RHOPOINT INSTRUMENTS

AESTHETIX
INSTRUMENT VISION SYSTEM

AESTHETIX IVS –
The ultimate optical surface characterization tool

“Aisthēsis“, Greek: "perception / sensation"

“-ix“, Latin: "pertaining to / concerning"

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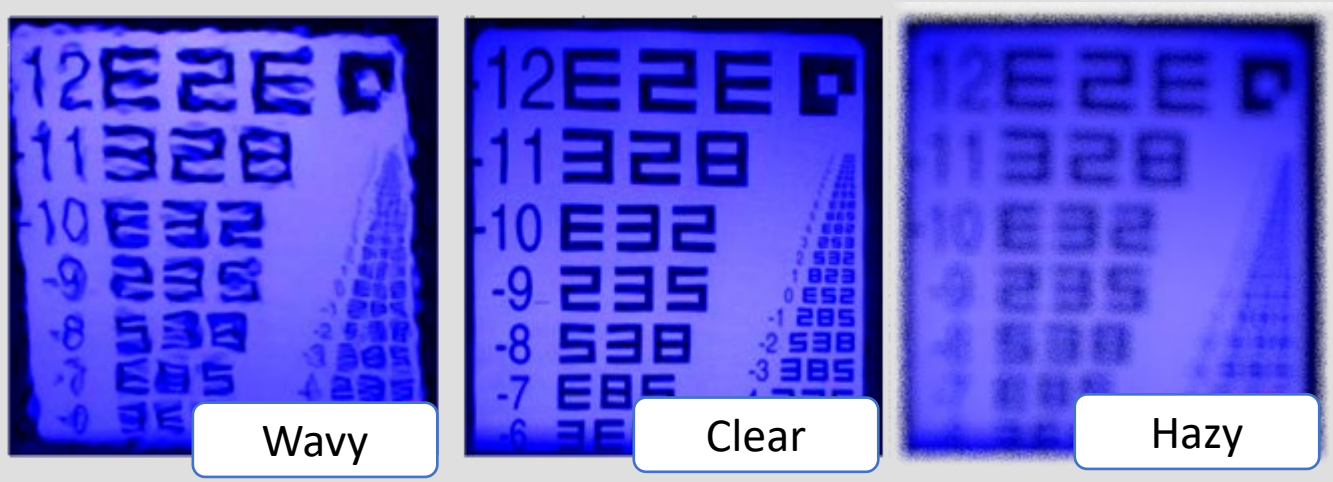
One meter to rule them all

Measure and characterize all aspects on a surface – technically and how the eye sees.

This is what Aesthetix is made for – to measure all effects that compromise surface reflective appearance.



The world of material appearance

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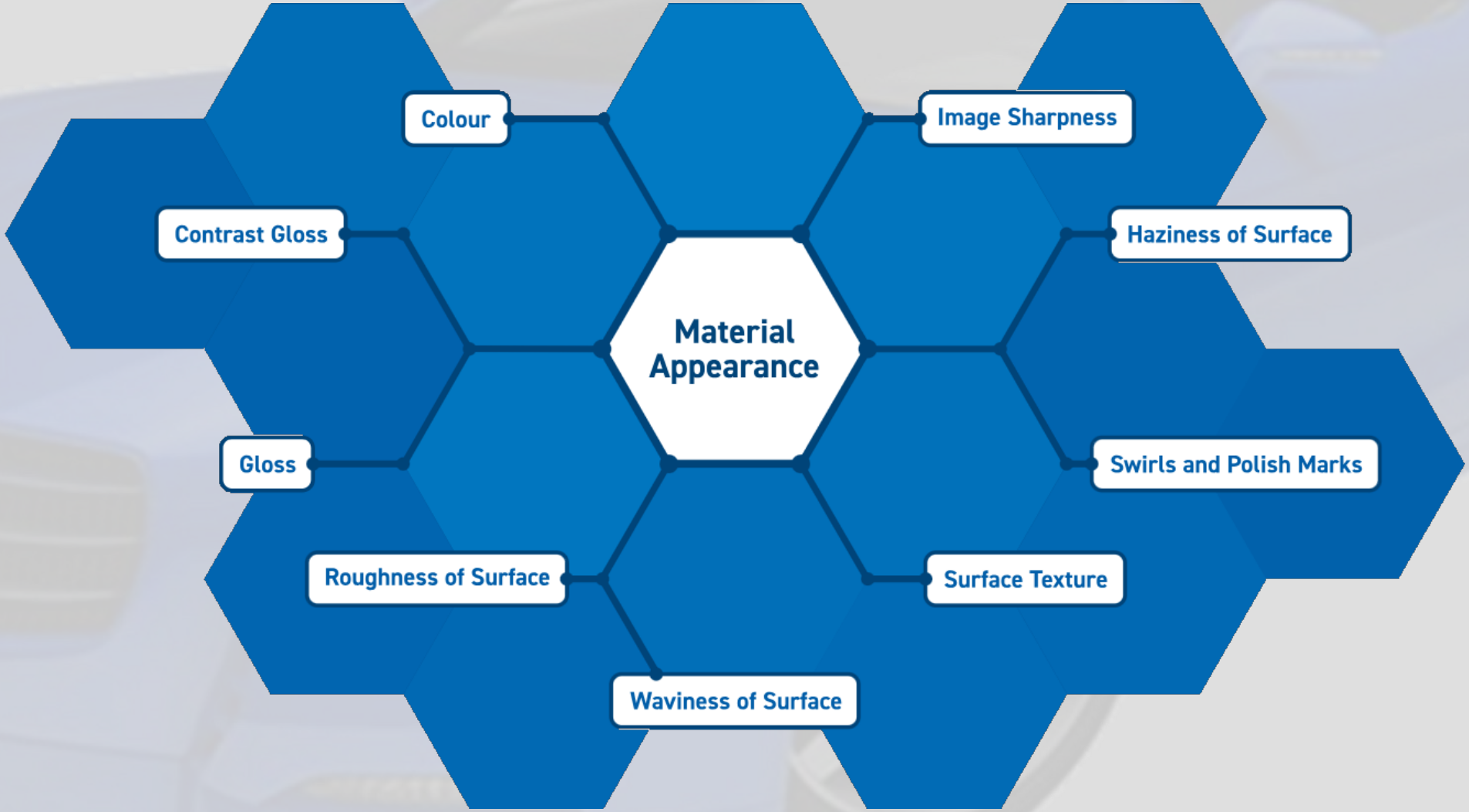

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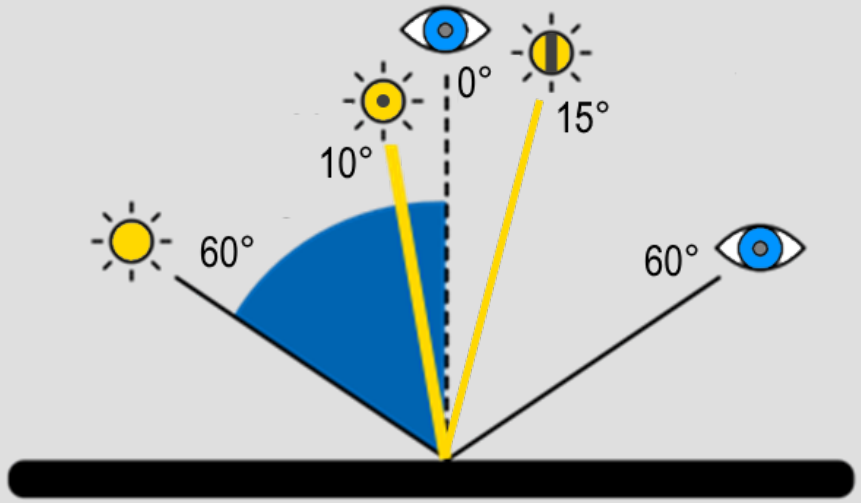
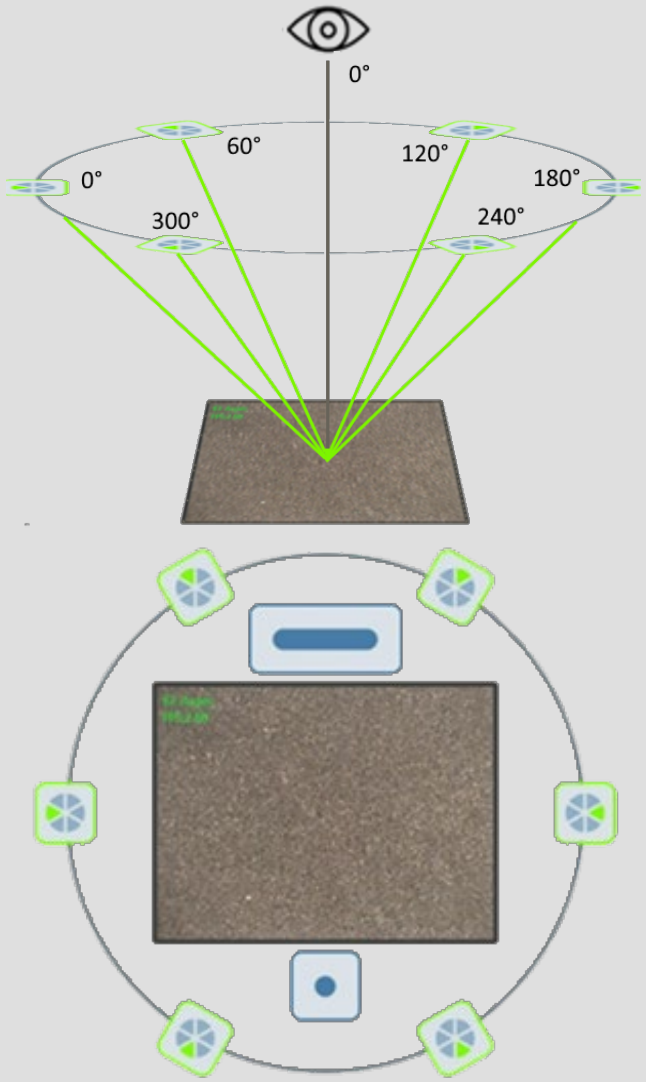
Cameras (CMOS):

