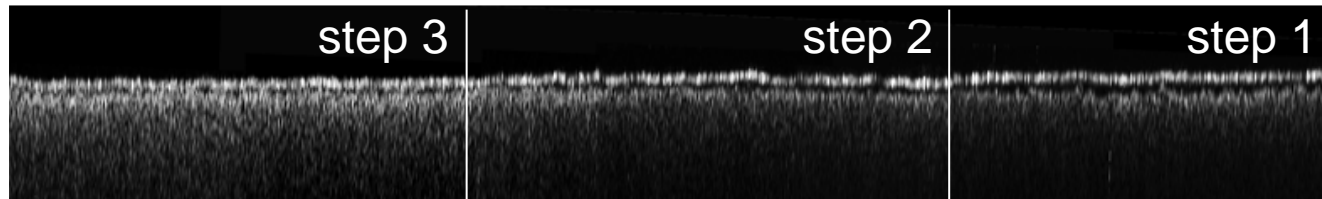
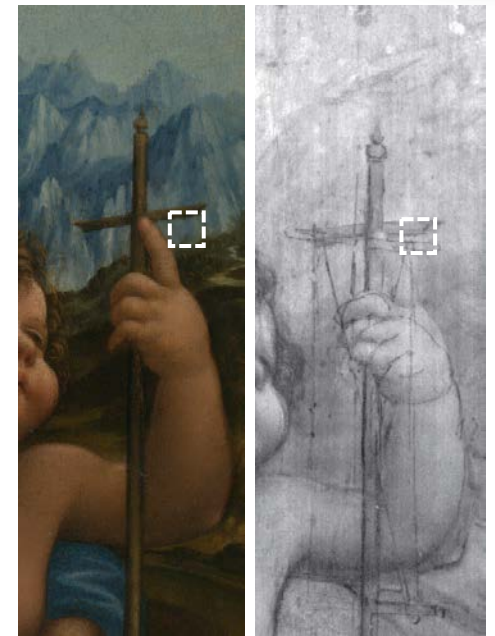
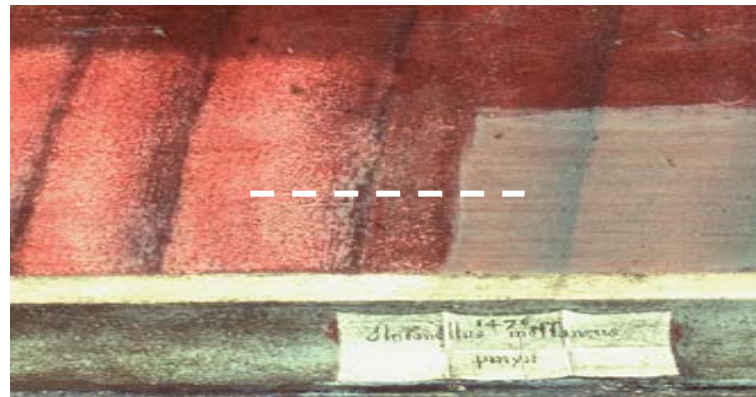
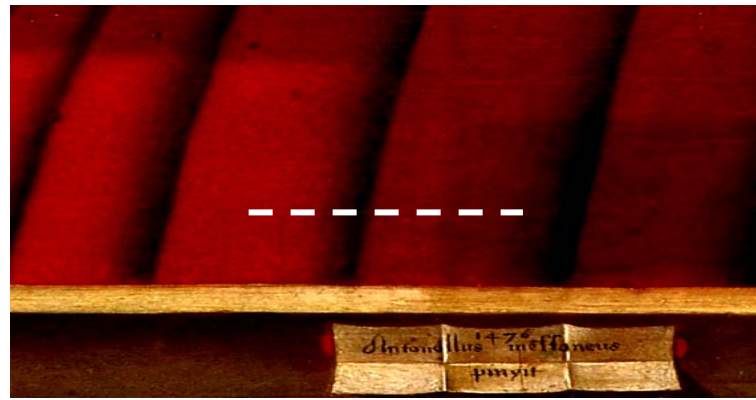
Instrument scheme



Central wavelength: 1550 nm
Axial res.: $\approx 10 \mu\text{m}$ (in air)
Lateral res.: $2.5 \mu\text{m}$
Working distance: 3 mm
Max scanning length (x, y): 25 mm



OCT: examples



Future developments



- Scanner upgrade: from multispectral to hyperspectral & wavelength extension toward the UV
- Microprofilometry upgrade: 3D survey from the micro to the macro scale
- Optical Coherence Tomography upgrade: moving towards “exotic” wavelengths



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Thank you for your attention