

Surface Roughness and the Appearance of Objects in Cultural Heritage

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Optical Coherence Tomography for Examination
of Art, Torun, Poland 2008

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“Lady in a Green Jacket”, August Macke 1913

Ludwig Museum, Cologne



2. Technical properties of the object

1. Light



3. Perception



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(Ethical issues) in Perception

Cleaning of objects;
Removal of varnishes and coatings

Appearance: perception / documentation / “rendering”



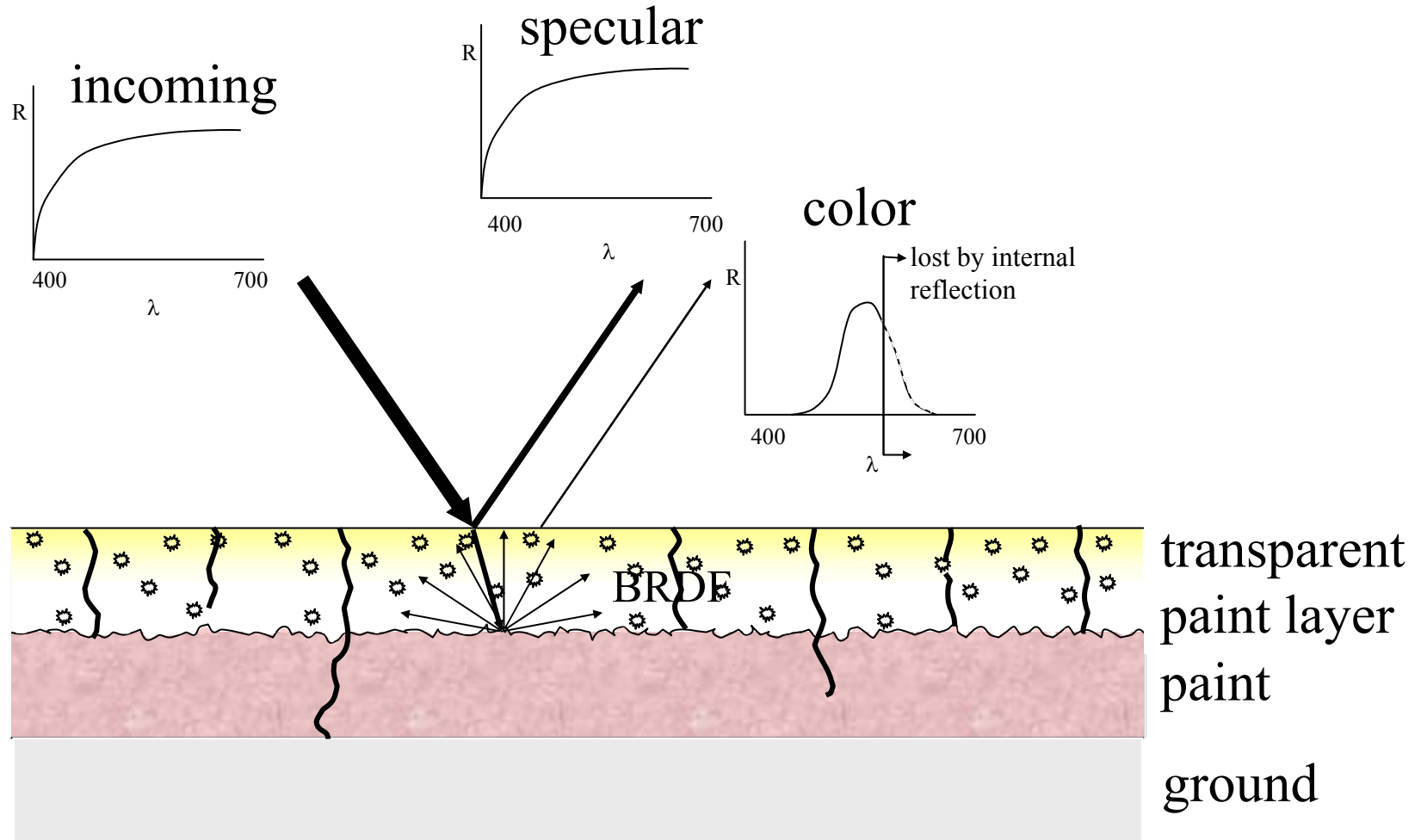
Technical properties

- Reflection, absorption, transmission, light refraction
- Materials (composition)
- Paint layer structure
- Roughness
- Aging (reactions and kinetics)
- Pigment distribution
- Craquelé / “cupping” / paint loss

Perception

- Color
 - Saturation
 - Glossy vs. matte
 - 3-D effects e.g. depth, transparency
 - Texture
 - Psychology; physiology
-
- Retouching; metamerism
 - Filling
 - Varnish or no varnish

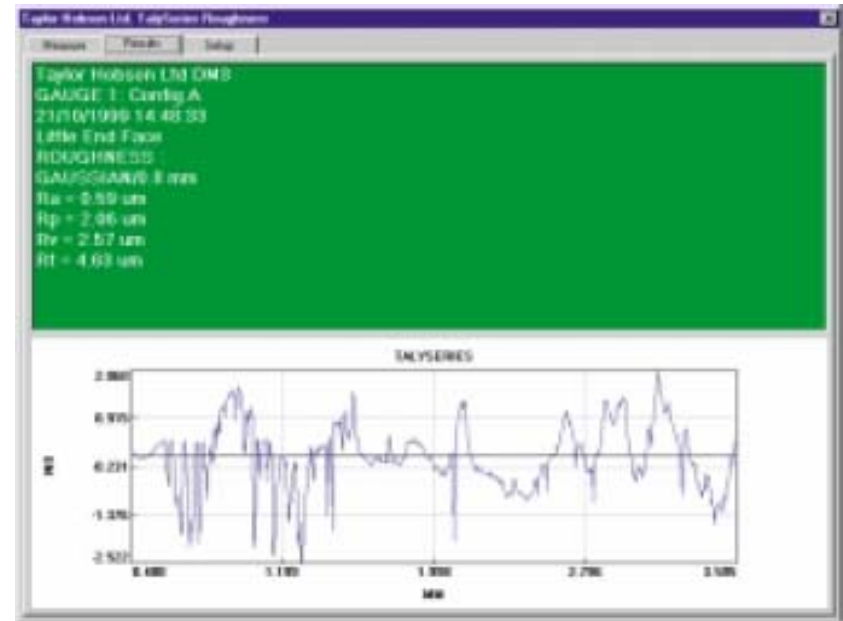
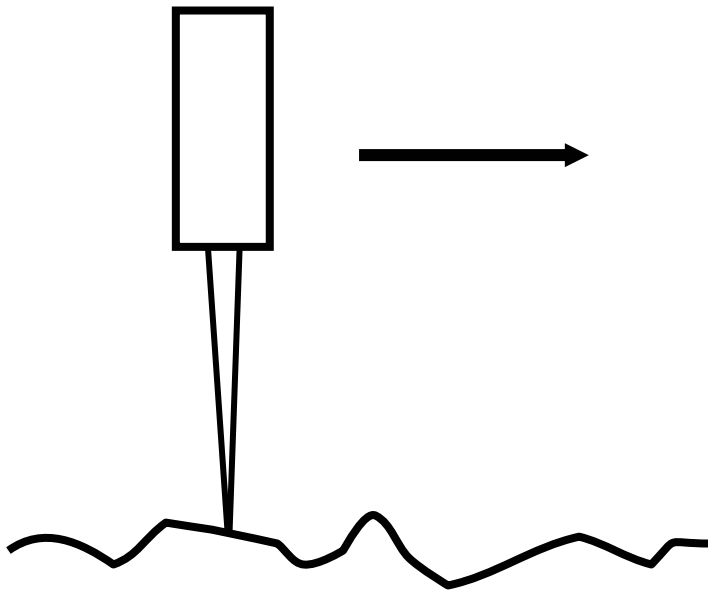
(3-D) Technical properties of a surface