- 60° specular
- 0° normal

Lightsources (LEDs):

- 60°
- 6x45°
- 10° spot
- 15° 20mm linelight





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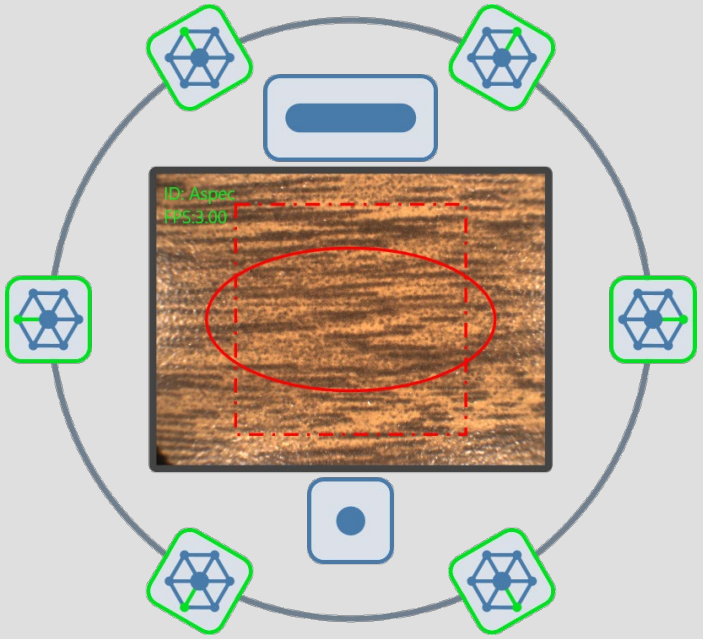
What you see is what you get

Measure parts with ease - the Live View observer camera gives a bird's eye view of the surface - target zones are overlayed, so the right spot is always measured.

The observer camera is fully calibrated to give dimensionally and color accurate images of the surface.

- Surface Image [mm]: 25x19
- Processed size [mm]: Sparkle: 10x10
  (depending on module) Gloss: 12x12
  Topo: 15x15
- Resolution [µm/pixel]: 10



Aesthetix Gloss Module

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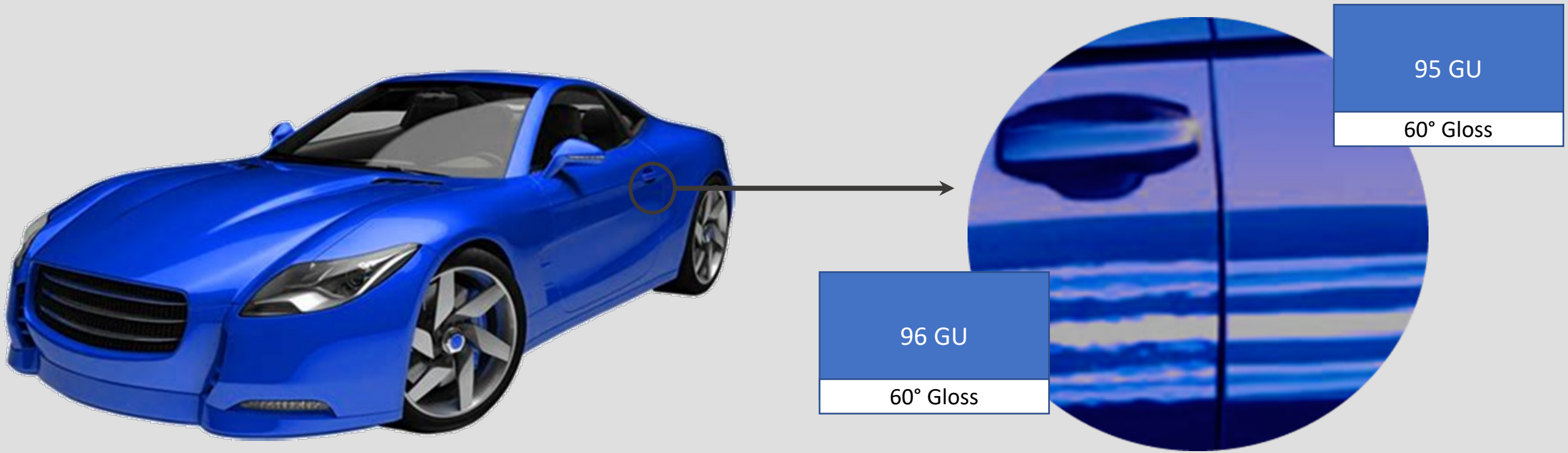
Why is a glossmeter not enough to measure surface finish?

A Glossmeter is virtually blind to effects that compromise surface reflective appearance like surface haze, lack of sharpness or orange peel that make a surface look bad but are not captured by the gloss unit (GU).



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World's first appearance measurement based on industry needs

Aesthetix is the 1st commercial instrument able to completely characterize all important effects that define gloss perception but is **build in compliance to ISO 2813 and ASTM D523** – just with a camera instead of a photodiode!

Yellow rectangle: area on the camera to be integrated according to ISO specification

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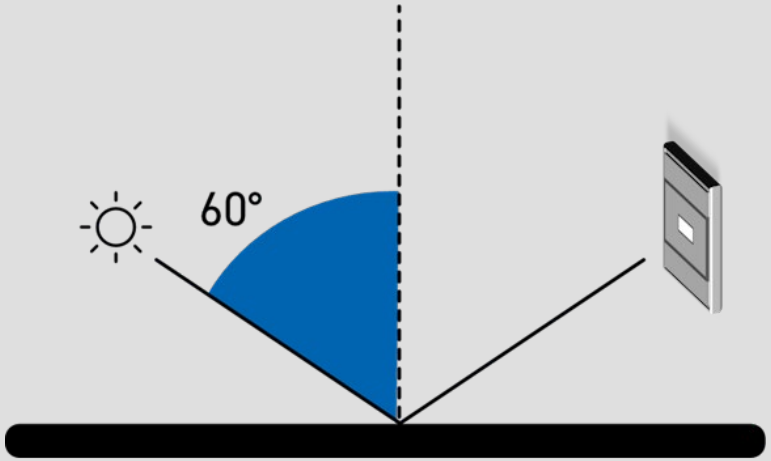

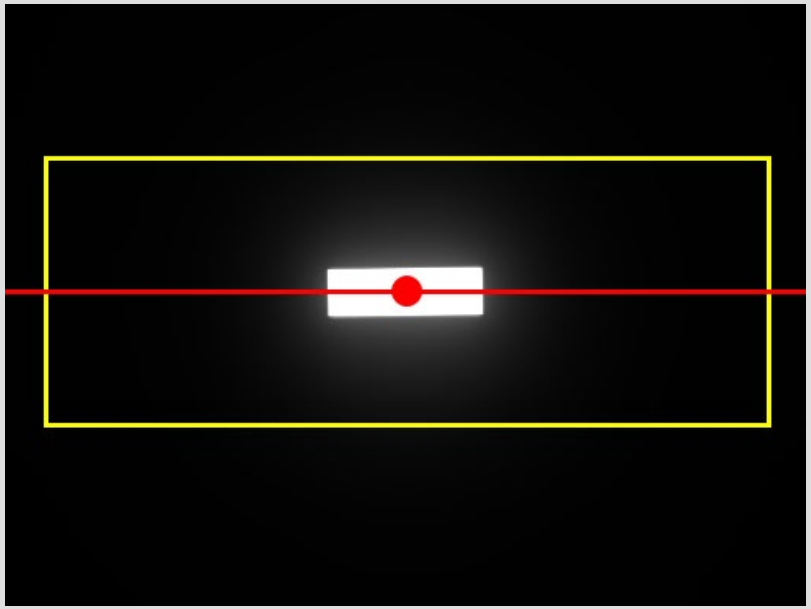

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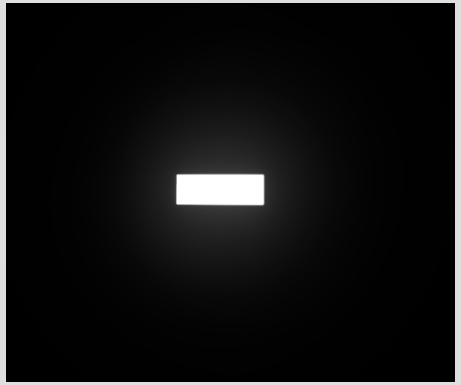
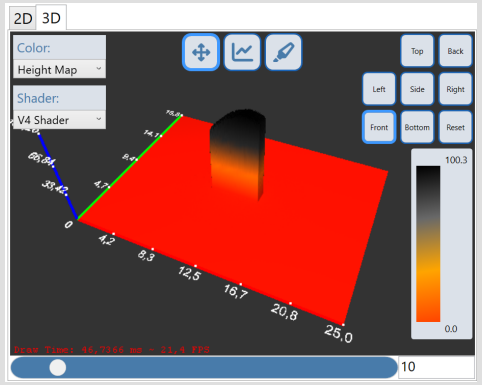
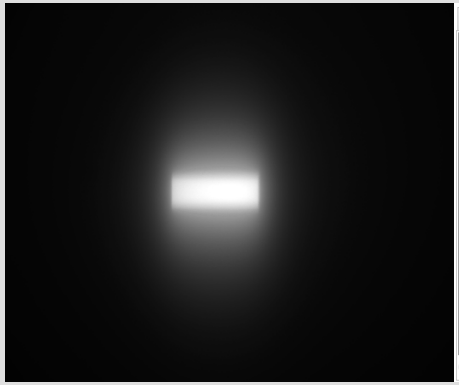
Examples

