FABRIC SURFACE AREA MEASUREMERNT USING 3D PROFILOMETRY

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INTRODUCTION:

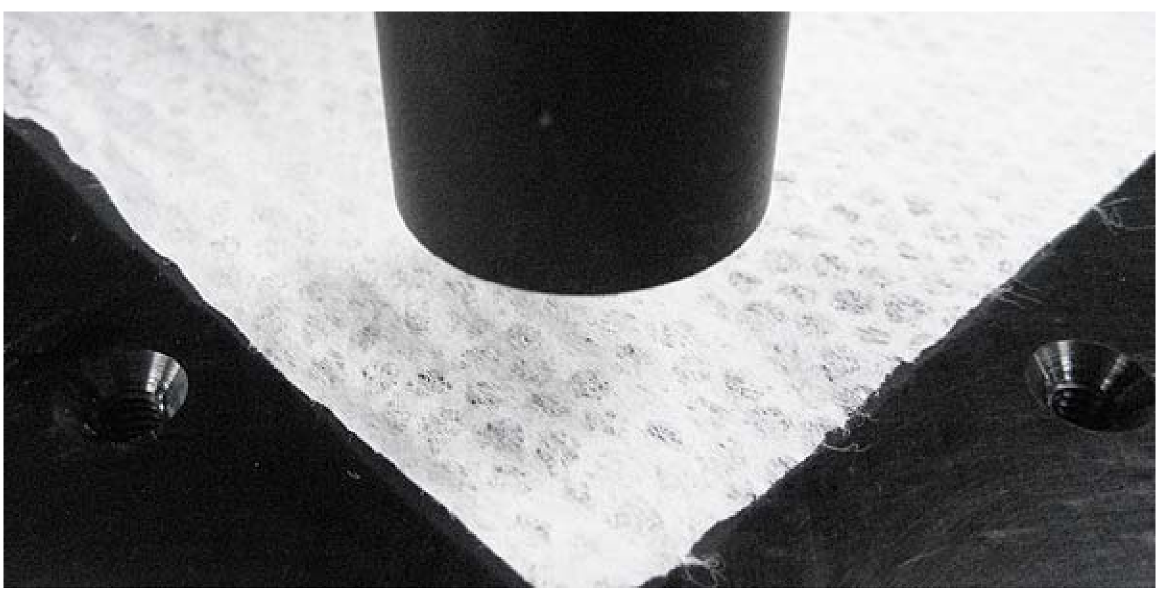
Surface area measurement can be critical when studying the intended interaction of fabric cleaning supplies on various types of surfaces. Projected and developed surface areas of cleaning supplies can translate into superior absorbency of germs and other unfavorable residues. The developed surface area is not the only contributing factor to its efficiency. For example, the unique pattern found on the surface of cleaning wipes is intended to increase the effectiveness of its use.

IMPORTANCE OF 3D NON CONTACT PROFILOMETER FOR SURFACE AREA ANALYSIS

The Nanovea 3D Non-Contact Profilometer is ideal for measuring the surface of a cleaning wipe with its use of axial chromatism. The technique provides measurement on nearly any surface, sample sizes can vary widely due to open staging and there is no sample preparation needed. The Nanovea 3D Non-Contact Profilometer has the advanced ability to measure high surface angles without software manipulation of results. Easily measure any material, such as transparent, opaque, specular, diffusive, polished, rough, etc. Techniques such as touch probes and other non-contact techniques would have difficulties properly measuring the fabric surface of a cleaning wipe. The technique of the 3D Non-Contact Profilometer provides an ideal, broad, and user friendly capability to maximize studies of unique surfaces such as fabric cleaning wipes.