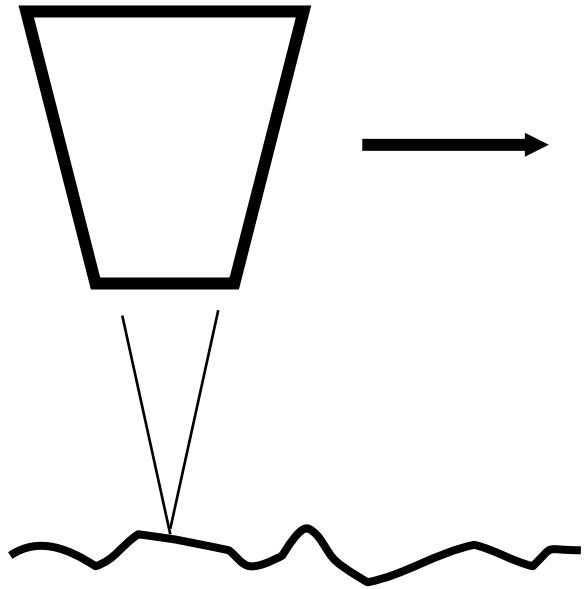
(3-D) Technical properties of a surface

- Reflection, absorption, transmission, light refraction
- Materials (composition)
- Pigment distribution
- Paint layer structure
- **Roughness**
- Aging (reactions and kinetics)
- Craquelé / “cupping” / loss of paint

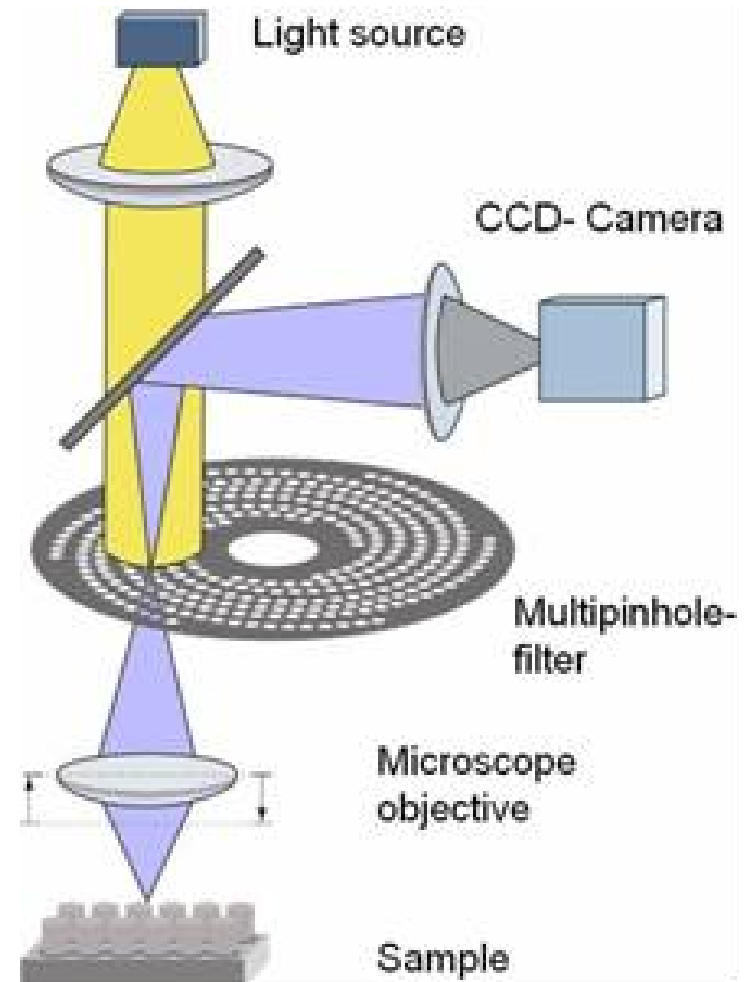
Tradition roughness measurement (science of tribology)



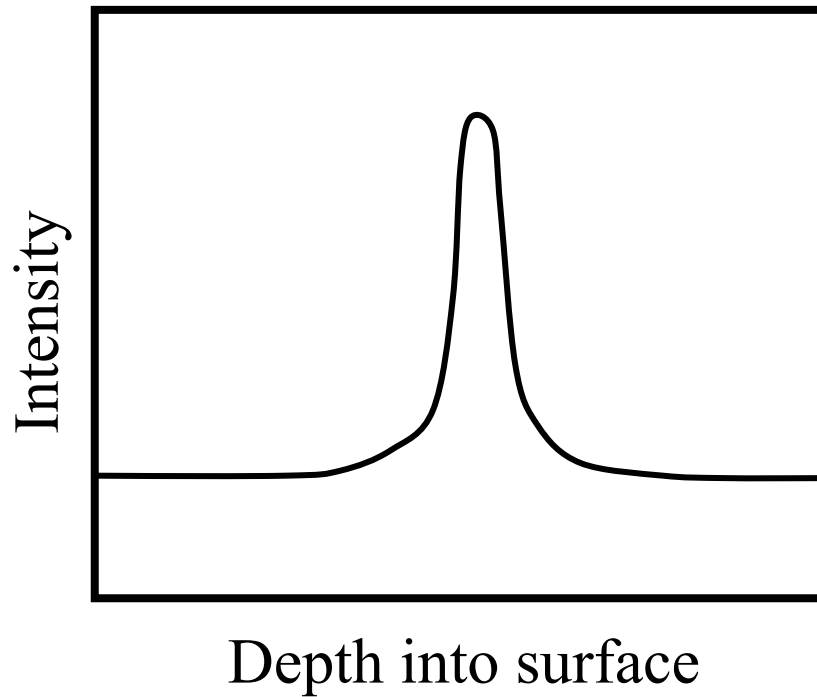
Real data, R_a , R_q , etc.



