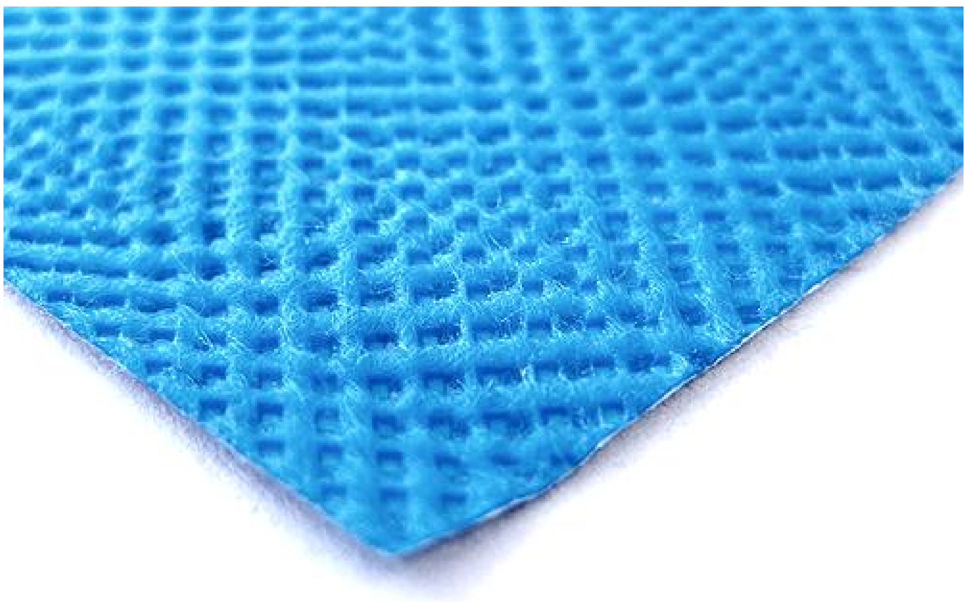
SURFACE TOPOGRAPHY OF NONWOVEN USING 3D PROFILOMETRY



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INTRO:

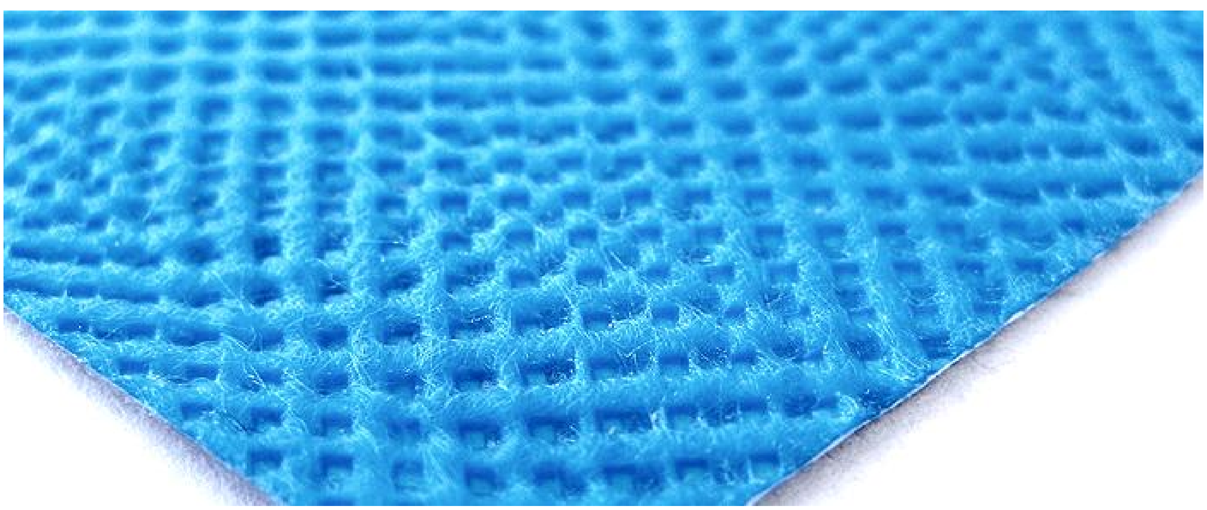
Nonwoven material is fabric like but made from long fibers bonded into sheets or web-like structures by entangling fiber or filaments through a mechanical, thermal or chemical process; unlike textiles that are woven or knitted. Nonwovens are most commonly produced as flat, textured and or porous sheets made from separate fibers, molten plastic or plastic film. The formula of fabrics and materials used to create Nonwoven materials are engineered for a range of intended purposes including biodegradability, single-use or durability while their surfaces are engineered for specific functions.