MEASUREMENT OBJECTIVE

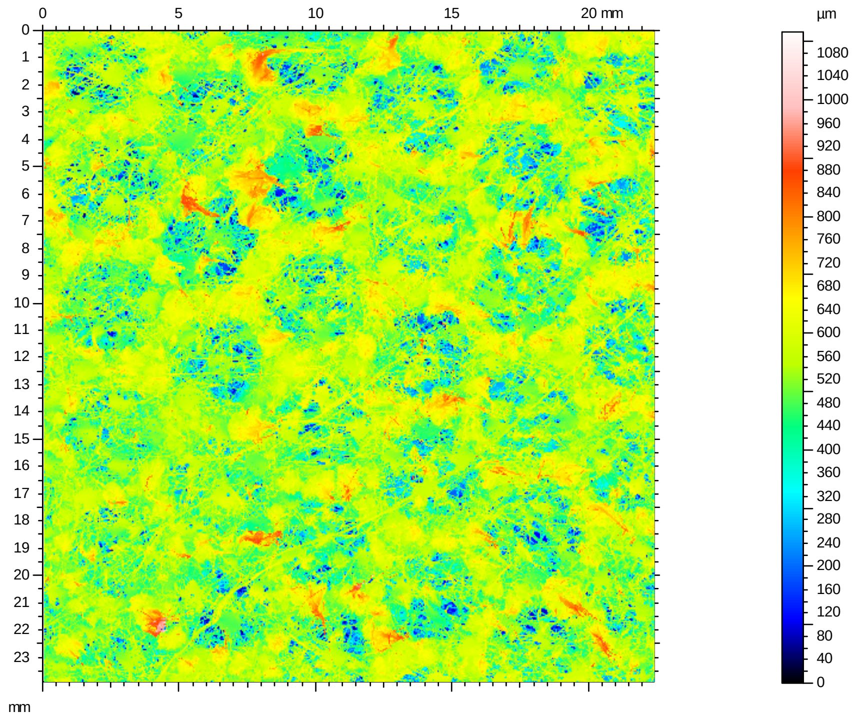
In this application the Nanovea ST400 Profilometer was used to measure the surface area of a fabric cleaning wipe to determine amount of projected and developed surface areas as well as a contour analysis of the texture on the surface.



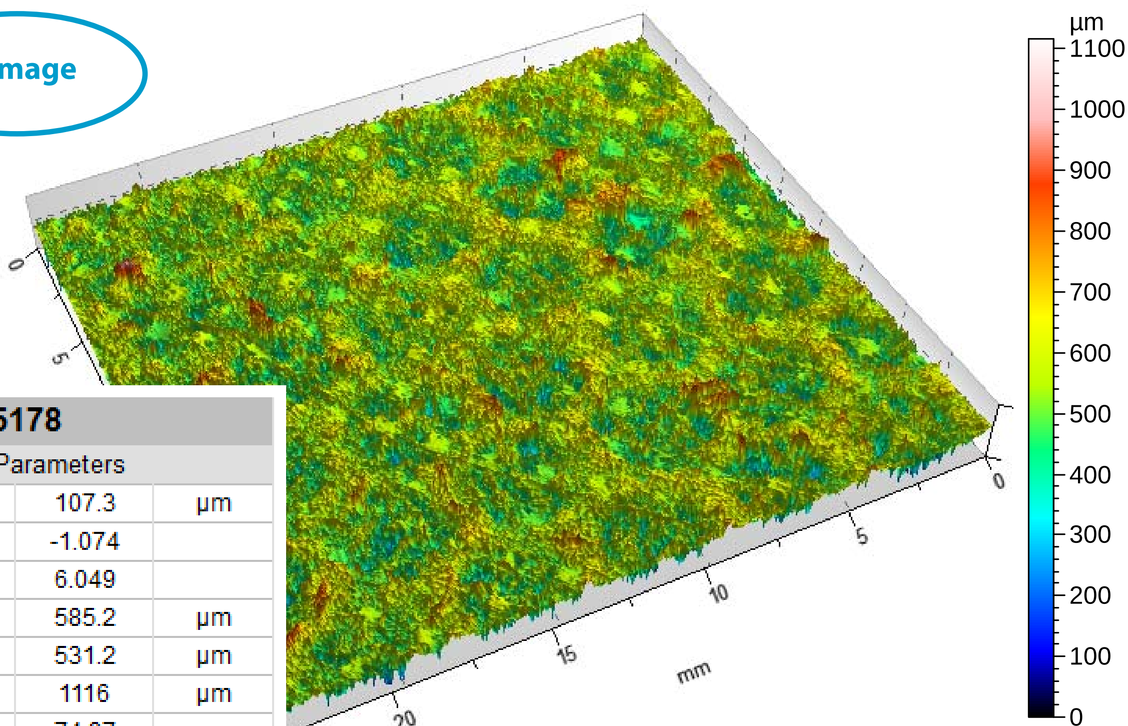
RESULTS: Projected Surface Area and Developed Surface Area (Cleaning Wipe)

Parameters Used: X- Scan Length: 30.0mm, Scan Step Size: 12.0µm, Pen Settings Pen: 1.2mm, Acqusition Rate: 180Averaging: 1

