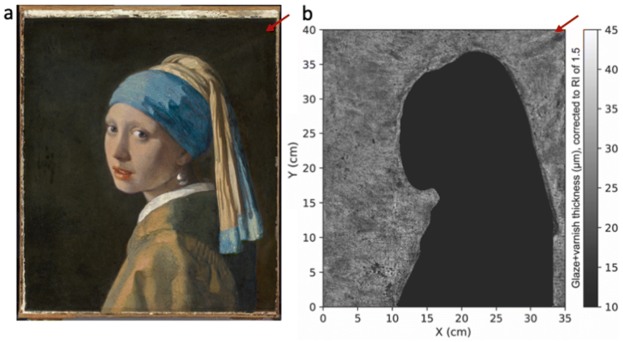
Art Conservation

THORLABS
APP HIGHLIGHT

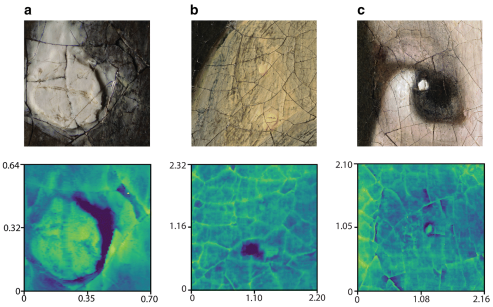
APPLICATION

OCT is a non-destructive, sub-surface, 3D imaging technique that can be used to assess the state of various forms of art, understand past conservation attempts, and plan future restoration efforts.



Vermeer's *Girl with a Pearl Earring*. (a) Polarized light photograph and (b) glaze and varnish layer thickness map extracted from OCT data.*

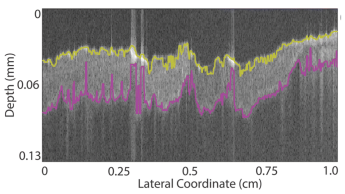
EXAMPLE IMAGES



Three close-up areas of *Girl with a Pearl Earring*.

Top row: Photographs

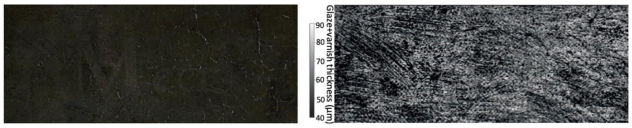
Bottom row: Surface height deducted from OCT images.[2,] *



Left: Automatic detection of air-varnish interface (yellow) and underlying glaze layer (purple).

Bottom left: Photograph of Vermeer's signature.

Bottom right: Glaze and varnish layer thickness automatically extracted from OCT images.[1,] *



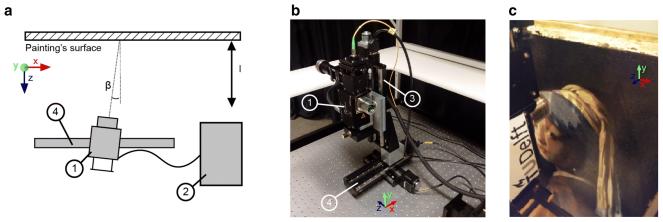
QUICK FACTS

- OCT is a non-destructive technique to image the layered or coated structure of various samples.
- OCT is well suited to examine the varnish and glaze layers of paintings; however, its penetration into paint is strongly dependent on the scattering properties.
- Cross Polarization can be used to reduce artifacts from strong surface reflections.
- The OCT scanner can be mounted on a gantry system to image small paintings as a whole[2] or particular areas of larger paintings.
- OCT has been used to examine cracks and bubbles in jade[7], varnish and paint layers in ancient artifacts like Egyptian coffins[8], and varnish on ceramics.

TYPICAL SETUP

Smaller samples can be placed right under the scanner of the OCT system.

For imaging whole works of art, an automated control a gantry system can be employed[2]:



Automatic scanning of *Girl with a Pearl Earring*. (a) Sketch of setup, (b) photograph of scanner on gantry system, and (c) OCT system scanning the painting.[2,]*

RECOMMENDED ITEMS

Choice of OCT System:

- **GAN332C1 or GAN632C1:** For Most Applications
  - High-Resolution imaging at 880 nm
- **TEL221C1:** For Ceramics
  - Deeper Penetration into Material at 1300 nm

GAN632C1

Useful Accessories:

- Thorlabs' OCTP series scanners are alternative scanners on Thorlabs' 30 mm cage system. These scanners can be adapted by the user, e.g. to accommodate beams of other imaging modalities or to implement cross polarization.

Interested? Email OCT@thorlabs.com for more information.

PUBLICATIONS

1) A. Vandivere, A. van Loon, T. Callewaert, R. Haswell, A.N. Proaño Gaibor, H. van Keulen, E. Leonhardt, J. Dik, Herit. Sci., **7**, 69, 2019
2) W.S. Elkhuizen, T.W.J. Callewaert, E. Leonhardt, A. Vandivere, Y. Song, S.C. Pont, J.M.P. Geraedts, J. Dik, Herit. Sci., **7**, 89, 2019
3) S. Kogou, A. Lucian, S. Bellesia, L. Burgio, K. Bailey, C. Brooks, H. Liang, Appl. Phys. A, **121** (3), 999, 2015
4) C.L. Koch Dandolo, M. Lopez, K. Fukunaga, Y. Ueno, R. Pillay, D. Giovannacci, Y.L. Du, X. Bai, M. Menu, V. Detalle, Appl. Opt., **58** (5), 1281, 2019
5) T. Callewaert, J. Dik, J. Kalkman, Opt. Express, **25** (26), 32816, 2017
6) R. Tonga, M. Hu, X. Liua, Q. Zhang, H. Ge, T. Gang, X. Bai, C. Zuo, C. Bian, Optik, **199**, 163311, 2019
7) M.L. Yang, A.M. Winkler, J. Klein, A. Wall and J.K. Barton in Selected Topics in Optical Coherence Tomography, G. Liu, IntechOpen, 2012
8) C.L. Koch Dandolo, L. Brunel-Duverger, D. Giovannacci, R. Pillay, M. Lopez, X. Bai, S. Pagès-Camagna, N. Brodie-Linder, M. Menu, V. Detalle, Proc. SPIE 11058, Optics for Arts, Architecture, and Archaeology VII, 1105817, 2019