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PAINT ORANGE PEEL TEXTURE ANALYSIS

USING

3D PROFILOMETRY

Prepared by

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Introduction

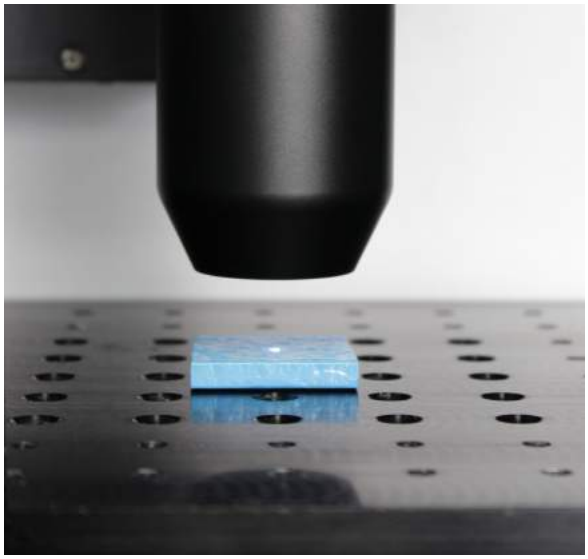
The size and frequency of surface structures on substrates affect the quality of gloss coatings. Orange peel, named after its appearance, can develop from substrate influence and paint application technique. Texture problems are commonly quantified by waviness, wavelength, and the visual effect they have on gloss coatings. The smallest textures result in gloss reduction while larger textures result in visible ripples on the coated surface. Understanding the development of these textures and its relation to substrates and techniques are critical to quality control.

Importance of Profilometry for Texture Measurement

Unlike traditional 2D instruments used to measure gloss texture, 3D non-contact measurement quickly provides a 3D image used to understand surface characteristics with the added ability to quickly investigate areas of interest. Without speed and 3D review, a quality control environment would solely rely on 2D information that gives little predictability of the entire surface. Understanding textures in 3D allows for the best selection of processing and control measures. Assuring quality control of such parameters heavily relies on quantifiable, reproducible, and reliable inspection. Nanovea 3D Non-Contact Profilometers utilize chromatic confocal technology to have the unique capability to measure the steep angles found during fast measurement. Nanovea Profilometers succeed where other techniques fail to provide reliable data due to probe contact, surface variation, angle, or reflectivity.

MEASUREMENT OBJECTIVE

In this application, the Nanovea HS2000L measures the orange peel texture of a gloss paint. There are endless surface parameters automatically calculated from the 3D surface scan. Here we analyze a scanned 3D surface by quantifying the characteristics of the orange peel texture.



Measurement Setup	
Instrument	Nanovea HS2000L
Optical Sensor	LS2 Lens (1mm Z-Range)
Scan Size (mm)	25mm x 25mm
Step Size (um)	5µm x 5µm
Scan Time (h:m:s)	00:03:20

Orange Peel sample being analyzed with the Nanovea 3D Profilometer.

Orange Peel Sample used for testing.