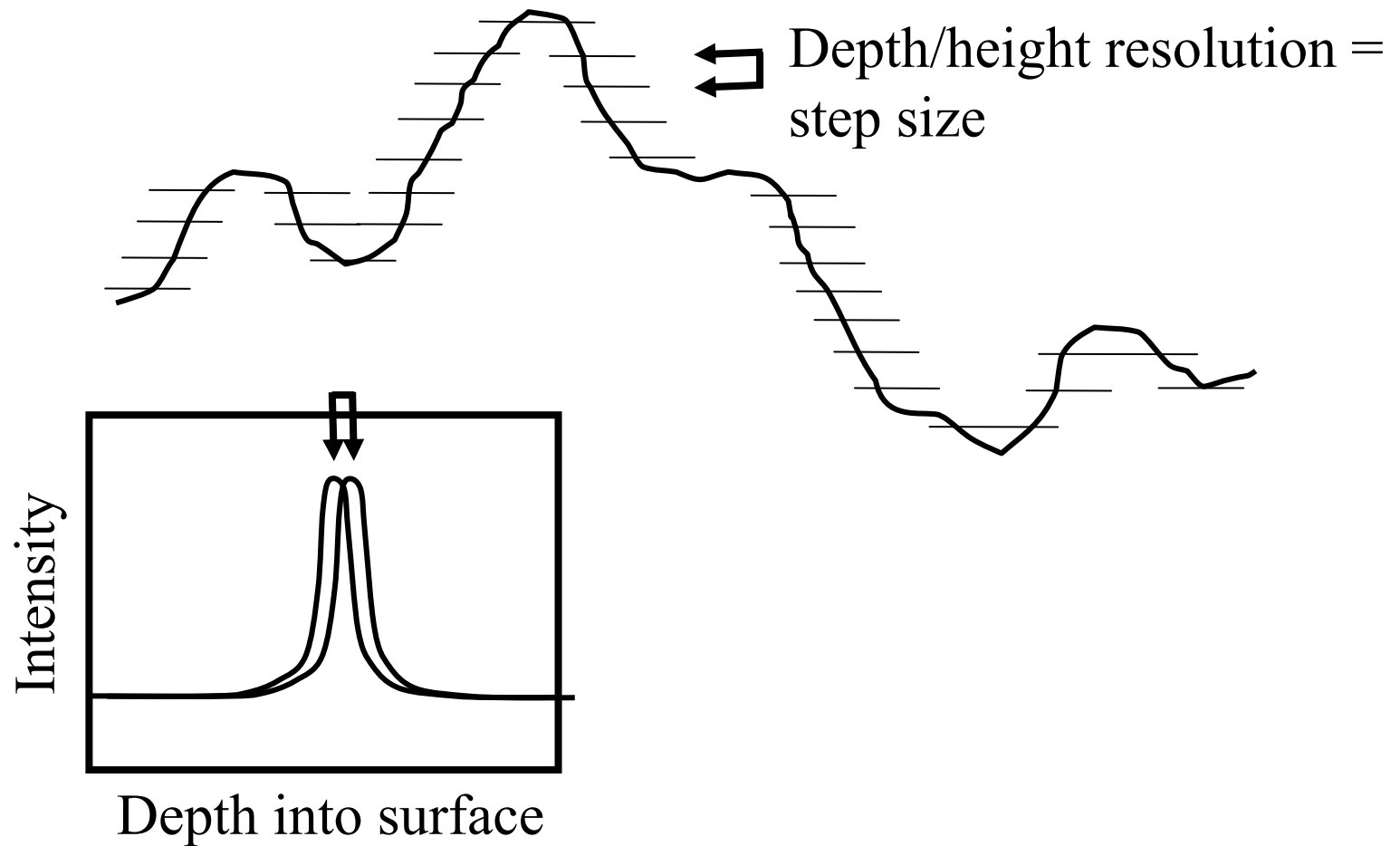
Confocal White Light Profilometry



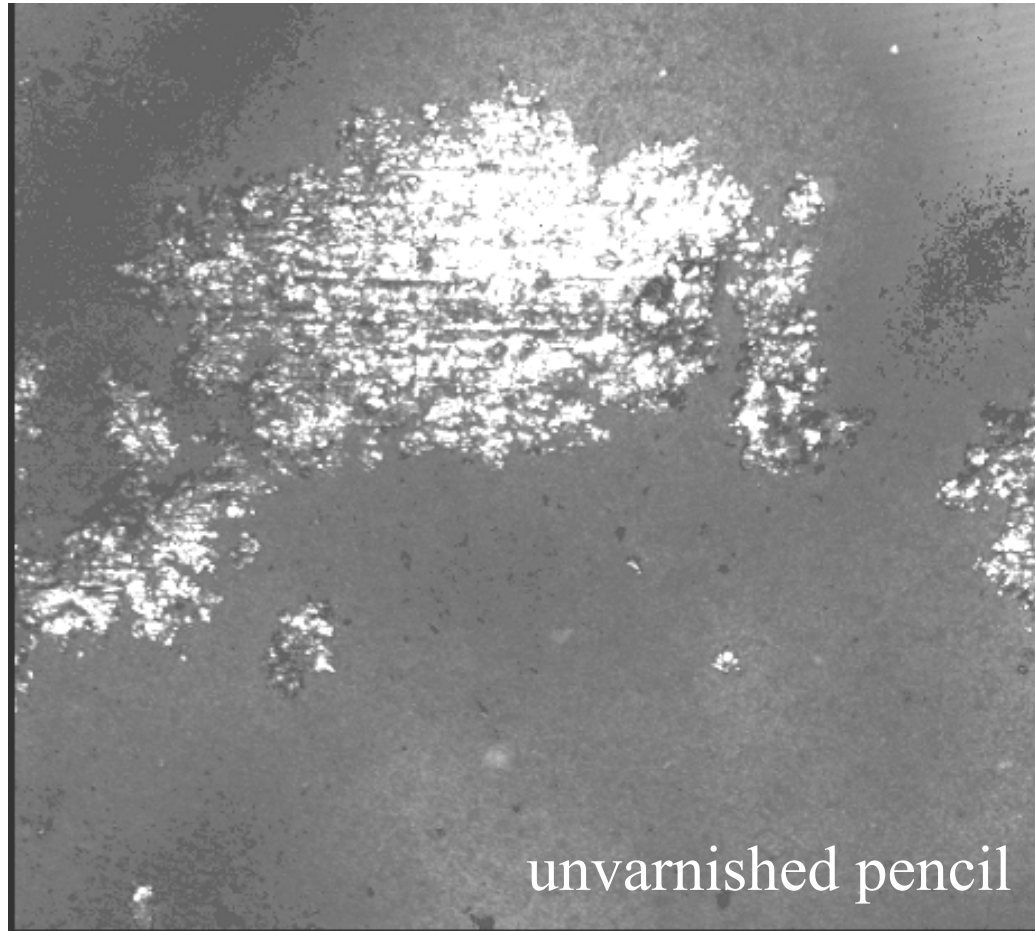
Confocal White Light Profilometry

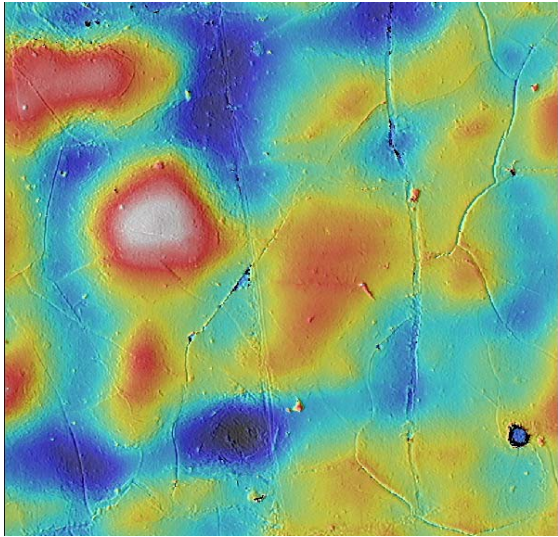


Confocal White Light Profilometry

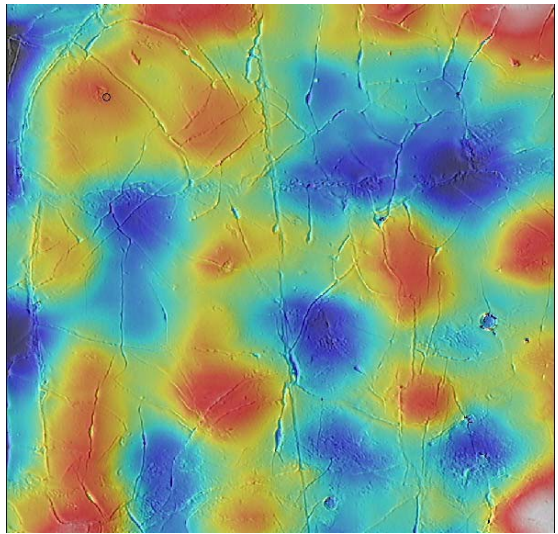
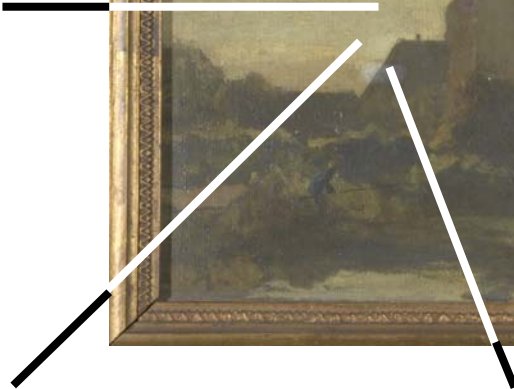
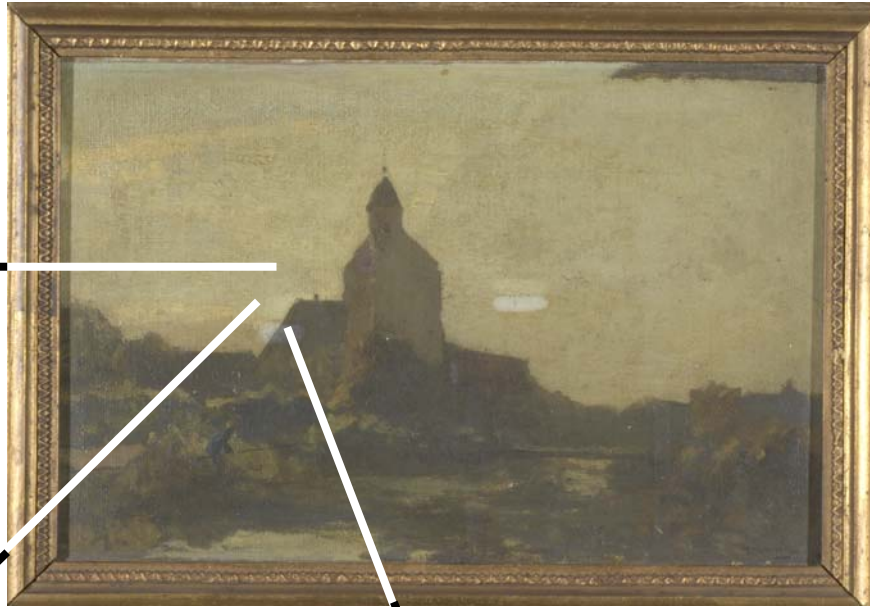