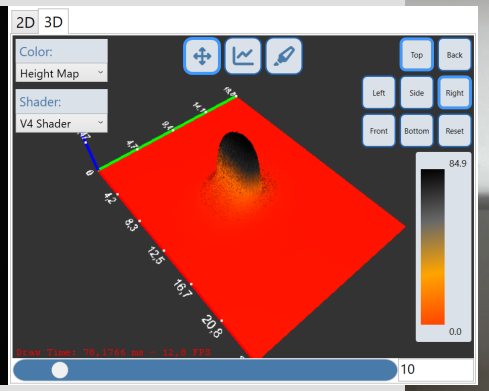
Two glossy surfaces, black glass vs white ceramic

	#	SN	Sample	60° SGU
☐	2	Aesthetix	Black	100,26
☑	3	Aesthetix	White	84,93









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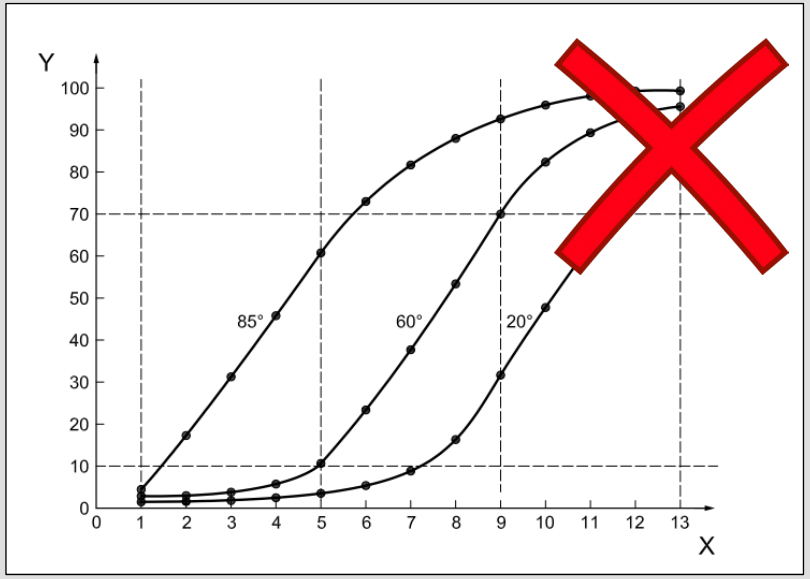
Why only 60° gloss measurement?

- Controlling multiple angles make specifications difficult, especially close to the border values, one single angle is much easier to implement in a quality control specification
- Using the standard 60° angle only is already common practice, e.g., in Automotive Interior specs



Hunter & Judd 1939

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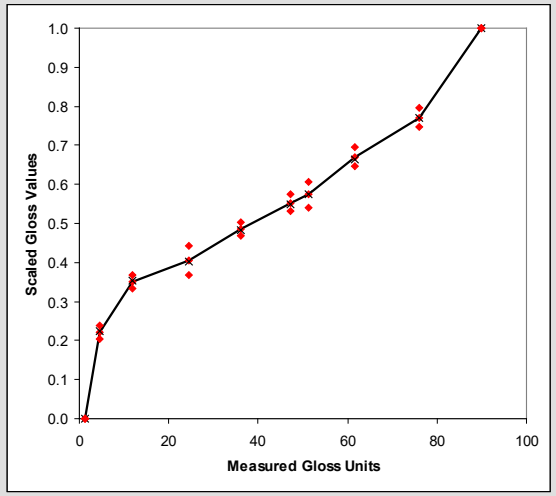
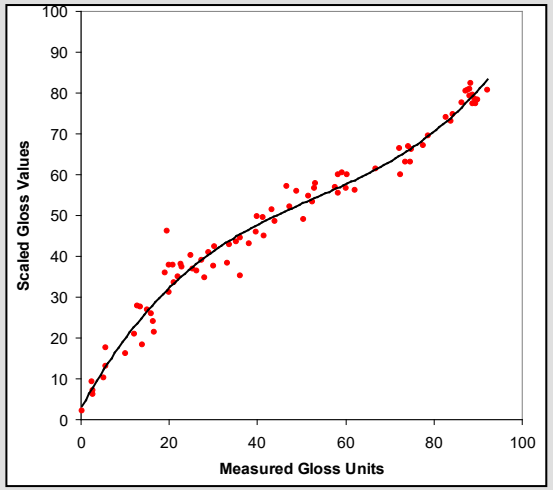
Why only 60° gloss measurement?

Latest “Up to date” psychometric studies have proven the concept of 20/60/85° to be outdated, and that for high gloss ranges, effects like waviness or Haze have more influence on the observer than “gloss”.

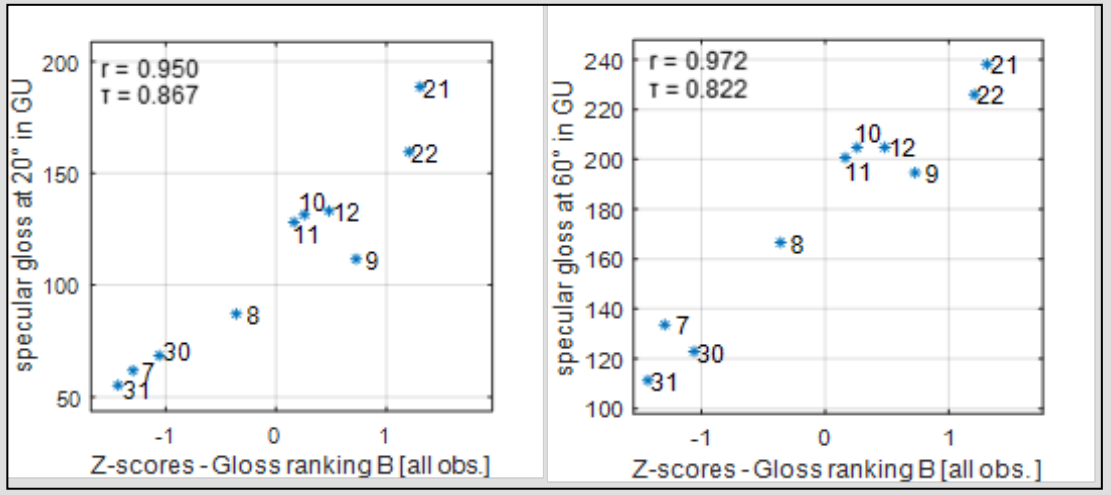
Conclusion: a single angle 60° measurement is enough match gloss perception for all gloss levels



Obein & Viénot, 2002



Ji & Pointer, 2006



C.-F. Weber, 2023

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How the eye sees – and why that is important for your quality assurance

But not only the technical approach (e.g., to guarantee product stability) is important – also the way the eye perceives **contrast and brightness is essential** for ensuring or developing product standards.

95 GU
60° Gloss

95 GU
60° Gloss

95 GU
60° Gloss

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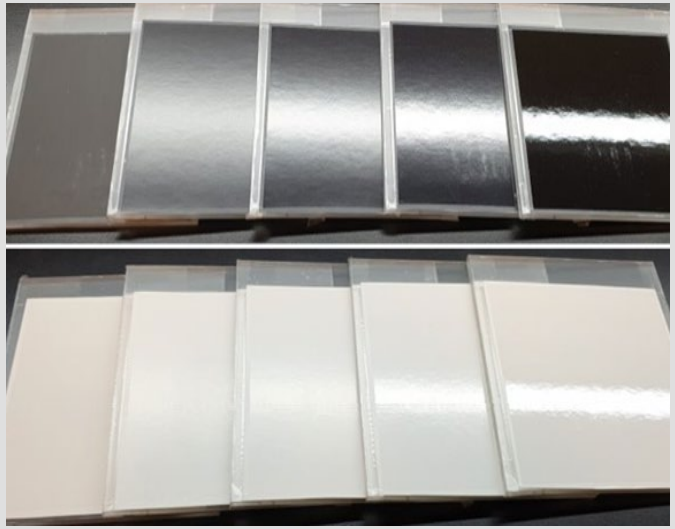
How the eye sees – and why that is important for your quality assurance

When judging surface reflection effects like reflection Haze or waviness, the background colour has an important influence.

Human gloss perception is strongly influenced by background colour.

If the surface colour is different, we also perceive the gloss as being different.



This effect is called “**Contrast Gloss**” and was first described in the 1930s.

Together with renown researchers from KU Leuven, this concept was finetuned with perception studies and developed for industrial usage.

Contrast gloss evaluation by use of a camera-based gloss meter
Stijn Beuckels*, Jan Audenaert, Peter Hanselaer, Frédéric B. Leloup Light&Lighting Laboratory, Dept. of Electrical Engineering (ESAT), KU Leuven,

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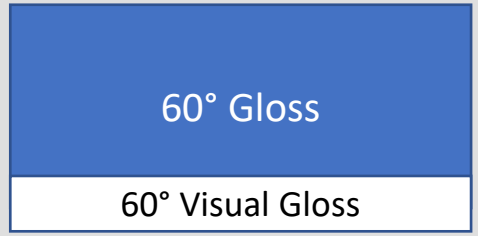
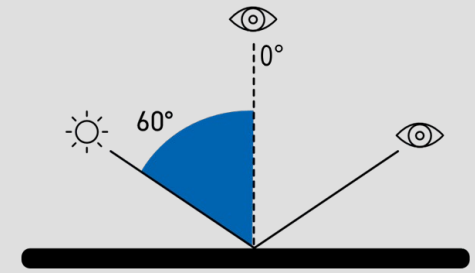
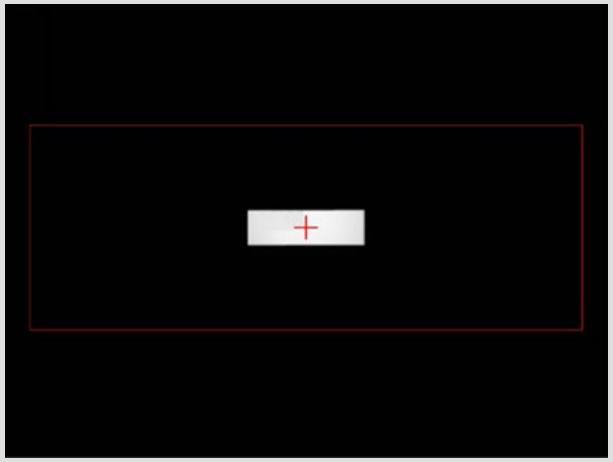
The Aesthetix includes a new parameter: Visual Gloss (VGU)

Using its 0° HDR camera, the device can “see” (measure) the surface colour (background) of the sample to calculate “perceived brightness”.