RESULTS AND DISCUSSION

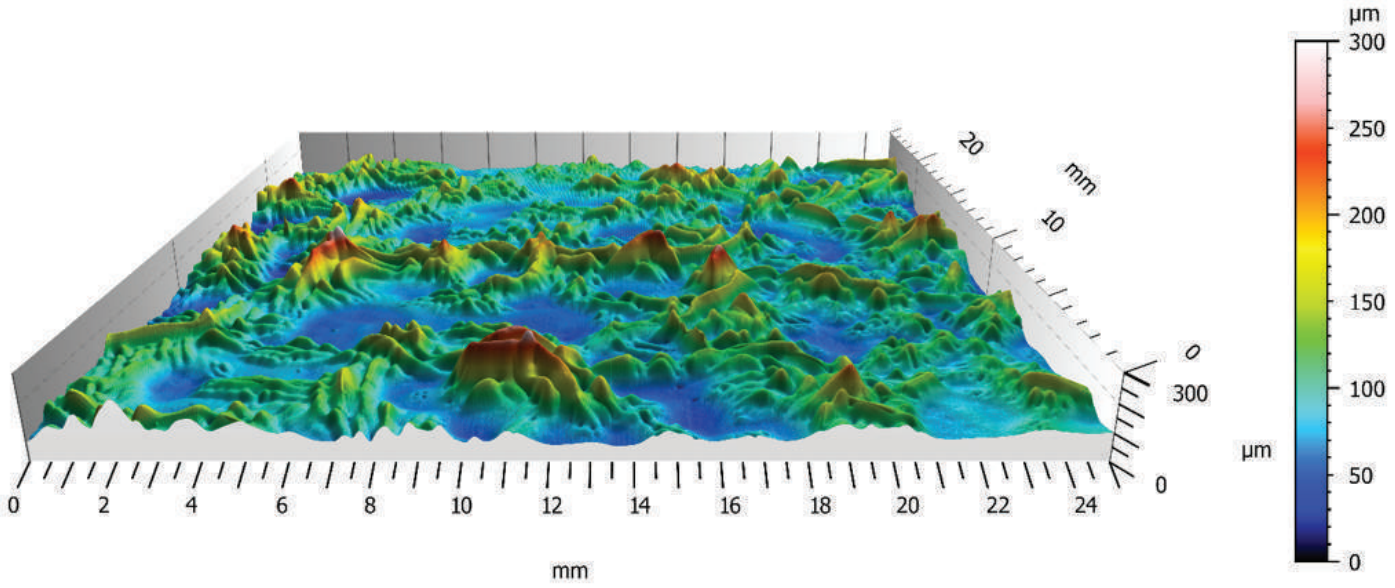


Figure 1: 3D view of the surface.

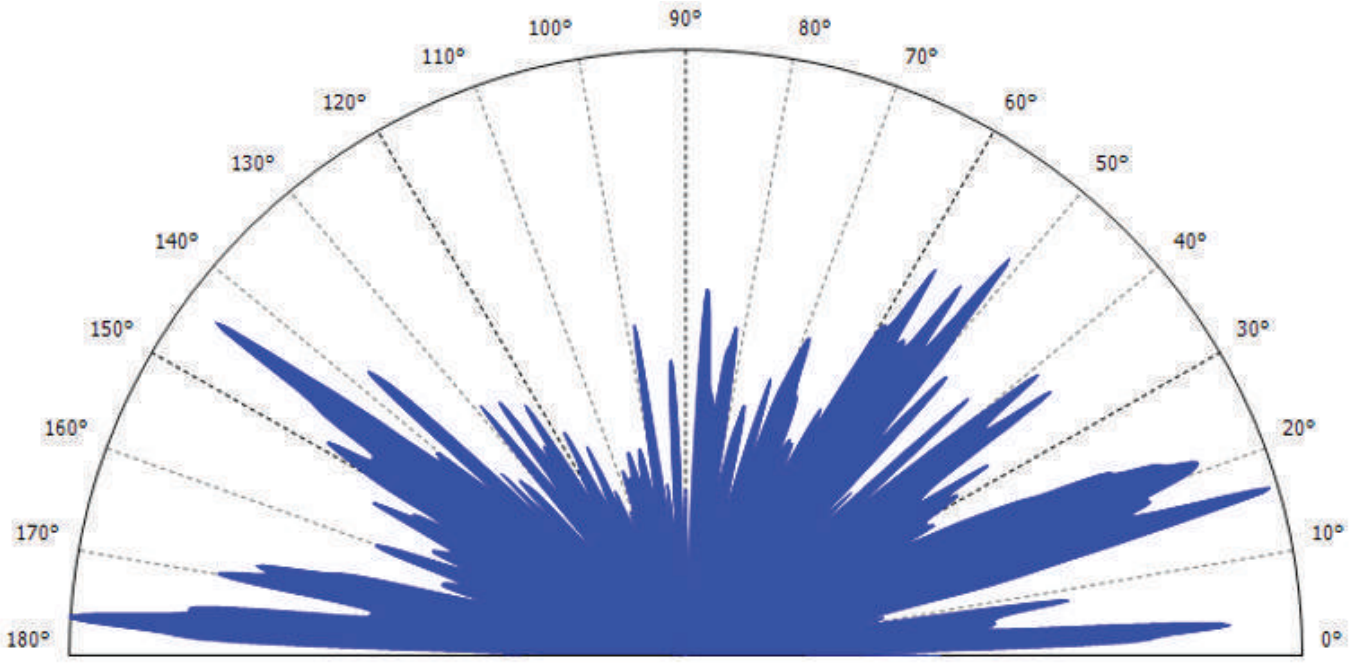


Figure 2: Texture direction polar coordinate graph. Isotropy of the orange peel texture is 94.40%.