Confocal microscopy

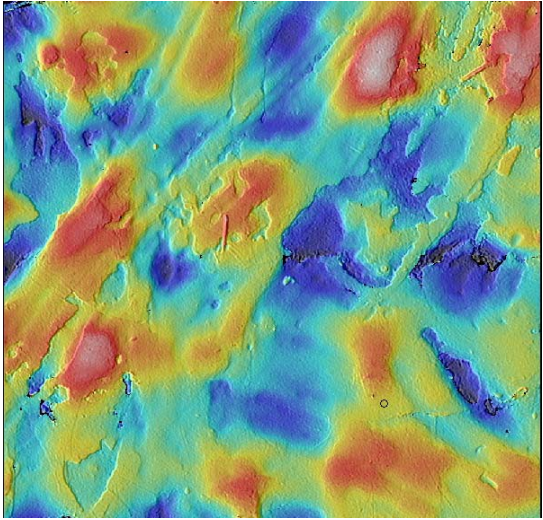




Uncleaned



Saliva



Roughness Measurements of Cleaning Procedures

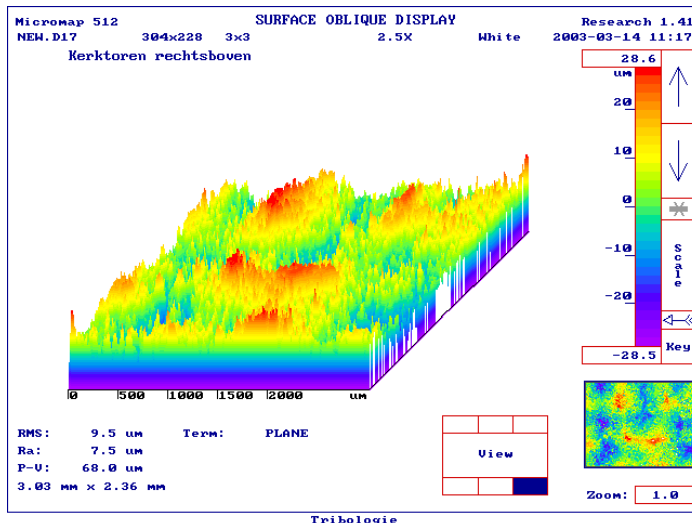
1:1 isopropyl alcohol:iso-octane

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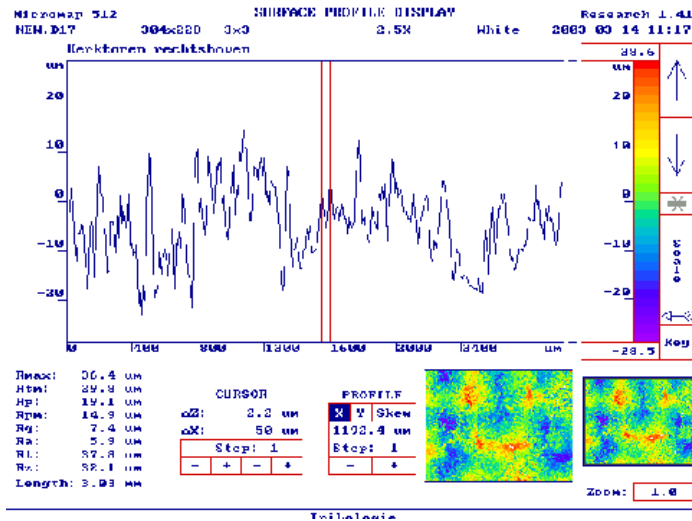


ONDER
NOSSEM
LTUUR
NIEEM
SCHAP

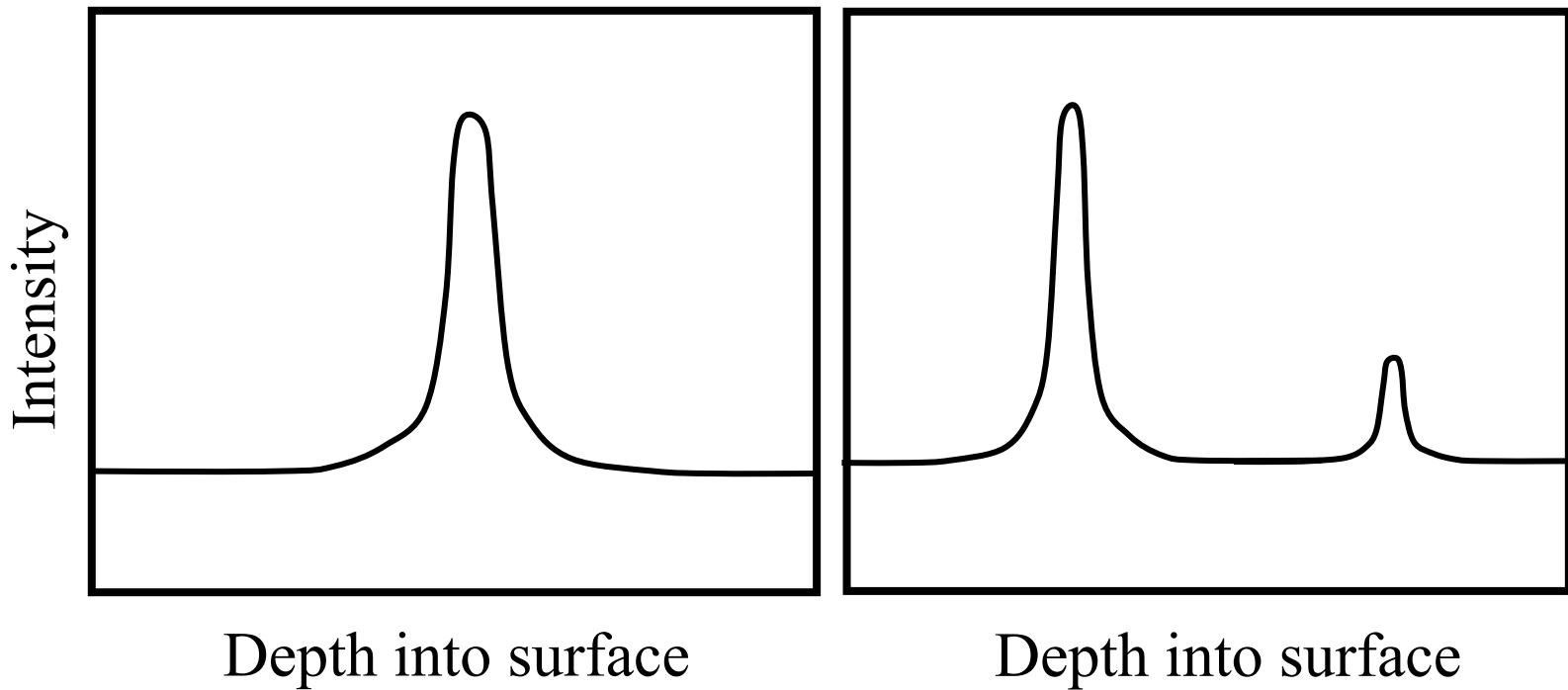
Digital documentation of 3-D (micro)structures