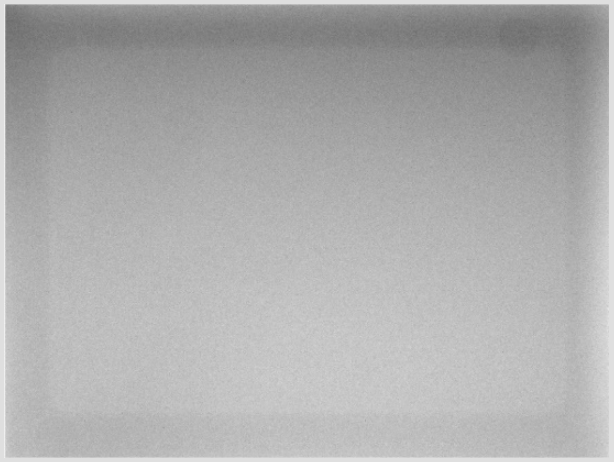
The new parameter “Visual gloss”, aka “Psychometric contrast”, **describes the perceived glossiness** of samples with varying contrast (e.g., for designing surfaces).







Sample Luminance



Background color

Visibility

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Why Visual Gloss is important for your product design

At certain VGU levels, differences between parts are less visible – the lighter the color, the higher the tolerance.

Or in other words, VGU highlights the visibility of the traditional technical gloss effect

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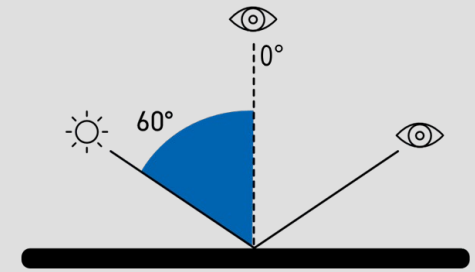
Haze, logHaze
DOI, Waviness
Sharpness, Sparkle

And their “V” partners

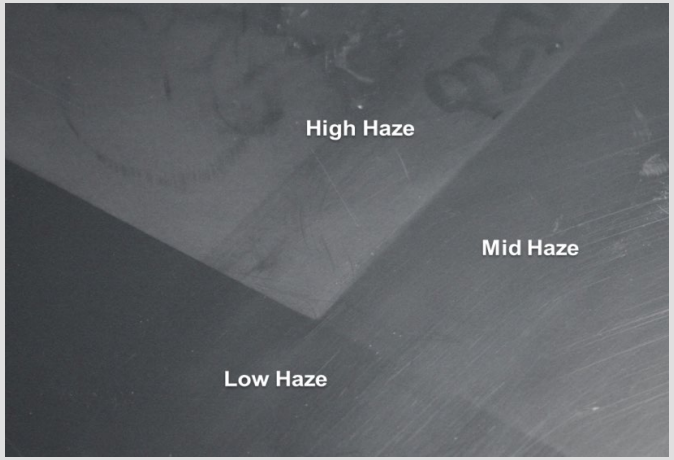
The visual concept

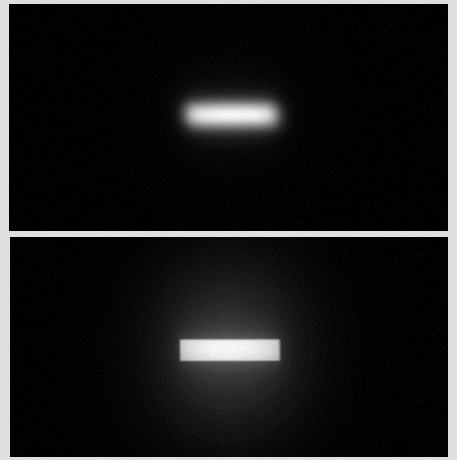
“Psychometric contrast” cannot only be used to describe the effect of color on gloss:

Aesthetix uses the same concept for all related parameter: Haze, Waviness, Sharpness, etc.



Haze [HU]:
scattering of light at the glossy surface of a specimen responsible for the apparent reduction of contrast of objects viewed by reflection at the surface.





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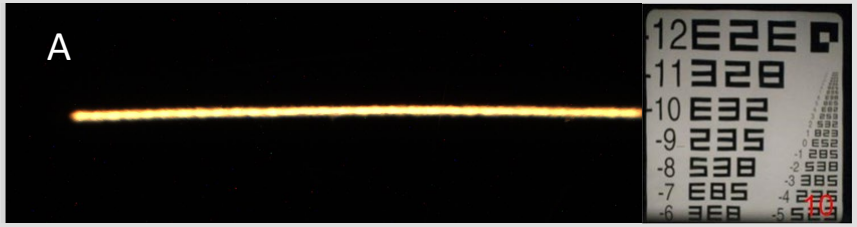
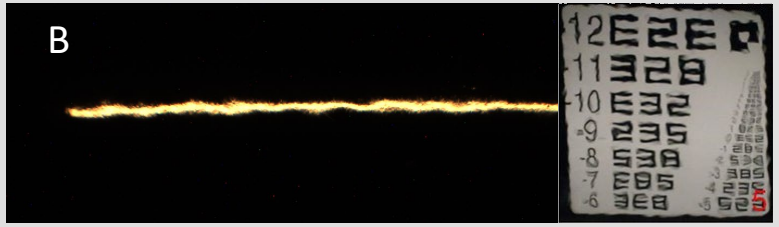
Simple but effective measurement of surface structures

The parameter **“Waviness” (W)** describes the visual impact of “Orange peel” on a scale from 0-30 when the surface is viewed from a distance of 1.5m away (based on AUDI/VW perception studies already used for the Rhopoint TAMS)

Aesthetix waviness measurements made on ACT orange peel standards vs comments made by untrained consumers.



Waviness (1.3)
“The paint is amazing the surface is perfectly smooth.”



Waviness (9.5)
“This paint finish is worse than A, I see some ripples.”

Waviness (28.6)
“I don’t like this paint- it looks very bumpy and bad quality.”

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Sharpness and Wavniess

In our black and white example, Sharpness and waviness can be used to characterize the surface as well

☐	#	SN	Sample	60° SGU	60° VGU	S	Waviness
☐	2	Aesthetix	Black	100,26	95,87	100,33	0,00
☑	3	Aesthetix	White	84,93	43,68	12,98	6,20

Sparkle measurements

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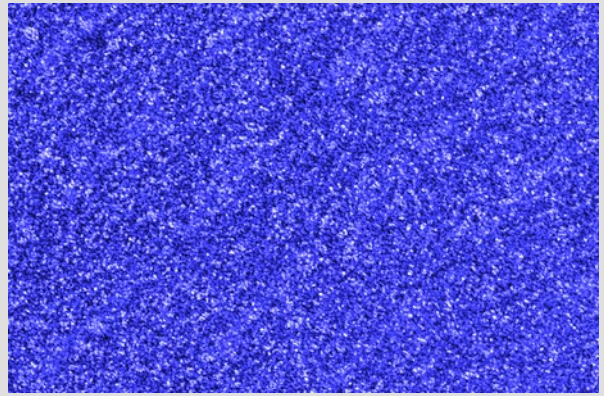
Sparkle and Graininess

Sparkle:

The sensation of randomly distributed, unstable and highly-luminous objects on a more extended and darker surface with uncorrelated lightness.

Graininess:

The sensation of non-uniformity in a surface produced in the consciousness of the observer only when such a surface is viewed under diffuse or partially diffuse illumination.



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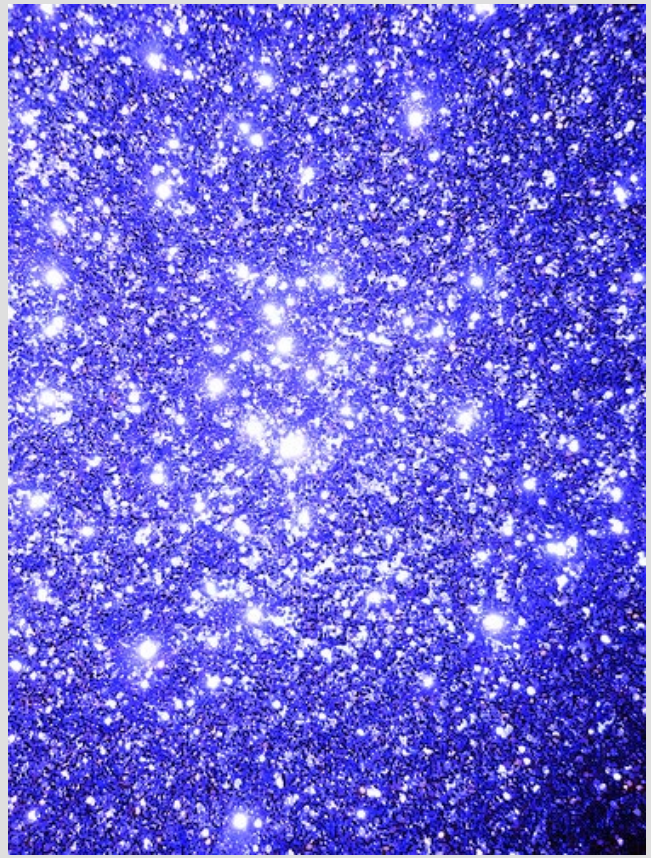
Sparkle and Coarseness

The characterization of appearance for surfaces including effect pigments is crucial in industries such as paint and coatings, printing, and plastics.

