

OPTICAL COHERENCE TOMOGRAPHY FOR EXAMINATION OF STRATIGRAPHY OF EASEL PAINTINGS

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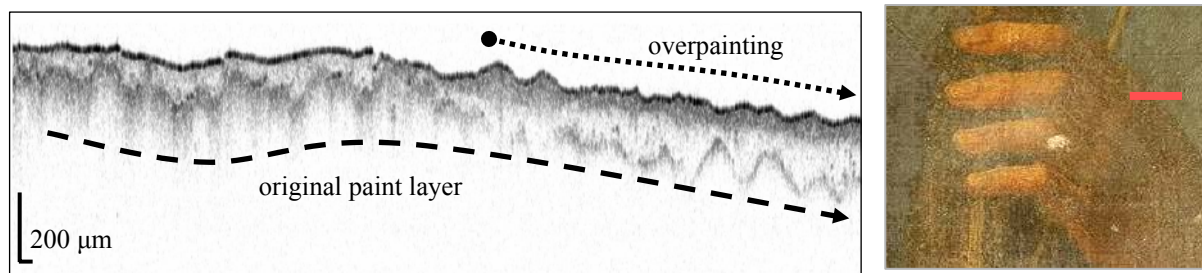
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Over the last few years it has been known that the OCT technique may be utilised for examination of inner structure of artworks, especially layers of varnish and semi-transparent paint.¹⁻⁷ The crucial point seems to be the implementation of the technique into the conservation practice. That would mean solving specific problems emerging from conservation and restoration of real objects of art. Therefore, in this contribution, the major emphasis will be laid on practical applications.

Examples of imaging of varnish layers and semi-transparent paint layers of old paintings will be presented. The thickness of these layers may be directly measured with OCT in completely non-destructive, quick and convenient way as many times as necessary. Comparison of OCT tomograms obtained from easel paintings with microphotography of a cross-section of the sample taken nearby will enable the evaluation of the OCT analysis' reliability. Furthermore, the question of representativeness of the sample will be discussed.

The solution of the problem of authentication of some regions within the painting by means of the OCT will be also presented. Images of multiple varnish layers (up to four) and overpaintings laying on the varnish layer will be shown (Figure). Additionally, a tomogram of an internal crack at boundary between two varnish layers helps to prove the inauthenticity of the upper layer, besides the evaluation of the painting's state of preservation.



OCT tomogram (on the left) showing partial overpainting (region of background) of an oil painting (on the right)

Images of original, well preserved glaze layer in comparison with discolored glazes will be shown. In the latter case the UV/VIS inspection gives confusing results. Nevertheless, the OCT examination may help the restorer create virtual reconstruction of the painting's original appearance.

The OCT tomograms will be presented both as 2-D cross-sectional images and tomographic movies which enable 3-D analysis of the work of art's spatial structure. Also, the application of these images for real-time monitoring of conservation treatments will be shown.

Acknowledgment

The financial support from Polish Ministry of Science, grant for years 2008-2011, is gratefully acknowledged.

1. 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*, **49**(2), 107 (2004).
2. H. Liang, M.G. Cid, R. G. Cucu, G.M. Dobre, A.Gh. Podoleanu, J. Pedro, D. Saunders, "En-face Optical Coherence Tomography – a novel application of non-invasive imaging to art conservation", *Opt. Express* **13**, 6133, (2005). <http://www.opticsexpress.org/abstract.cfm?id=85276>.
3. H. Liang, M. G. Cid, R. G. Cucu, G. M. Dobre, B. Kudimov, J. Pedro, D. Saunders, J. Cupitt, A. Gh. Podoleanu, "Optical Coherence Tomography – a non-invasive technique applied to conservation of paintings", *Optical Methods for Arts and Archaeology*, Proc of SPIE, **5857**, 58570W (2005).
4. T. Arecchi, M. Bellini, C. Corsi, R. Fontana, M. Materazzi, L. Pezzati, and A. Tortora, "Optical coherence tomography for painting diagnostics," in *Optical Methods for Art and Archaeology*, Munich, Germany, Proc. SPIE **5857**, 278–282, (2005).
5. P. Targowski, B. Rouba, M. Góra, L. Tymińska-Widmer, J. Marczak, and A.Kowalczyk "Optical Coherence Tomography in Art Diagnostics and Restoration", *Applied Physics A* **92**, 1–9, (2008).
6. P. Targowski, M. Góra, T. Bajraszewski, M. Szkulmowski, M. Wojtkowski, A. Kowalczyk, B. Rouba, L. Tymińska-Widmer, M. Iwanicka "Optical coherence tomography for structural imaging of artworks" *Proc. of Lacona VII – Lasers in the Conservation of Artworks*, Madrid, Spain, 17 – 21 September 2007 – *in press*.
7. L. Tymińska-Widmer, P. Targowski, M. Góra, M. Iwanicka, T. Łękawa-Wysłouch, B. Rouba "Optical Coherence Tomography – a Novel Tool for the Examination of Oil Paintings", *Proceeding of "Conservation Science 2007"*, 10-11 May 2007, Milano; Archetype Books – *in press*.