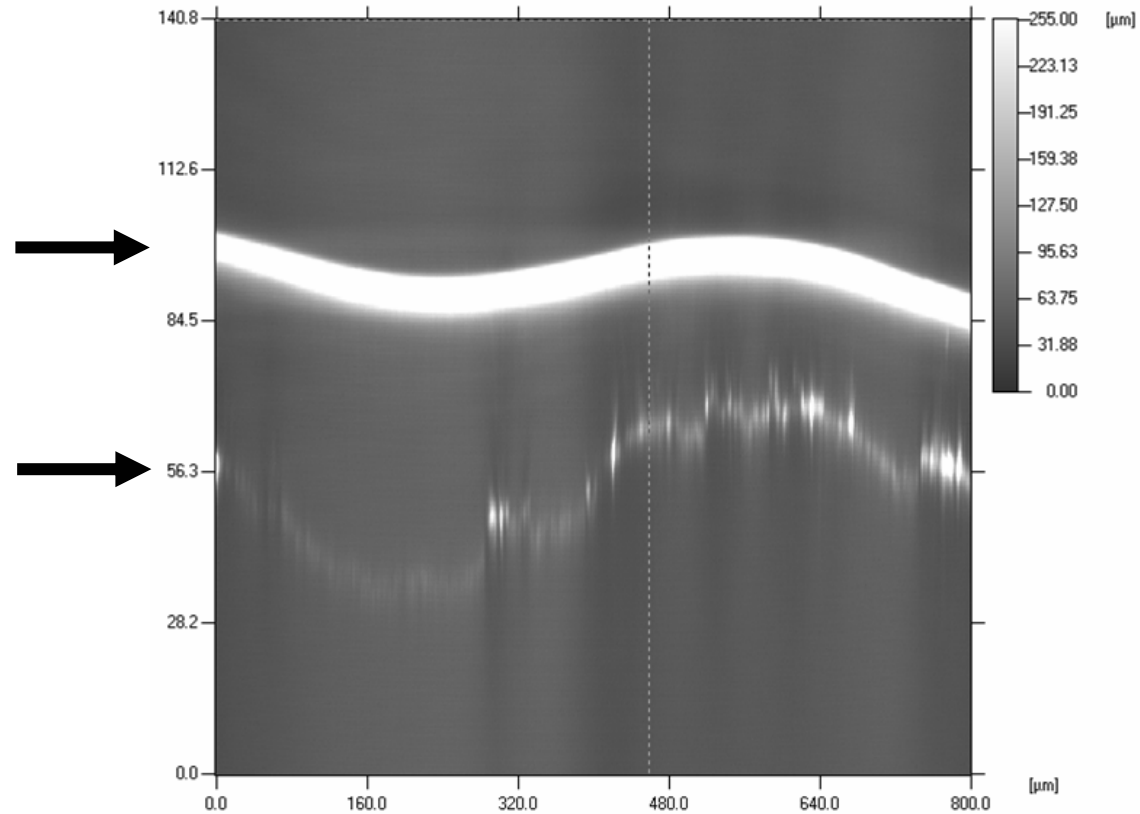
IJ. Wenning, Dorpskerk bij Avond

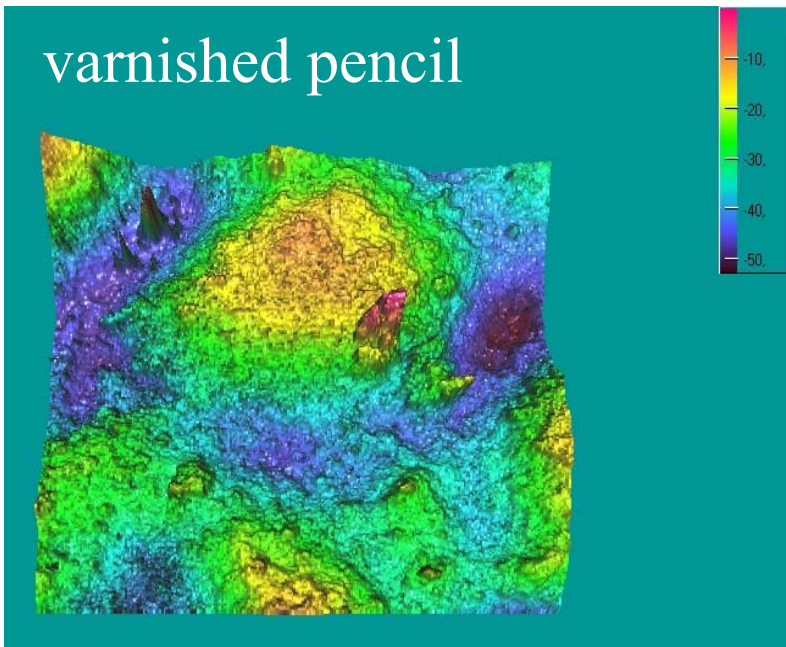
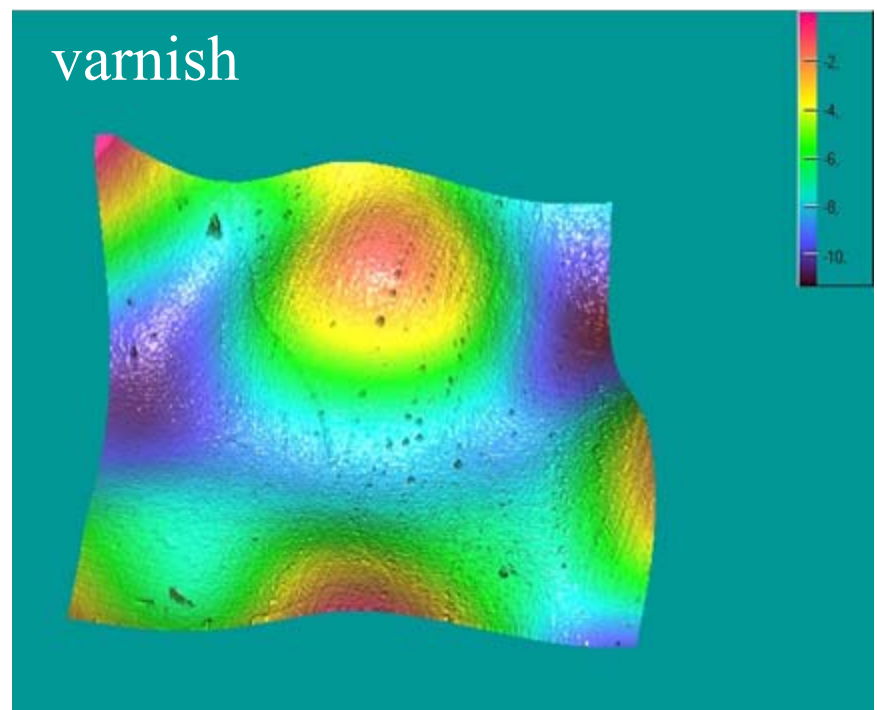
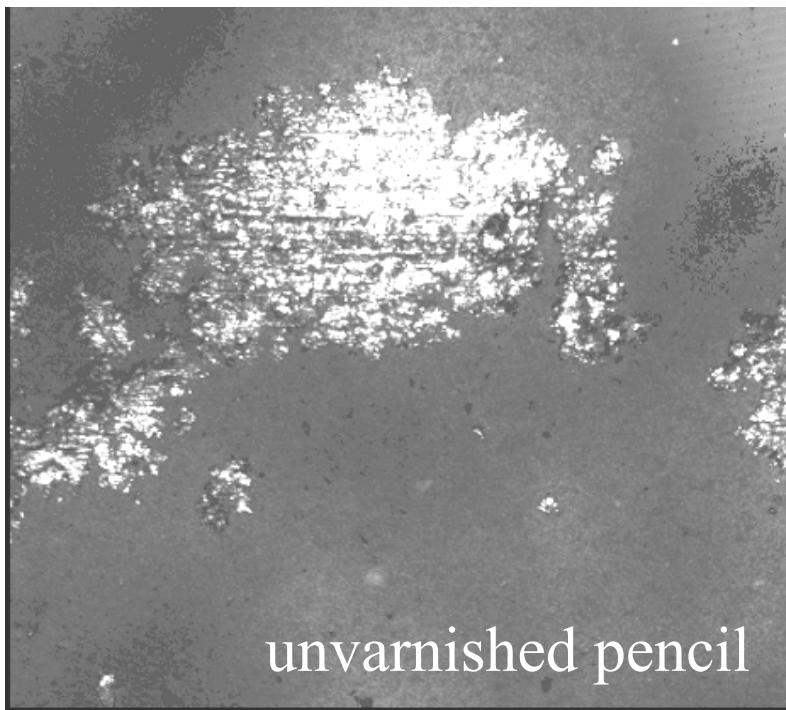