Two common attributes used to measure the texture of effect coatings are diffuse **coarseness**, also known as **graininess**, and the impression of **sparkle or glint**.



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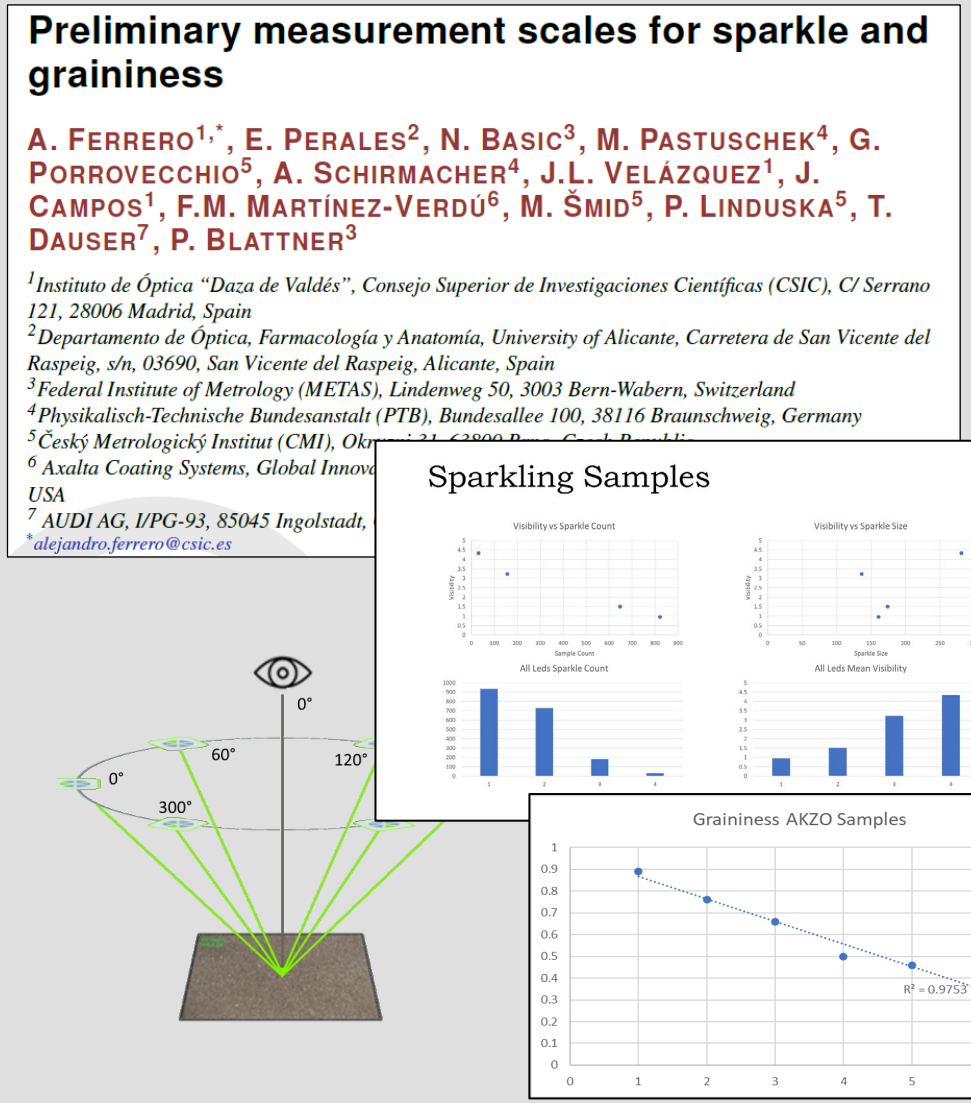
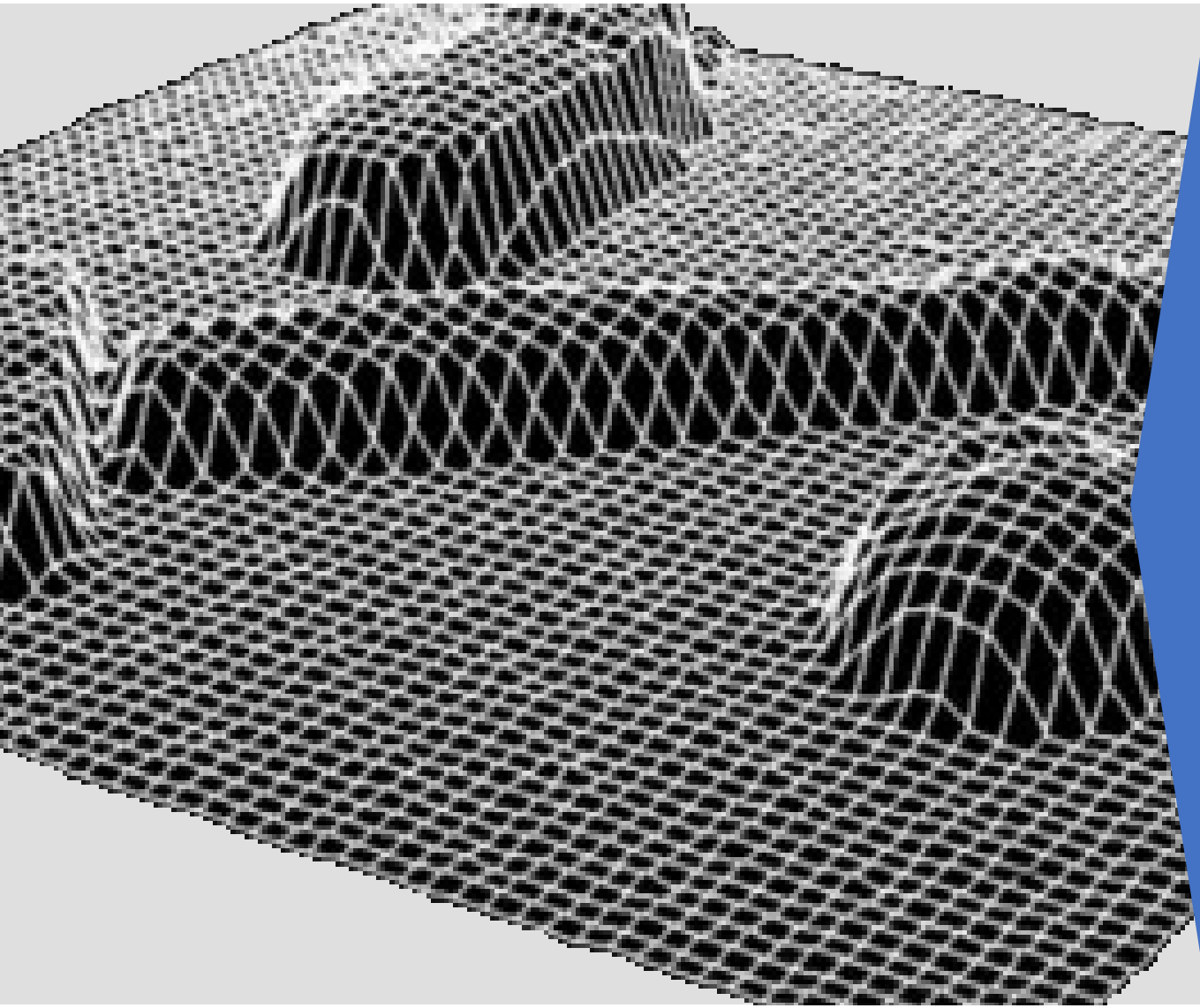
Sparkle and Graininess

Until now, Sparkle and Graininess QA was only possible with expensive goniophotometric equipment.

Using its six circumferential 45°c:0°LEDs, Aesthetix uses a new method developed by renown researchers, providing an easy QA indication of sparkling (e.g., Visibility, Intensity, Density, Colour, etc.) effects and graininess.





Photometric stereo

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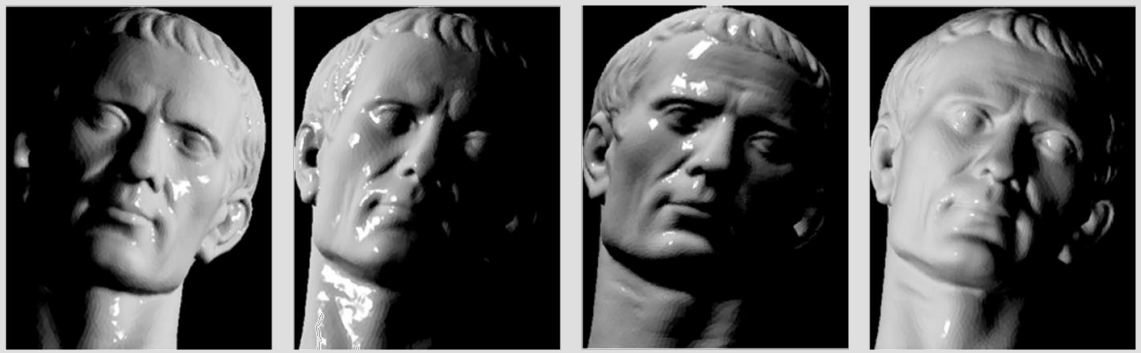
What is Photometric Stereo?

Photometric stereo is a computer vision technique introduced by Woodham in 1980 and utilizes the principle that the amount of light a surface reflects varies with its orientation relative to the light source and observer.

With sufficient light sources from different angles and a camera to capture the reflected light, the technique can accurately determine the surface orientation.



[Source:Wikipedia, Photometric stereo, 12.03.24.]

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Where would you use that?

It is particularly useful for applications such as surface inspection, pattern recognition, wear analysis, texture control or computer vision tasks requiring precise surface information, to name just a few.