False Color View



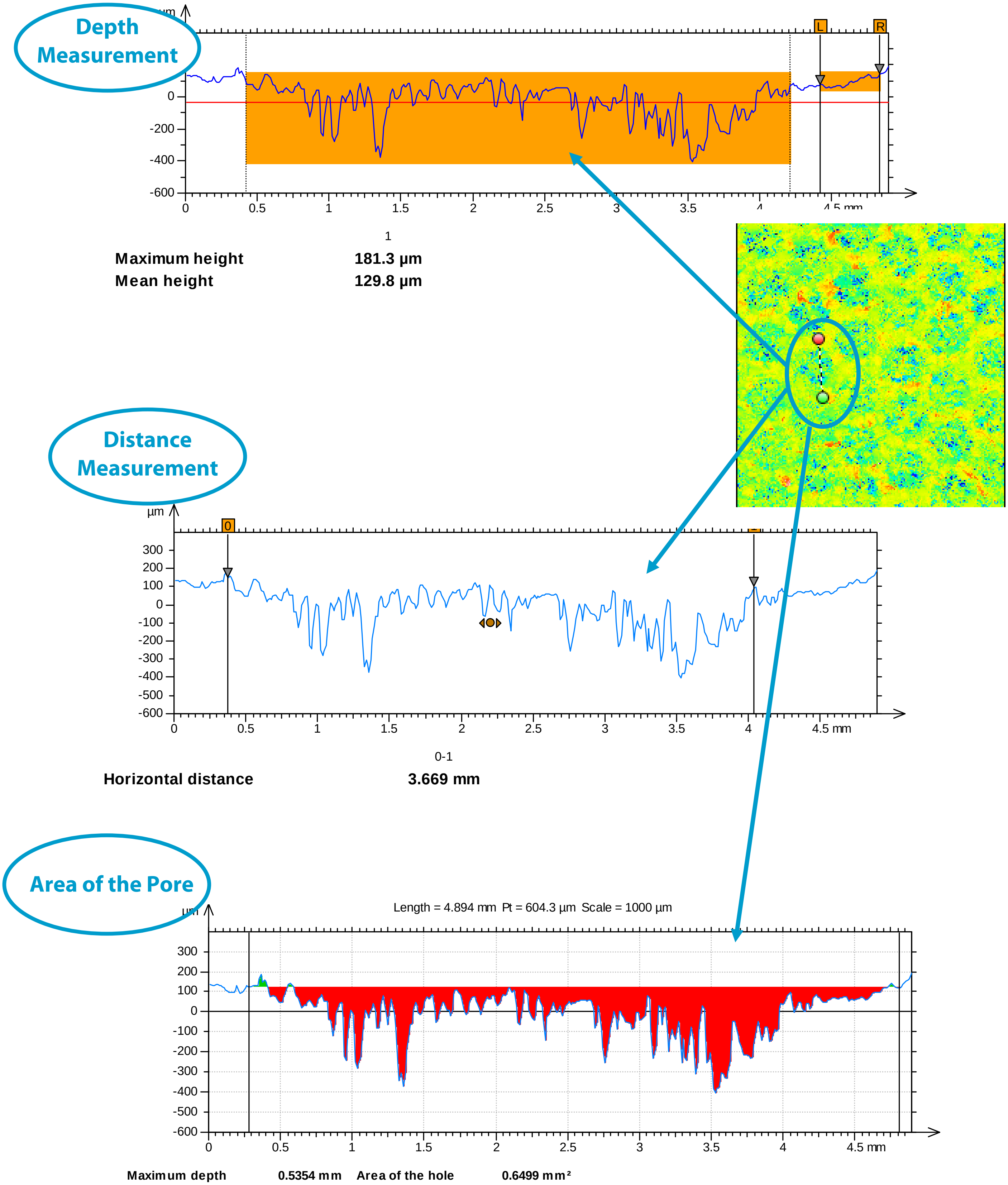
3D Image



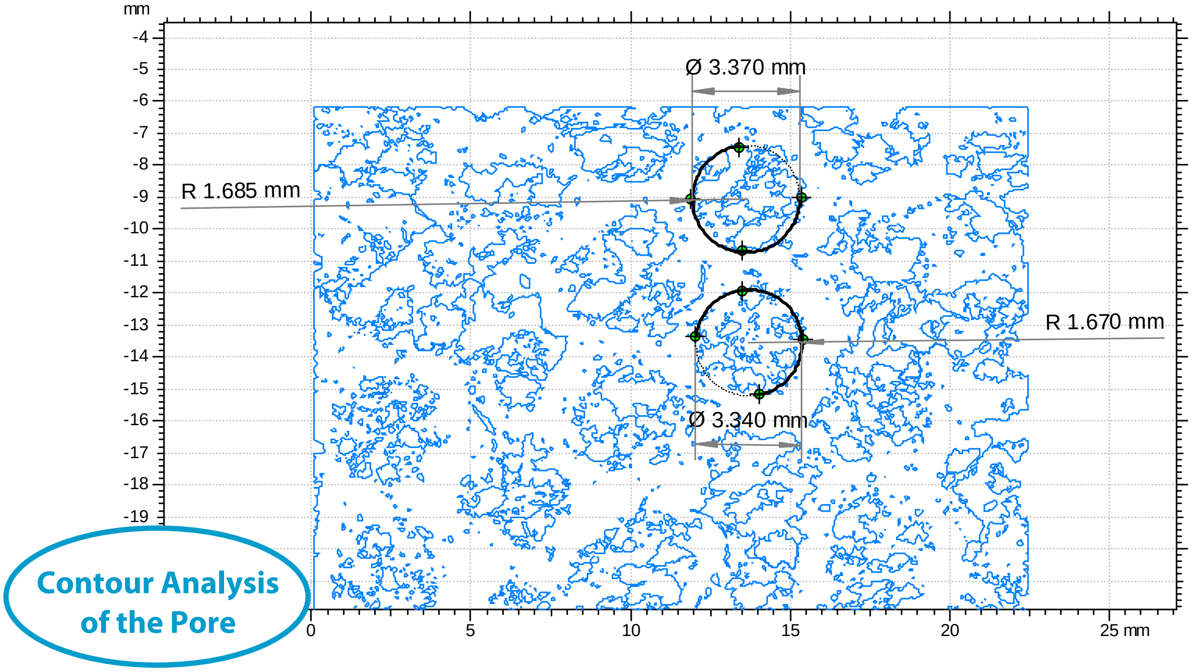
ISO 25178		
Height Parameters		
Sq	107.3	µm
Ssk	-1.074	
Sku	6.049	
Sp	585.2	µm
Sv	531.2	µm
Sz	1116	µm
Sa	74.97	µm
Other 3D Parameters		
Miscellaneous		
Sdar	5080	mm²
Spar	535.8	mm²

Sdar: **Developed Surface Area**

Spar: **Projected Surface Area**



Depth Measurement
µm
0
-200
-400
-600
0
0.5
1
1.5
2
2.5
3
3.5
4.5 mm
L
R
1
Maximum height 181.3 µm
Mean height 129.8 µm
Distance Measurement
µm
300
200
100
0
-100
-200
-300
-400
-500
-600
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5 mm
0-1
Horizontal distance 3.669 mm
Area of the Pore
Length = 4.894 mm Pt = 604.3 µm Scale = 1000 µm
300
200
100
0
-100
-200
-300
-400
-500
-600
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5 mm
Maximum depth 0.5354 mm Area of the hole 0.6499 mm²