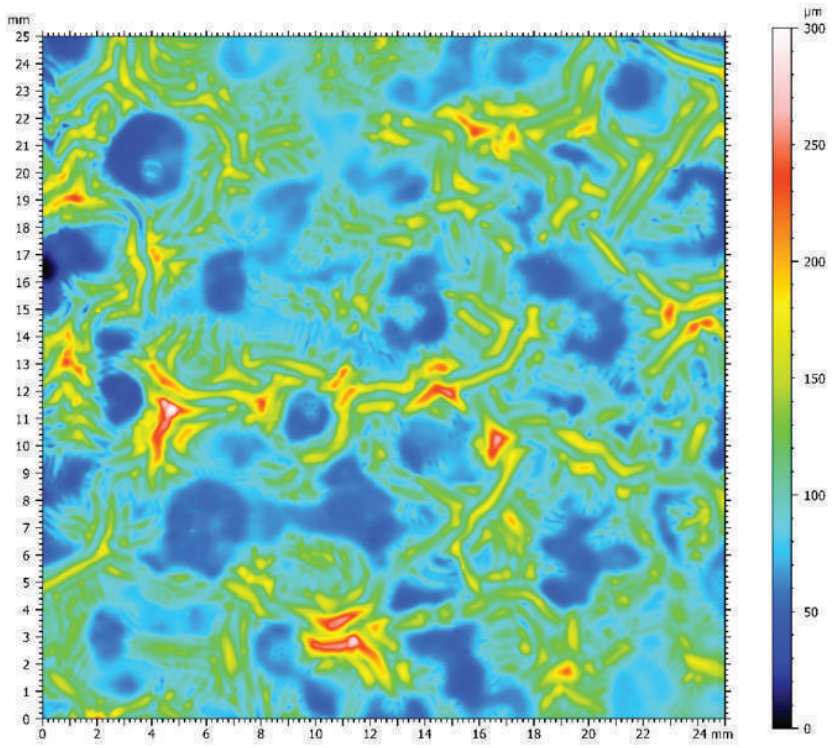
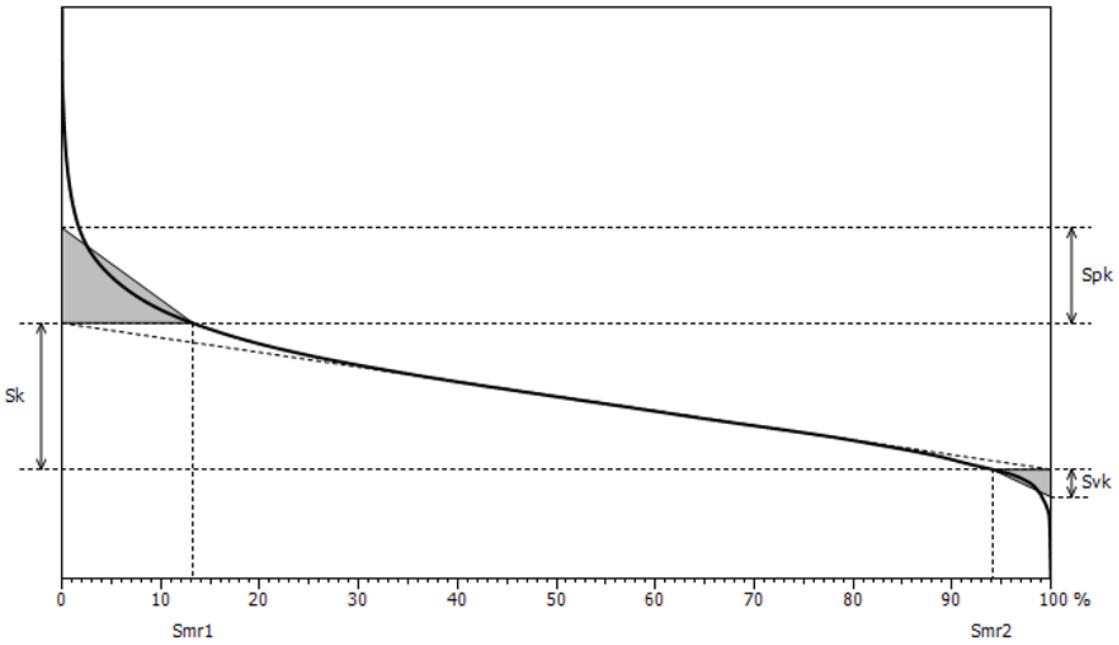