IMPORTANCE OF SURFACE MEASUREMENT INSPECTION FOR QUALITY CONTROL

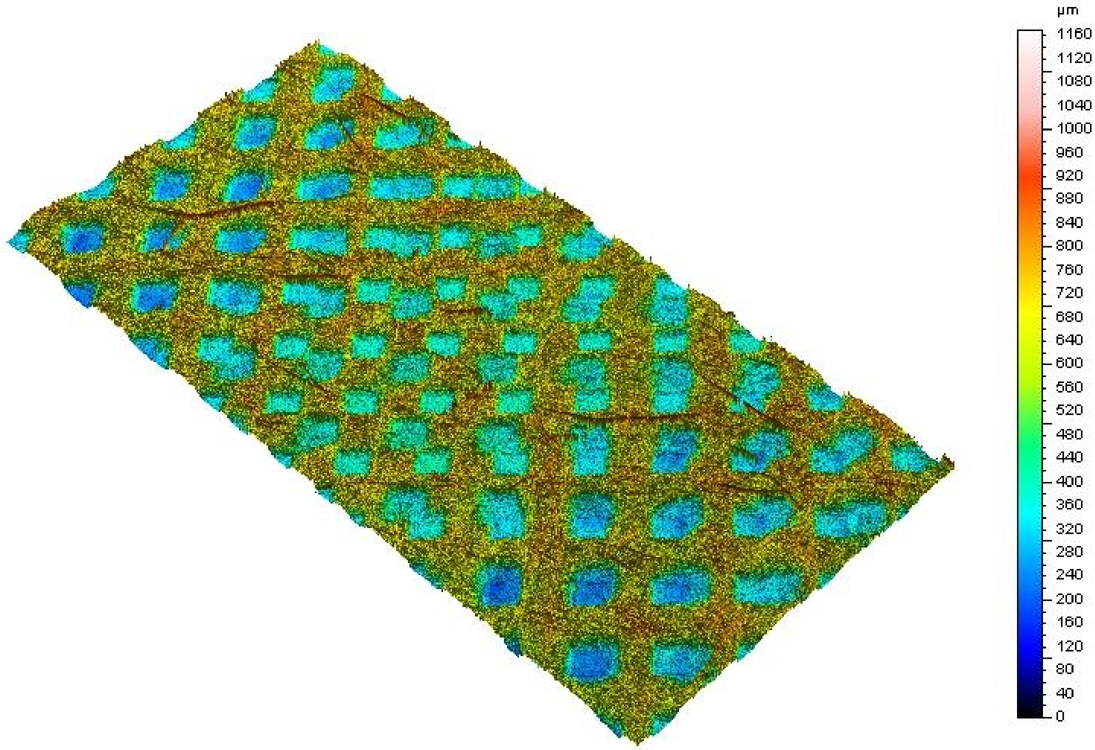
The intended surface function of Nonwoven material (absorbency, repellency, resiliency, softness, strength, washability, filtering etc) require controlled surface characteristics such as roughness, texture and or dimensional consistency. As a result, accurate surface measurement and characterization are critical to the quality control of a Nonwoven material for their intended use.

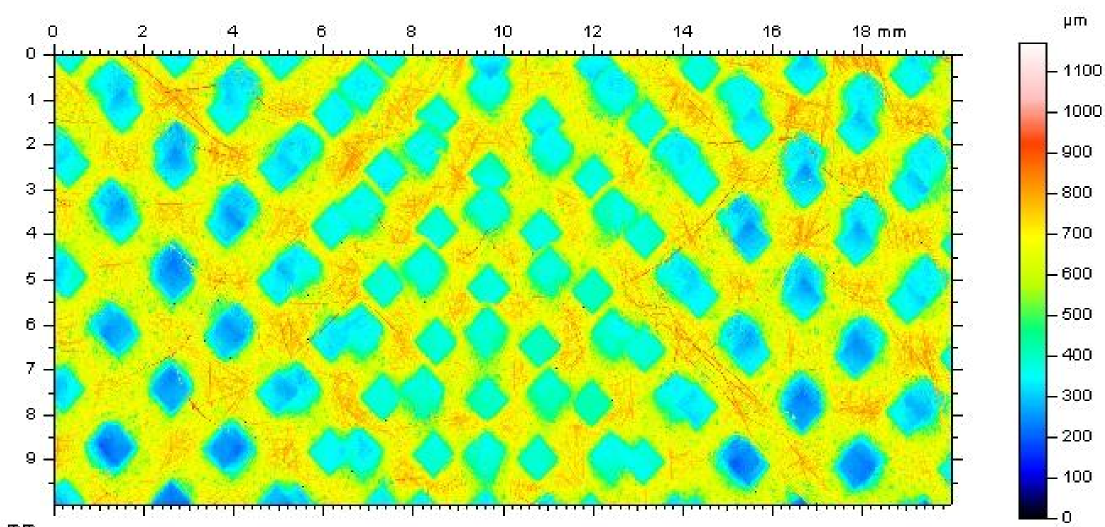
MEASUREMENT OBJECTIVE

In this application, the Nanovea ST400 is used to measure the surface of the Nonwoven material shown below. The Nanovea ST400 provides superior non-contact measurement and zero influence to surface reflectivity making it an ideal instrument for nanometer measurement of Nonwoven surfaces.