[Source: https://pxhere.com/en/photo/1405168, 12.06.23]

Figure 3: Overview of the samples in the material class *Leather*.

[Source:Data-Driven Enhancement of SVBRDF Reflectance Data / Steinhausen et. Al.]

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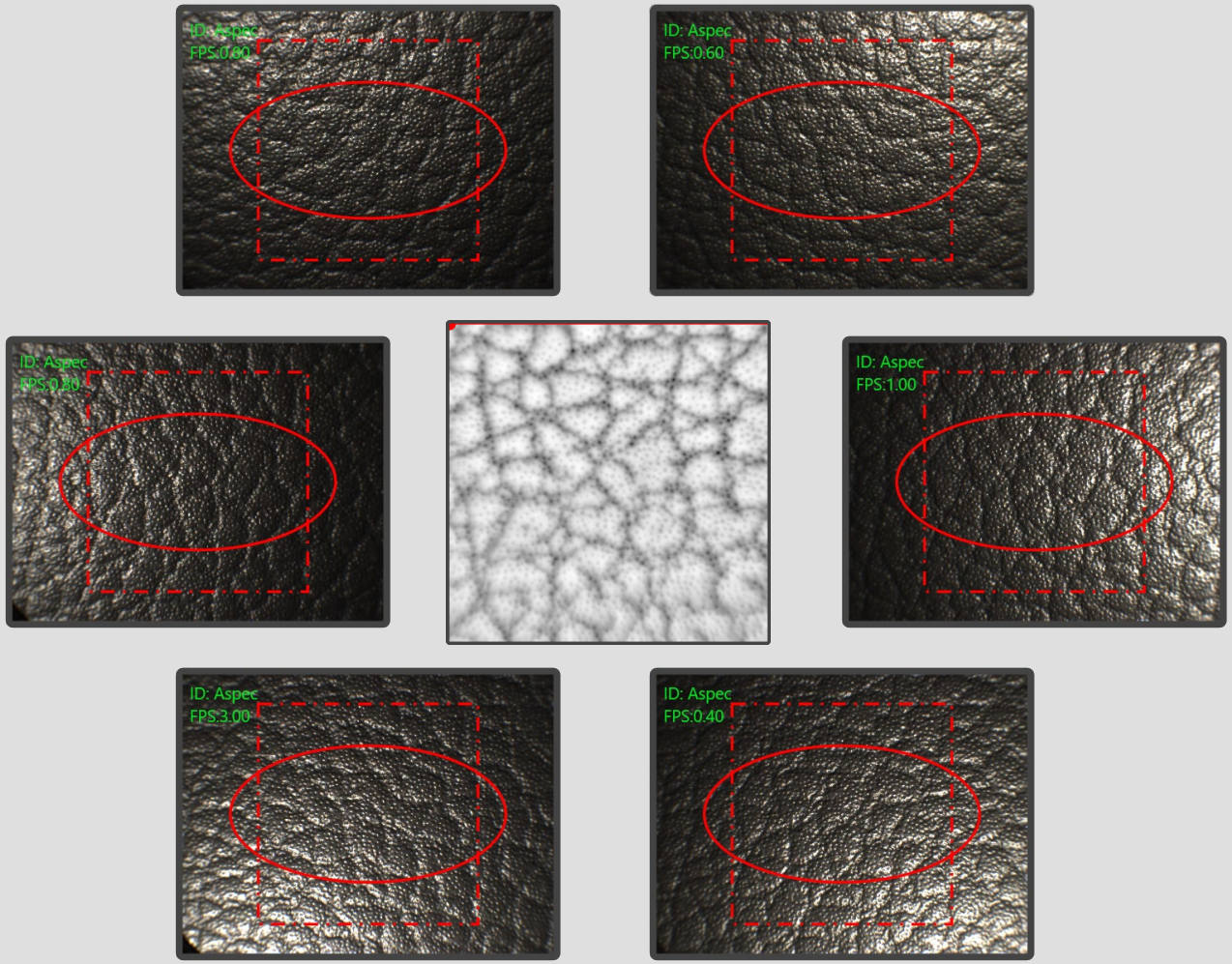
How does this work in the Aesthetix?

With six circumferentially positioned LEDs the Aesthetix captures six images around the object and combines these into a heightfield image.

Each LED provides a unique lighting direction to calculate the topographic information at each pixel based on the variations in brightness across the images.



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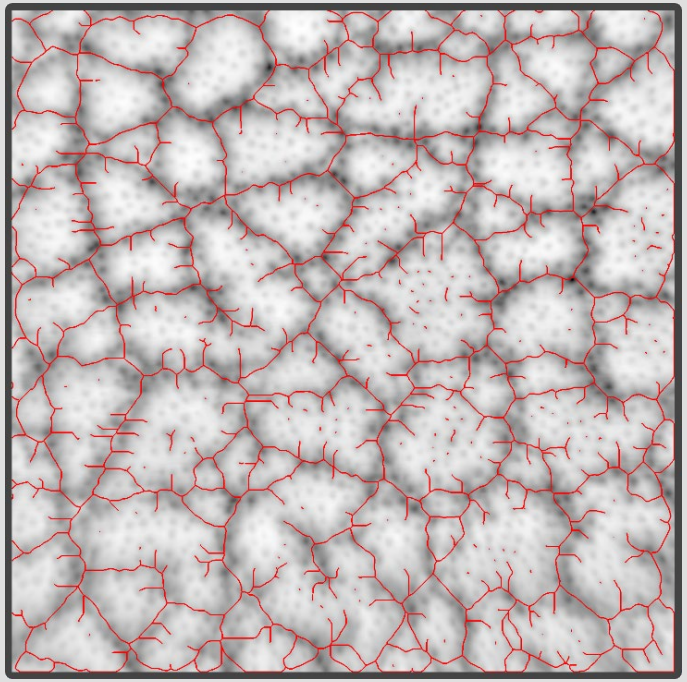
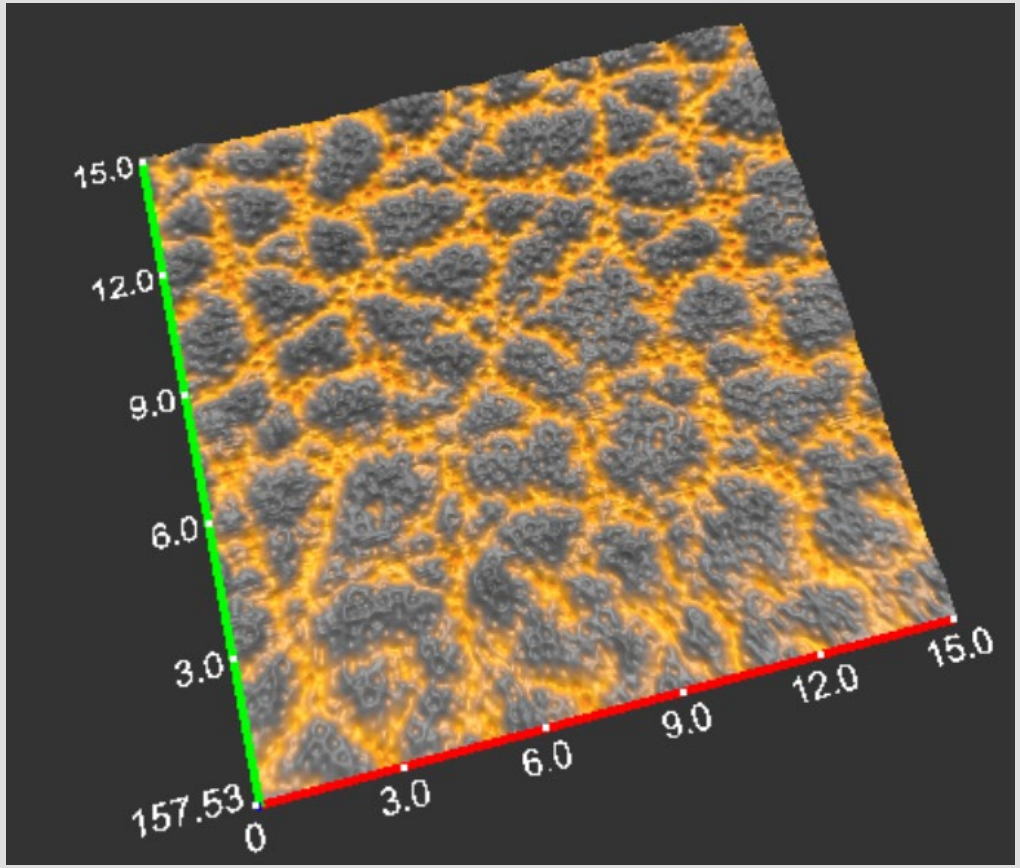
Topographic measurements

- Complete topographic pattern and shape recognition
- Analyze cell sizes, cell form, cell numbers, altitudes, profiles





