NEAR-INFRARED CONFOCAL LASER SCANNING MICROSCOPE FOR THE ANALYSIS OF PAINTINGS

Luca Pezzati, Claudia Daffara, Davide Bencini, Pierluigi Carcagnì
National Institute of Applied Optics, C.N.R., L.go E. Fermi 6, Firenze, 50125, Italy
E-mail: luca.pezzati@inoa.it

The use of confocal microscopy for artwork diagnostic, and in particular for the analysis of paint layers in ancient paintings, is strangely confined to some recently reported white-light applications[1]. For this type of analysis, optical coherence tomography (OCT) is widely preferred and its use is indeed well documented[2,3]. Laser-scanning near-infrared confocal microscopy (LSCM) can however be applied to optical sectioning, to 3D imaging, and to the measurement of surface roughness of ancient paintings. The paint layers are almost transparent to near-infrared radiation beyond 1.1 microns, and the scattering power of pigments in the same range is low, allowing for a good imaging of paint sections. This technique can thus be used as a simpler replacement of optical coherence tomography (OCT) for the analysis of varnish and paint layer thicknesses.

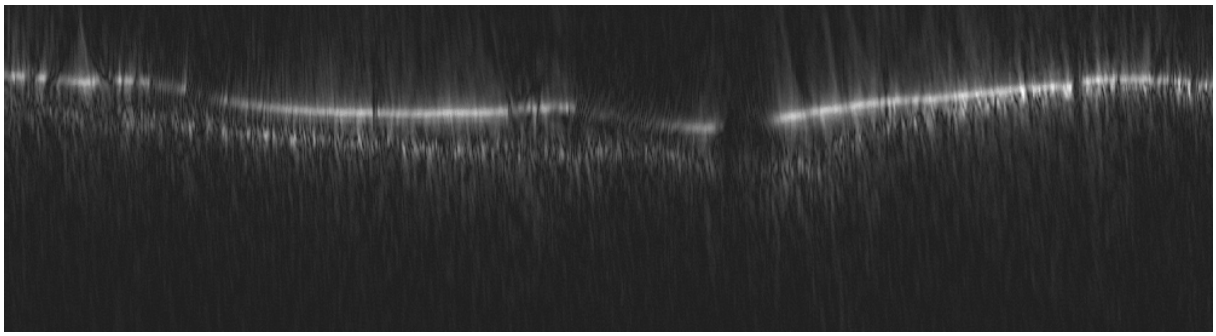

Figure 1. Optical (LSCM) section of the surface of a painting, 1000 x 270 µm^2, showing the varnish thickness profile.

To demonstrate the applicability of NIR confocal microscopy to artwork diagnostics, we designed and built a simple fibre-optic confocal laser scanning microscope operating in the near-infrared at 1.55 microns. The instrument has been tested on reference targets and then applied to the analysis of ancient paintings at the INOA Optical Metrology Lab at the Opificio delle Pietre Dure in Florence. Examples are provided on several paintings showing the imaging capabilities of this laser-scanning technique. The system could be easily upgraded to a multi-spectral NIR confocal microscopy. This approach, which we plan to exploit in the near future, makes this technique an interesting and promising tool for non invasive optical sectioning of paintings and of painted surfaces of artworks in general.

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2. P. Targowski, B. Rouba, M. Wojtkowski, and A. Kowalczyk, “The application of optical coherence tomography to non-destructive examination of museum objects,” *Studies in Conservation*, Vol. **49**, 107-114 (2004).
3. H. Liang, M. Gomez Cid, R. G. Cucu, G. M. Dobre, B. Kudimov, A. Gh. Podoleanu, J. Pedro, D. Saunders, J. Cupitt, “Optical Coherence Tomography: a non-invasive technique applied to conservation of paintings”, *Proc. SPIE*, Vol. **5857**, (2005).