Confocal White Light Profilometry

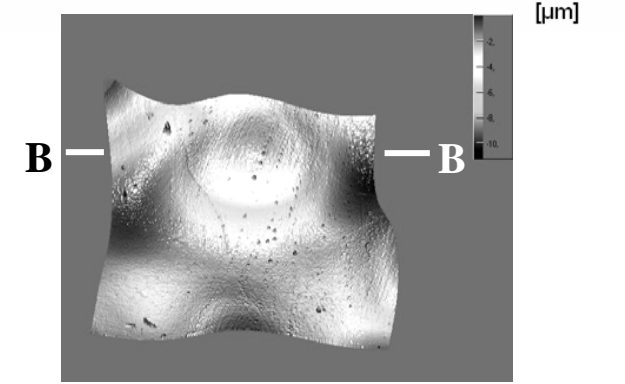
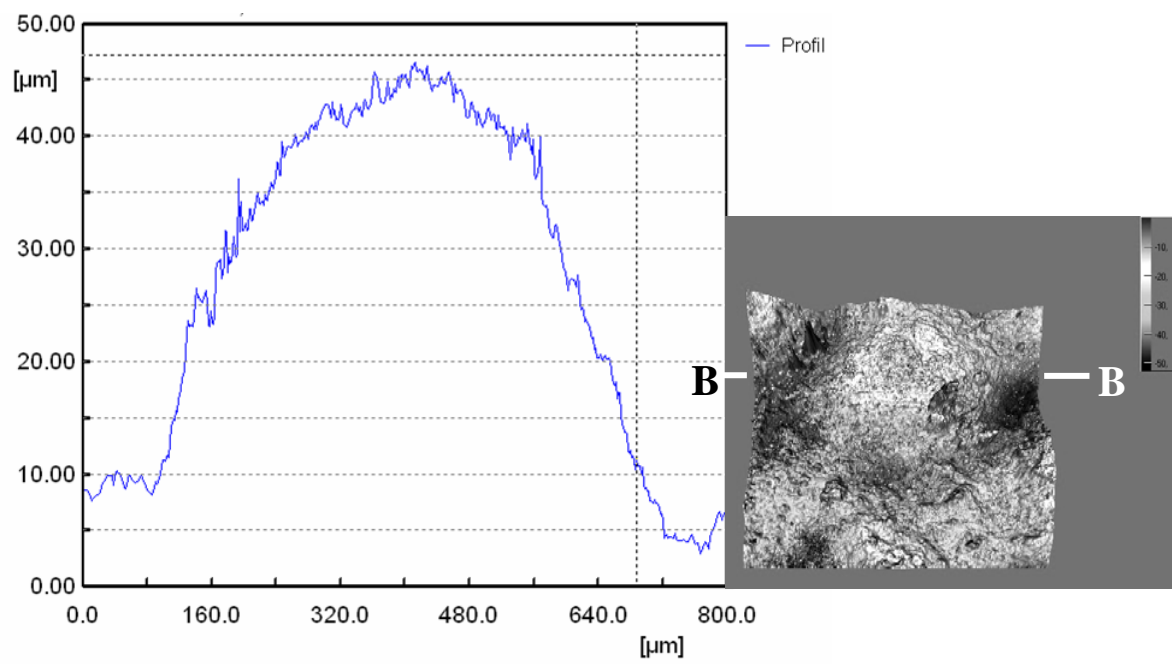
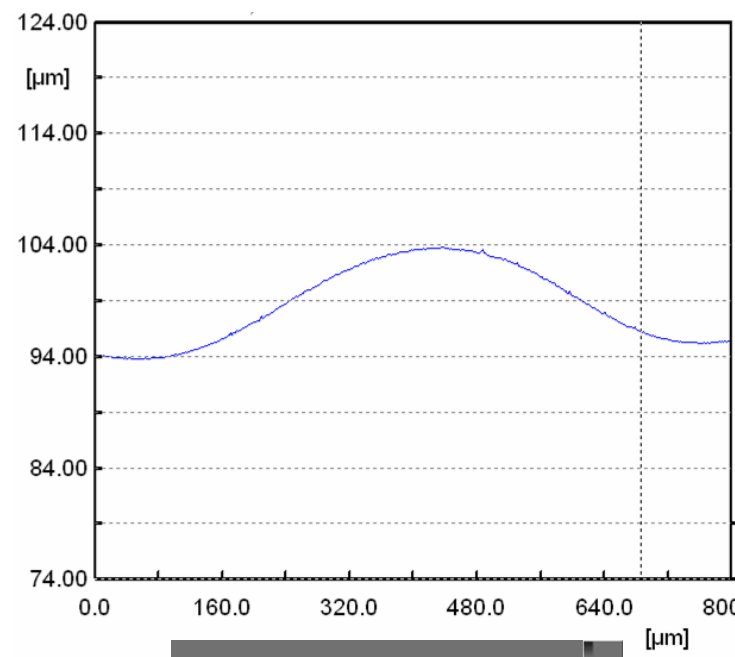
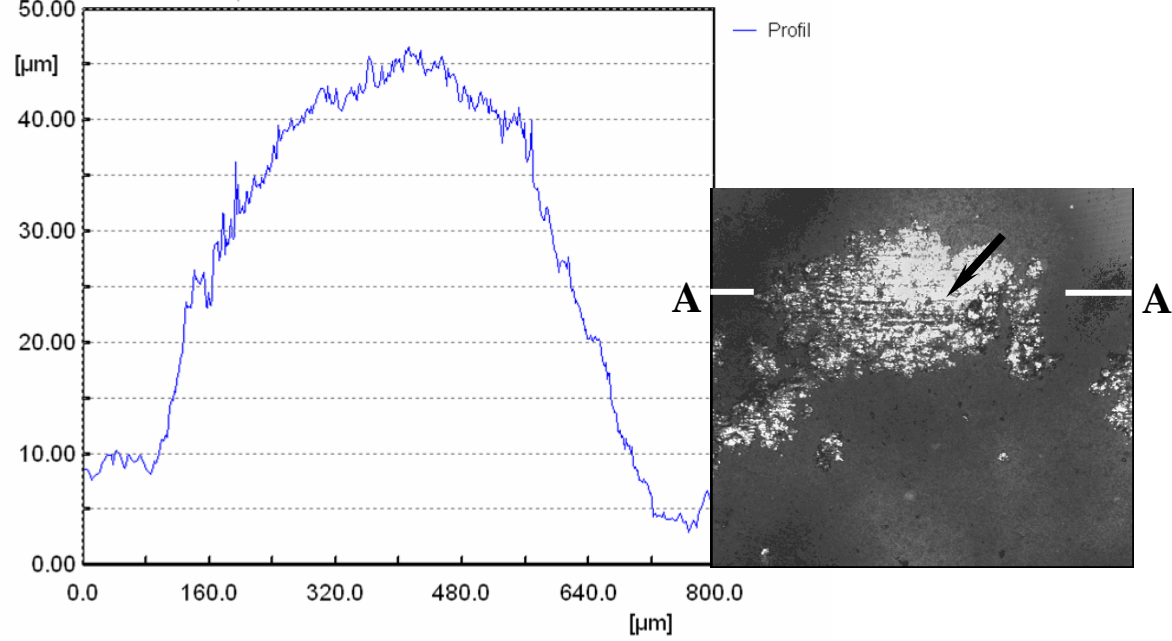