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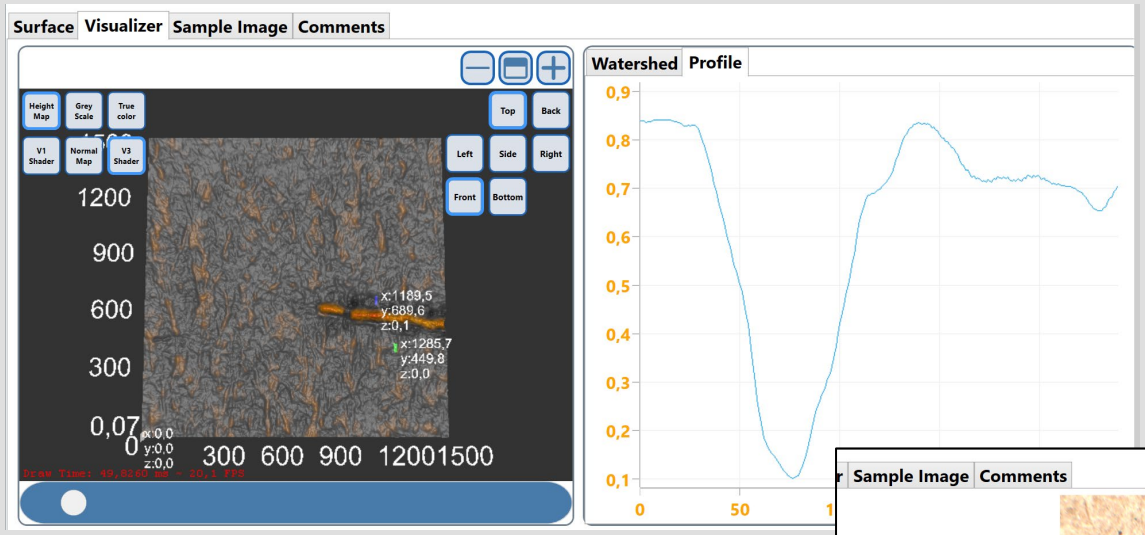
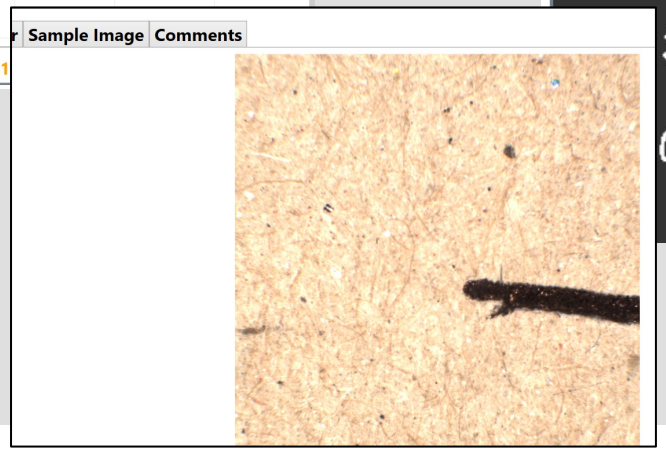
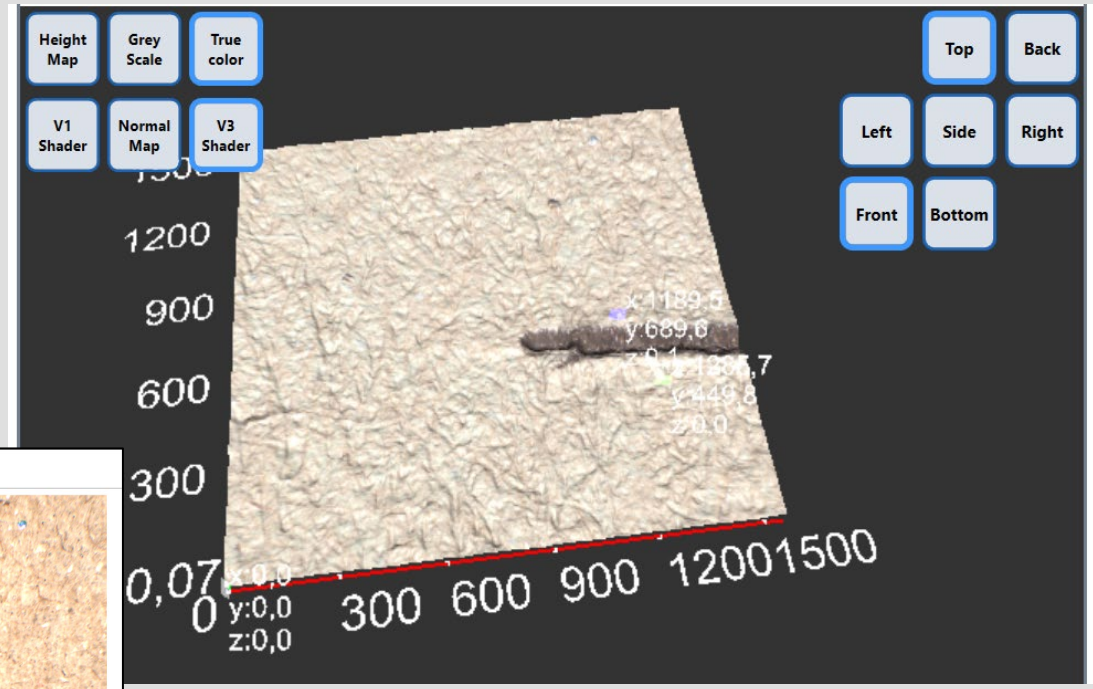
Topographic measurements: carton board with pen mark

Combine topographic map with surface image







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Upcoming further Image Analysis

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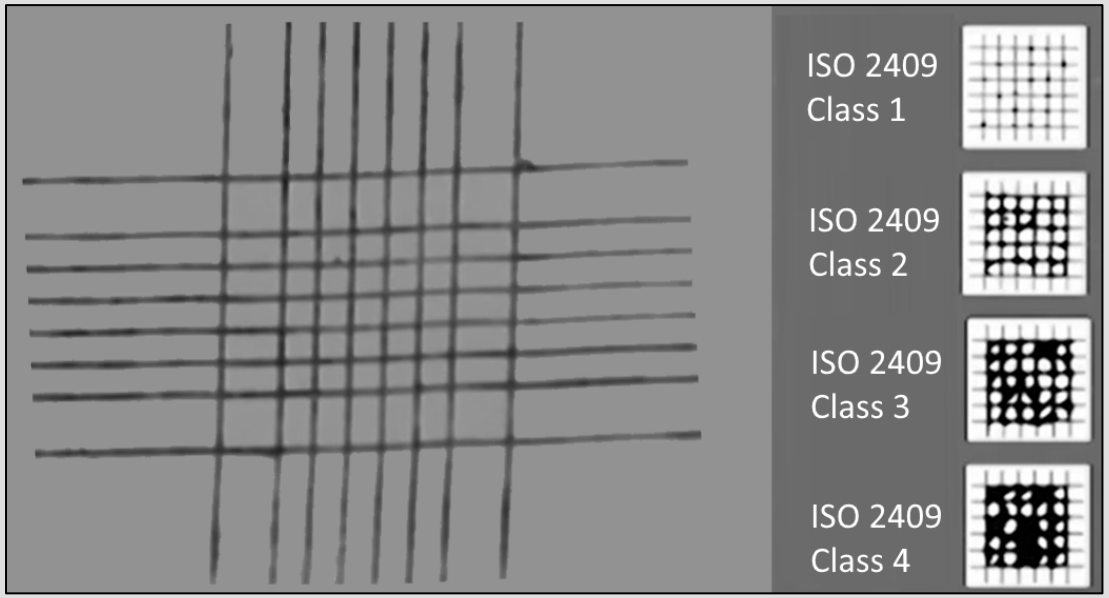
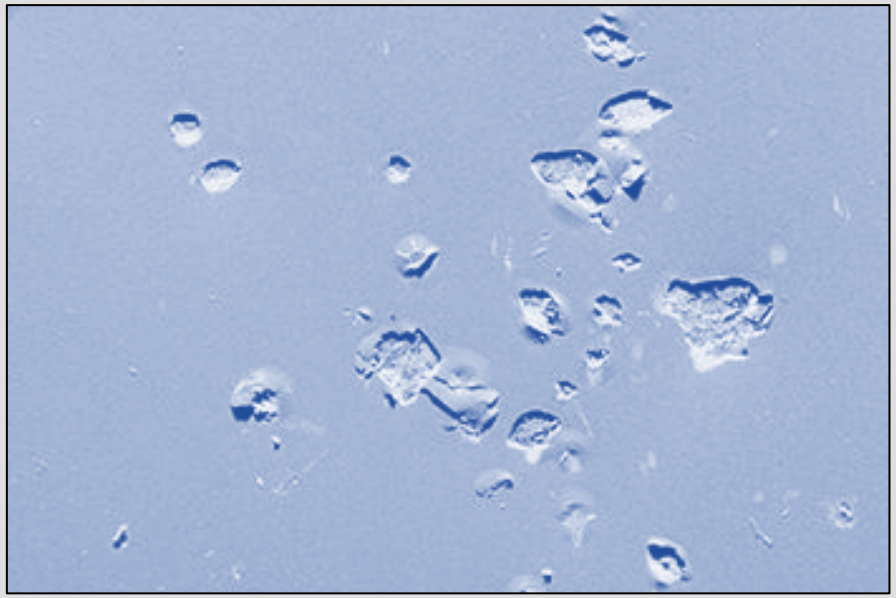
Cross-cut, stone chipping, defects and many others more…