Figure 3: 2D color view with height parameters of the surface.

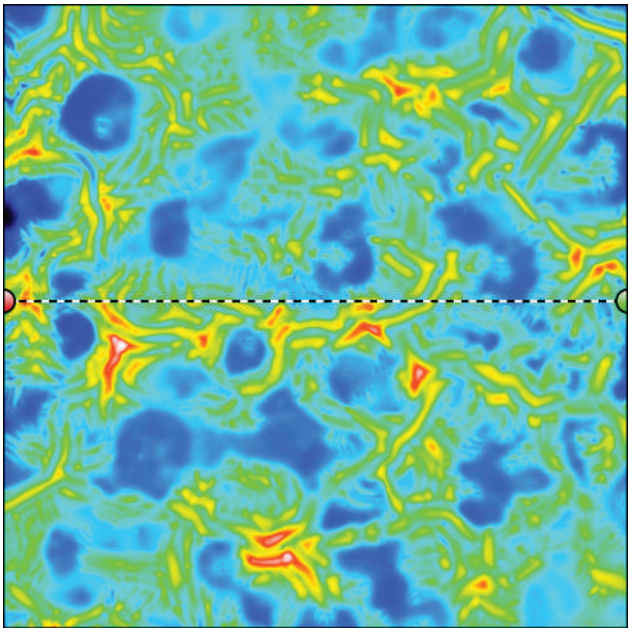
Height Parameter	Value	Explanation
Sa	24.84µm	Arithmetical Mean Height
Sq	32.15µm	Root Mean Square Height
Sp	199.6µm	Maximum Peak Height
Sv	98.97µm	Maximum Pit Height
Sz	298.5µm	Maximum Height
Ssk	0.9557	Skewness
Sku	4.756	Kurtosis

The Nanovea HS2000L quantified isotropy and height parameters of the orange peel paint. The orange peel texture quantified the random pattern direction with 94.4% isotropy. Height parameters quantify the texture with a 24.84µm height difference.



Sk Parameter	Value	Explanation
Sk	76.43µm	Kernal Roughness Depth
Spk	49.84µm	Reduced Peak Height
Rp	14.37µm	Reduced Valley Depth
Smr1	13.26%	Peak Material Portion 1
Smr2	94.08%	Peak Material Portion 2
Sa1	3303446µm³ / mm²	Upper Area (triangle equivalent to peaks)
Sa2	425493µm³ / mm²	Lower Area (triangle equivalent to holes)

Figure 4: Sk parameter graphical representation of the depth distribution.