Varnish on pencil line

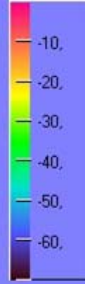
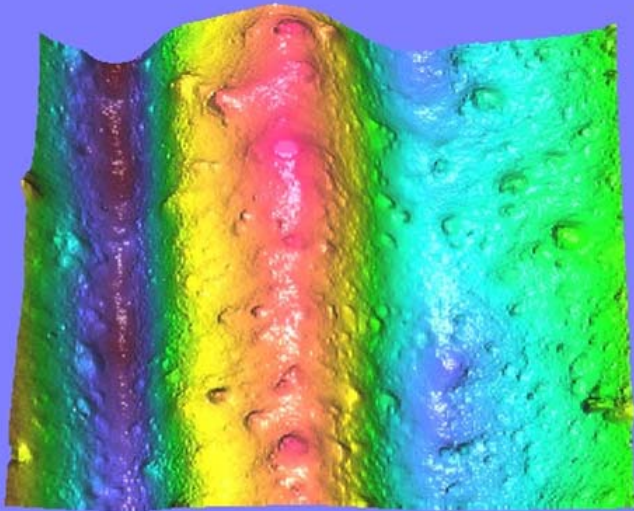




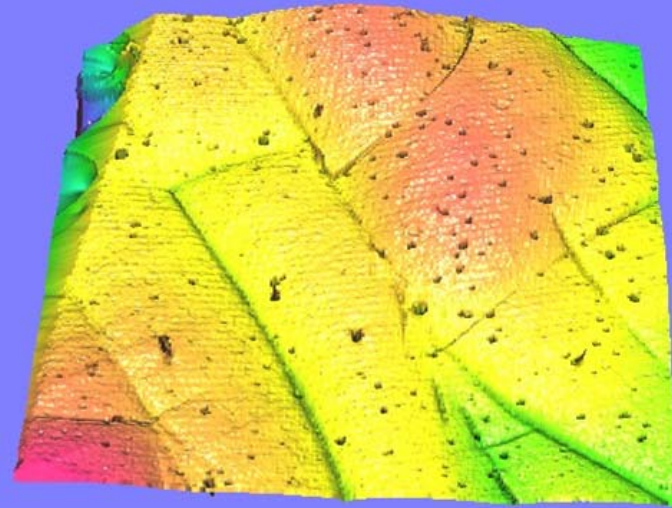
“Thick varnish on pencil line



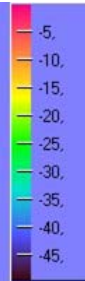
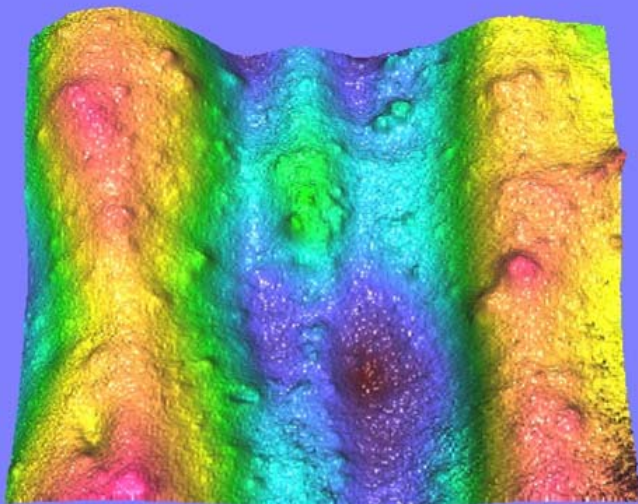
unvarnished paint



varnish



varnished paint



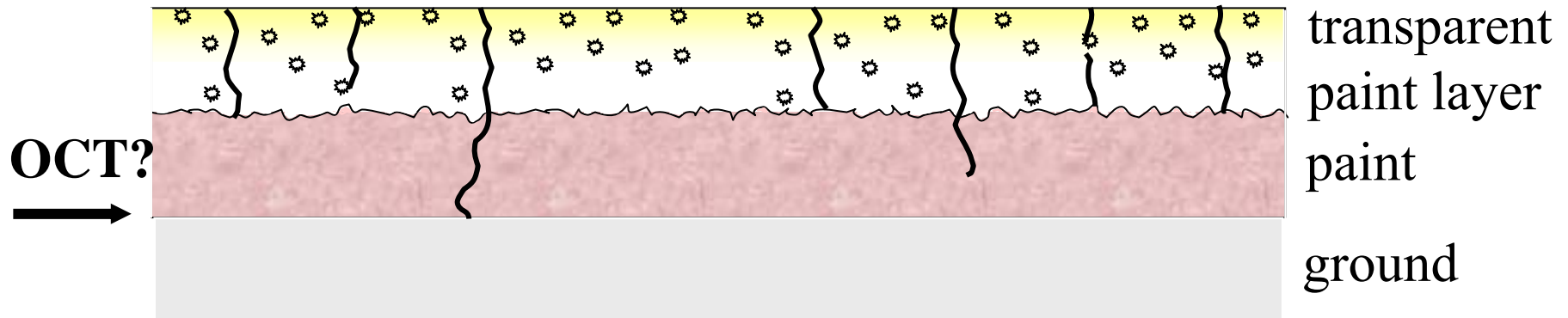
“Thick” varnish on
oil paint

Characterisation of the varnish-object interface using white light confocal profilometry

Initial Conclusions

- What can be seen can theoretically be measured
- Fast, high-resolution, quantitative measurement of areas possible (10 mm² software limited) (10x, 10 mm WD)
- Sub-surface roughness measurements possible with “thick” varnishes/transparent layers (20x/0.6)
- “Thin” layers require higher magnification at cost of loss of signal (low light levels) (> 50x)

(3-D) Technical properties of a surface



Characterisation of the varnish-object interface using white light confocal profilometry

Applications: Cleaning



- Physical damage to original paint surface by cleaning/varnish removal/revarnishing
- Physical state of the original surface
- Original appearance of (unvarnished) painting

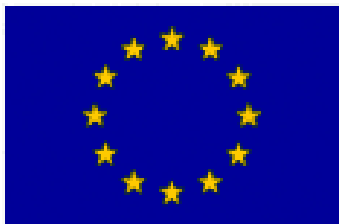
Characterisation of the varnish-object interface using
white light confocal profilometry