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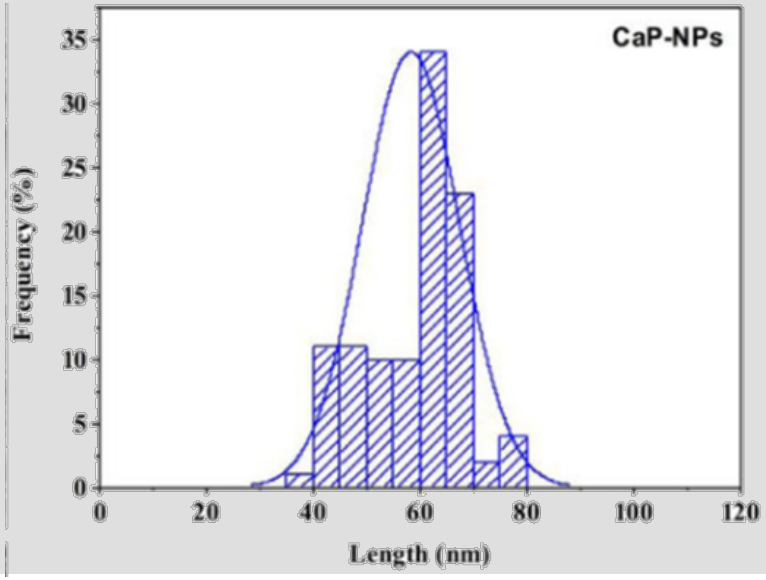
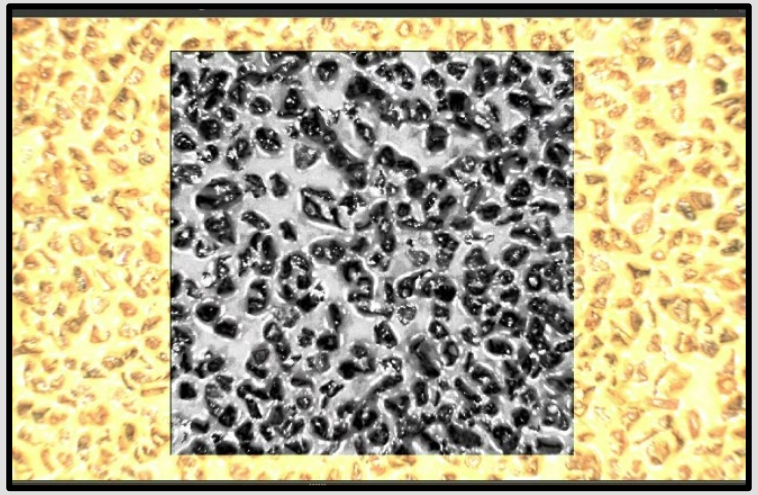
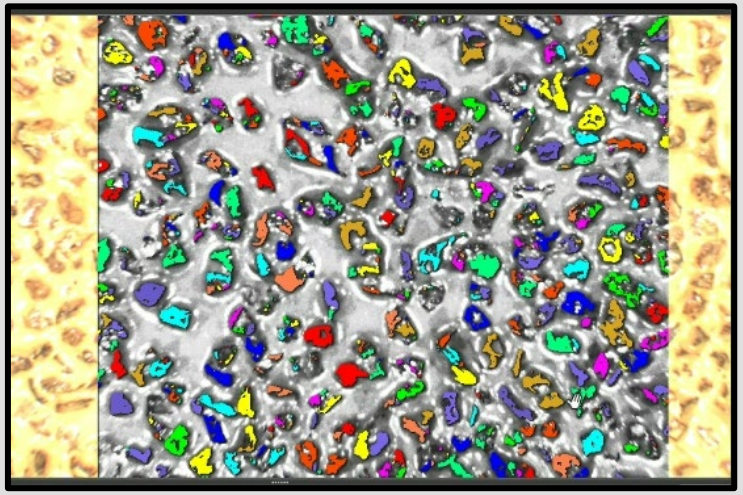
Distribution Image Analysis

- Particle size and distribution
- Areal coverage
- And much more







Taking measurements

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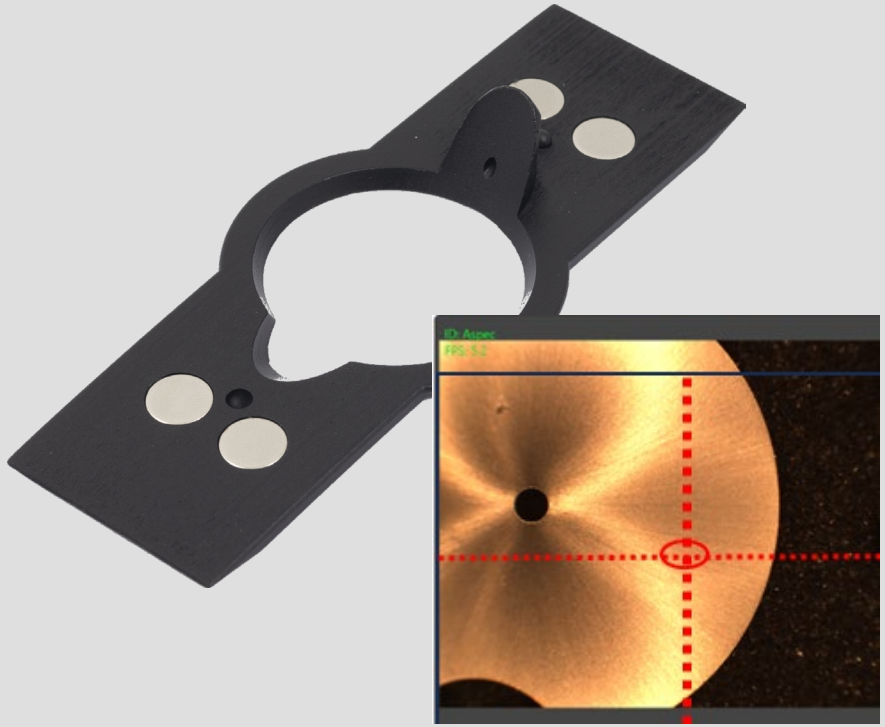
Gloss of curved & small Parts, wet surfaces

But not only “Live View” – reduce spot size by beam adaptors, reducing the measured area down to 2mm

or measures surfaces with curvature >7m^{-1} or cylinders with a radius >11mm with bespoke 3D adaptors



EFFECT OF SURFACE CURVATURE ON SPECULAR GLOSS EVALUATIONS
Ged, G.1 , Beuckels, S.2 , Bessenay, T1 ., Audenaert, J.2 , Leloup F.B.2 1 EssilorLuxottica / Lens R&D, Créteil, France

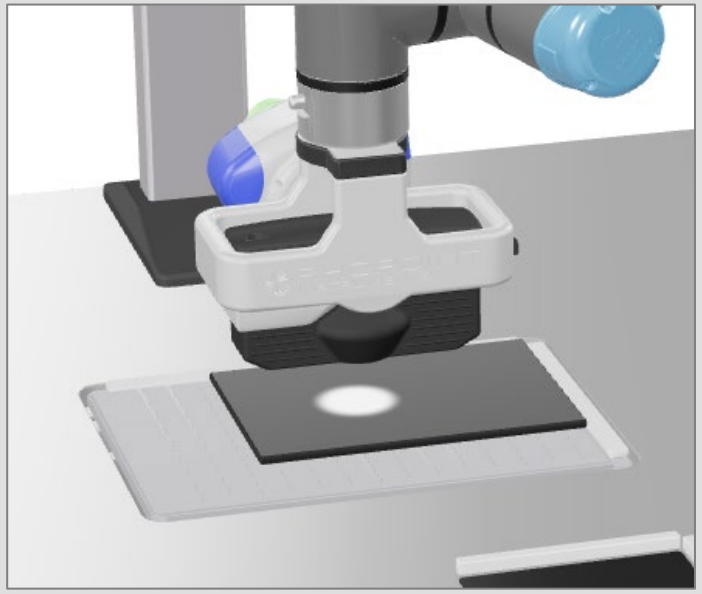
MEASURING THE GLOSS OF CURVED SURFACE Duncan, B NPL Teddington, UK

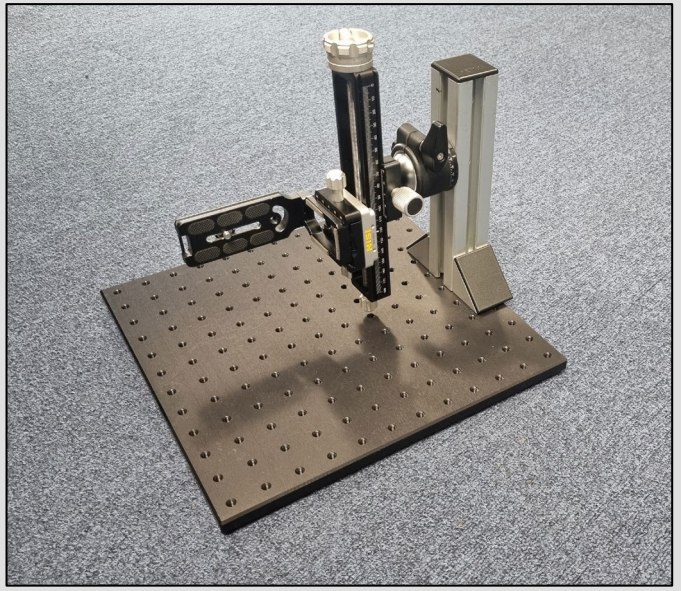
AESTHETIX
INSTRUMENT VISION SYSTEM

The key to measuring curved surfaces is accurate sample positioning

- Accurate positioning accuracy / **non-contact** with stand adaptor or Cobot
- Standard camera quick-fix ready

Surf to: My Portfolio (robotop.de) to see interactive example





AESTHETIX
INSTRUMENT VISION SYSTEM

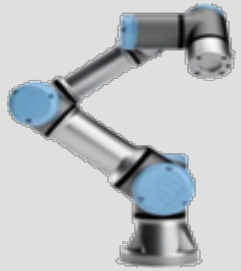
Aesthetix IVS: a modular sensor that fits into any measurement workflow

Portable Measurement
Surface Pro 9 & Rhopoint Analytics

For flexible workflows and mobility

Laboratory
Windows 10/11 PC & Rhopoint Analytics

Standard use case for:
QC, Research&Development



Cobot & Inline
Interfaced to 3rd party laboratory and production software

For production and automated workflows

Including modern QC Software!

AESTHETIX
INSTRUMENT VISION SYSTEM

The Aesthetix Instrument Vision System

The Aesthetix IVS is supplied with **upgradeable and selectable modules*** that group tools, parameters and expert tips to help users get maximum benefit from the advanced instrument vision measurement.

- Complete Gloss Module
- Sparkle Analysis
- Interior Topography & Appearance
- Upcoming: Cross-Cut and surface defects QA
- Upcoming: Metal finishing and Advanced metal finishing

This enables "purchase now and update later" invest strategy

Rhopoint provides a **custom-made module design** service to match any application - tools include those mentioned above and more

Control for your needs

Simple to use tools –
For the age of complexity

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