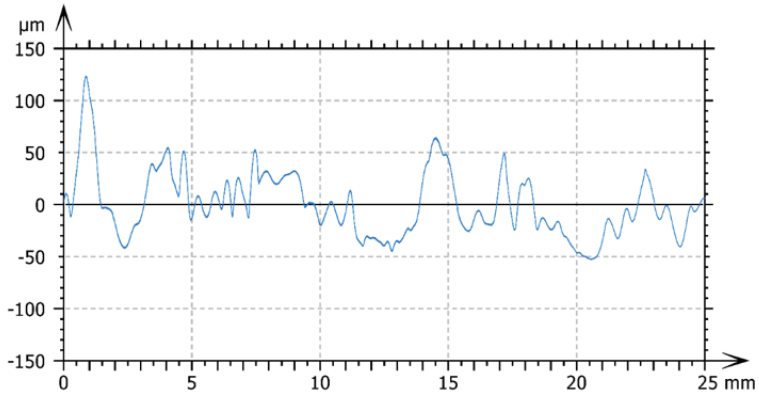
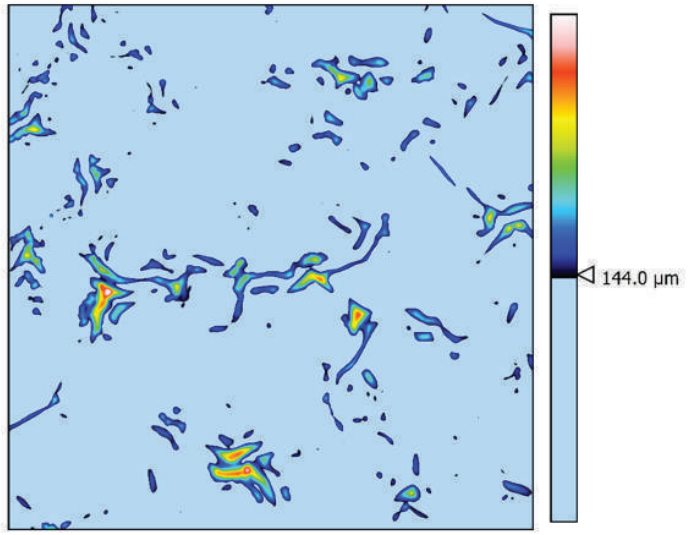


Figure 5: Extracted Profile of surface with total height range (Pt) = 176.5µm.



Island Parameter	Value
Number of Islands	720
Threshold	144.0µm
Projected Area	0.07351mm²
Volume	1848753µm³
Max Height	5.844µm
Height/ Area Ratio	1021µm/mm²

Figure 6: Extracted Peak Height Map displaying total density of peaks.

The bearing ratio curve in Figure 4 is a graphical representation of the depth distribution. This is an interactive feature within the software that allows the user to view distributions and percentages at varying depths. An extracted profile in Figure 5 gives useful roughness values for the orange peel texture. Peak extraction above a 144 micron threshold shows the orange peel texture. These parameters are easily adjusted to other areas or parameters of interest.

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Conclusion

In this application, the Nanovea HS2000L 3D Non-Contact Profilometer precisely characterizes both topography and nanometer details of the orange peel texture on a gloss coating. Areas of interest from 3D surface measurements are quickly identified and analyzed with many useful measurements (Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height, etc.). Quickly chosen 2D cross-sections provide a complete set of surface measurement resources on gloss texture. Special areas of interest can be further analyzed with an integrated AFM module. Nanovea 3D Profilometer's speed ranges from <1 mm/s to 500 mm/s for suitability in research applications to the needs of high-speed inspection. Nanovea 3D Profilometers have a wide range of configurations to suit your application.

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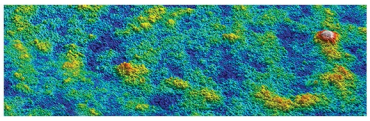
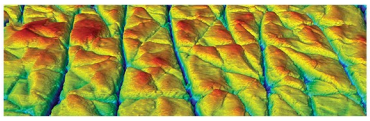
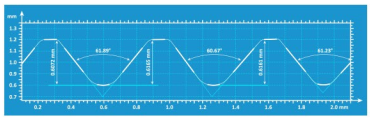


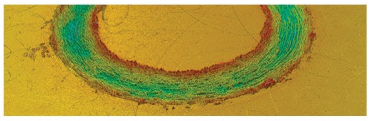
ROUGHNESS & FINISH



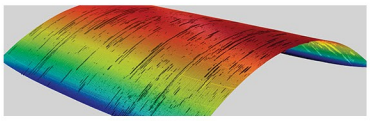
TEXTURE



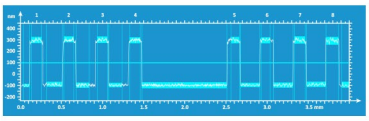
GEOMETRY & SHAPE



VOLUME & AREA



FLATNESS & WARPAGE



STEP HEIGHT & THICKNESS

PORTABLE ◆ COMPACT ◆ ZERO NOISE ◆ HIGH SPEED ◆ LARGE AREA