Applications: (Image-based) Rendering

Applications: (First-principles) Rendering

FING-ART-PRINT

Fingerprinting Art and Cultural Heritage –
in Situ 3D Non-Contact Microscale
Documentation and Identification of Paintings
and Polychrome Objects



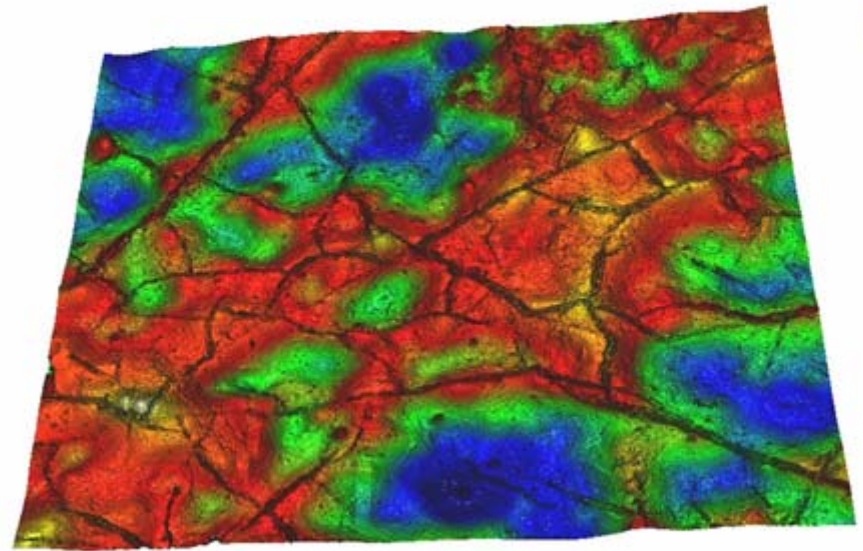
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FING-ART-PRINT Applications in Cultural Heritage

- Non-contact identification / marking (no need for stickers) for **archiving, documentation and restoration work**
- **Tracing:**
 - CD with fingerprint
 - GPS enabled tracker or smartcard chip
 - Barcode with object info and fingerprint file
- Protection against theft: **standards for sales of objects** (fingerprint + papers)

Table model



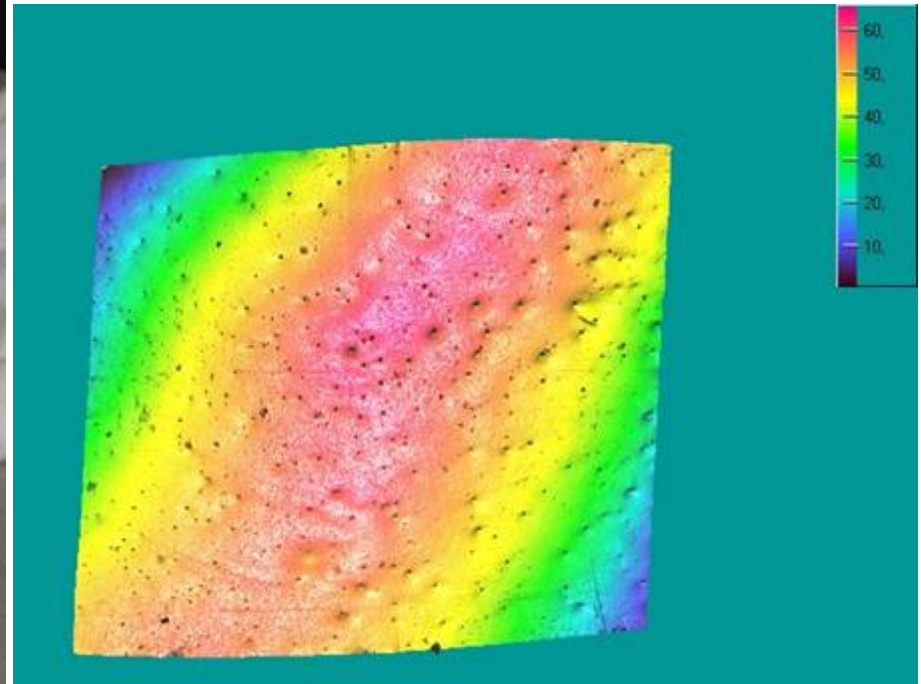
David van der Plaes, Mansportret, doek, 42,7 x 34 cm,
inv.nr. 1664.

Courtesy Museum Boijmans van Beuningen,
Rotterdam

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Table model



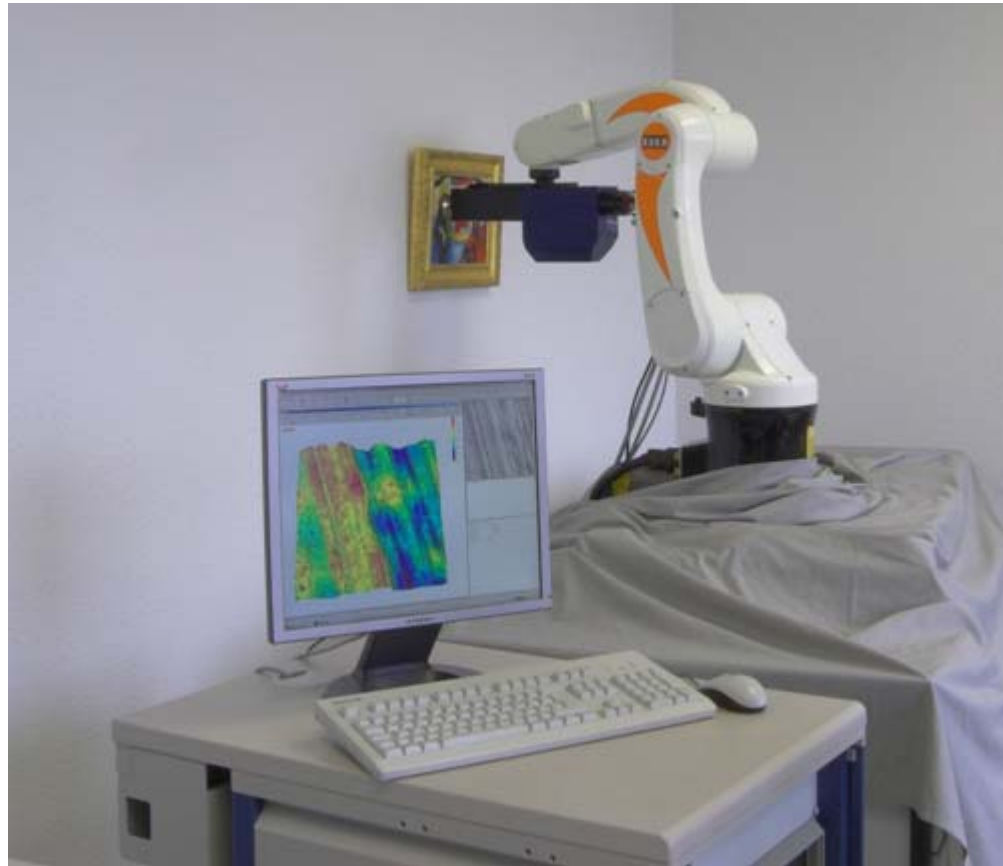
Courtesy Amsterdam Historisch Museum, Amsterdam

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FING-ART-PRINT

Integrated System / Methodology



FING-ART-PRINT Durability

- Aging
(climate, light)
- Colour changes
- Damage
- Clay, sand, dirt, etc.
- **Subsurface changes**
- **Geometrical changes
of the surface**



Dekselpot, Delft 1650-1670,
Instituut Collectie Nederland

Further work

- Thin varnish layers and other transparent coatings
- Measurements at the exact same location
- Use of roughness parameters vs. actual data for modelling and rendering
- Network against the illegal trafficking of objects of art and cultural heritage

Surface Roughness and the Appearance of Objects in Cultural Heritage

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www.fingartprint.org

www.nanofocus.de