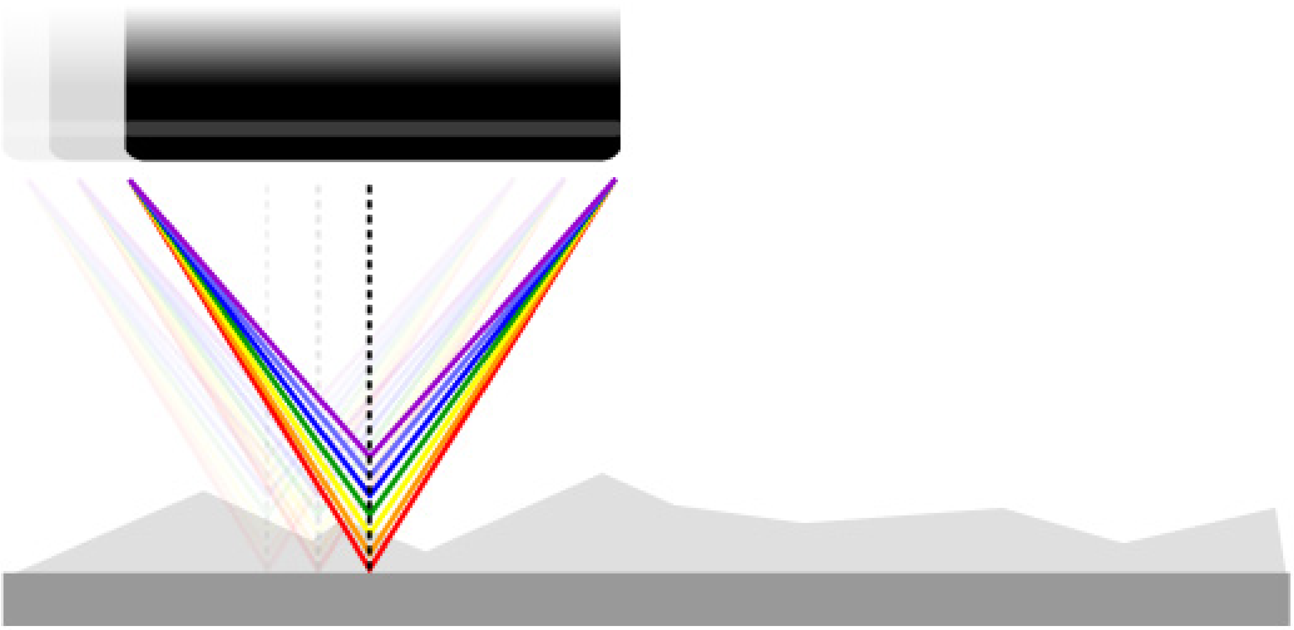


CONCLUSION:

In this application, using the Nanovea 3D Non Contact Profilometer, we have shown how the surface area increased with the honeycomb fabric design on the surface of the wipe. The developed area increased by approximately ten times the projected area. Other than the measurements shown here, the 3D No Contact Profilometer has an endless range of measurements (Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height Depth Thickness and others). With this information projected and developed surface areas can be broadly investigated with a complete set of surface measurements. To learn more about the [Nanovea Profilometer]

MEASUREMENT PRINCIPLE:

The Chromatic Confocal technique uses a white light source, where light passes through an objective lens with a high degree of chromatic aberration. The refractive index of the objective lens will vary in relation to the wavelength of the light. In effect, each separate wavelength of the incident white light will re-focus at a different distance from the lens (different height). When the measured sample is within the range of possible heights, a single monochromatic point will be focalized to form the image. Due to the confocal configuration of the system, only the focused wavelength will pass through the spatial filter with high efficiency, thus causing all other wavelengths to be out of focus. The spectral analysis is done using a diffraction grating. This technique deviates each wavelength at a different position, intercepting a line of CCD, which in turn indicates the position of the maximum intensity and allows direct correspondence to the Z height position.



Unlike the errors caused by probe contact or the manipulative Interferometry technique, Chromatic Confocal technology measures height directly from the detection of the wavelength that hits the surface of the sample in focus. It is a direct measurement with no mathematical software manipulation. This provides unmatched accuracy on the surface measured because a data point is either measured accurately without software interpretation or not at all. The software completes the unmeasured point but the user is fully aware of it and can have confidence that there are no hidden artifacts created by software guessing.

Nanovea optical pens have zero influence from sample reflectivity or absorption. Variations require no sample preparation and have advanced ability to measure high surface angles. Capable of large Z measurement ranges. Measure any material: transparent or opaque, specular or diffusive, polished or rough. Measurement includes: Profile Dimension, Roughness Finish Texture, Shape Form Topography, Flatness Warpage Planarity, Volume Area, Step-Height Depth Thickness and many others.

DEFINITION OF HEIGHT PARAMETERS

	Height Parameter	Definition
Sa	Arithmetical Mean Height	Mean surface roughness. $$Sa = \frac{1}{A}\iint_A \lvert z(x,y)\rvert dxdy$$
Sq	Root Mean Square Height	Standard deviation of the height distribution, or RMS surface roughness. $$Sq = \sqrt{\frac{1}{A}\iint_A z^2(x,y)dxdy}$$ Computes the standard deviation for the amplitudes of the surface (RMS).
Sp	Maximum Peak Height	Height between the highest peak and the mean plane.
Sv	Maximum Pit Height	Depth between the mean plane and the deepest valley.
Sz	Maximum Height	Height between the highest peak and the deepest valley.
Ssk	Skewness	Skewness of the height distribution. $$Ssk = \frac{1}{Sq^3}\left[\frac{1}{A}\iint_A z^3(x,y)dxdy\right]$$ Skewness qualifies the symmetry of the height distribution. A negative Ssk indicates that the surface is composed of mainly one plateau and deep and fine valleys. In this case, the distribution is sloping to the top. A positive Ssk indicates a surface with a lot of peaks on a plane. Therefore, the distribution is sloping to the bottom. Due to the large exponent used, this parameter is very sensitive to the sampling and noise of the measurement.
Sku	Kurtosis	Kurtosis of the height distribution. $$Sku = \frac{1}{Sq^4}\left[\frac{1}{A}\iint_A z^4(x,y)dxdy\right]$$ Kurtosis qualifies the flatness of the height distribution. Due to the large exponent used, this parameter is very sensitive to the sampling and noise of the measurement.
Spar	Projected Area	Projected surface area.
Sdar	Developed Area	Developed surface area.