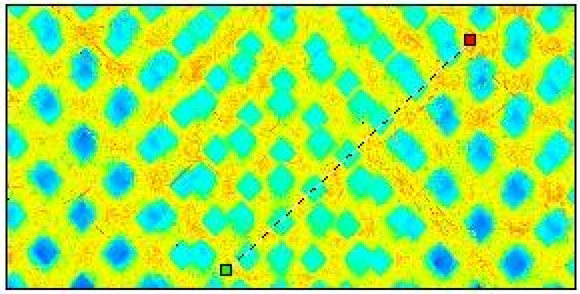


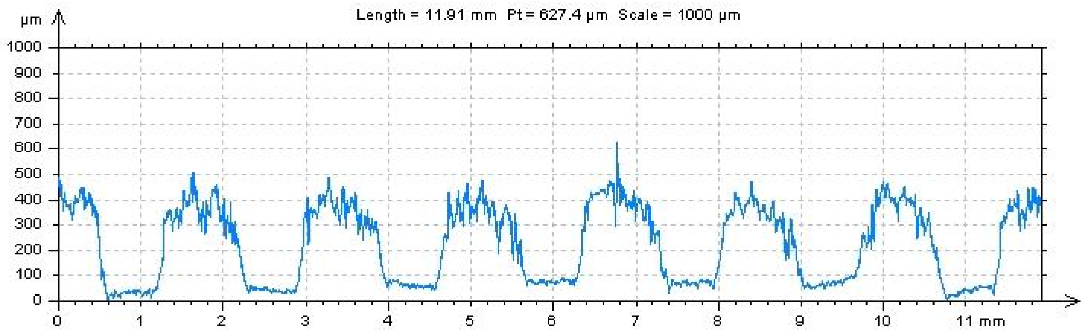
3D Image of Nonwoven Surface

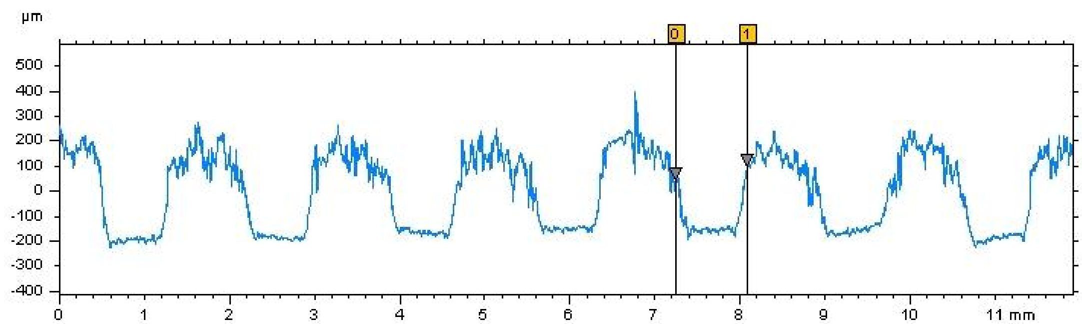




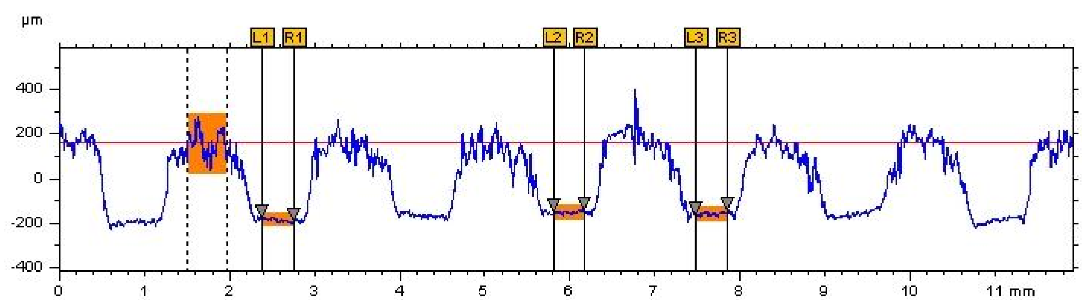
2D Cross Section







	0-1
Horizontal distance	0.8354 mm
Height difference	51.27 µm



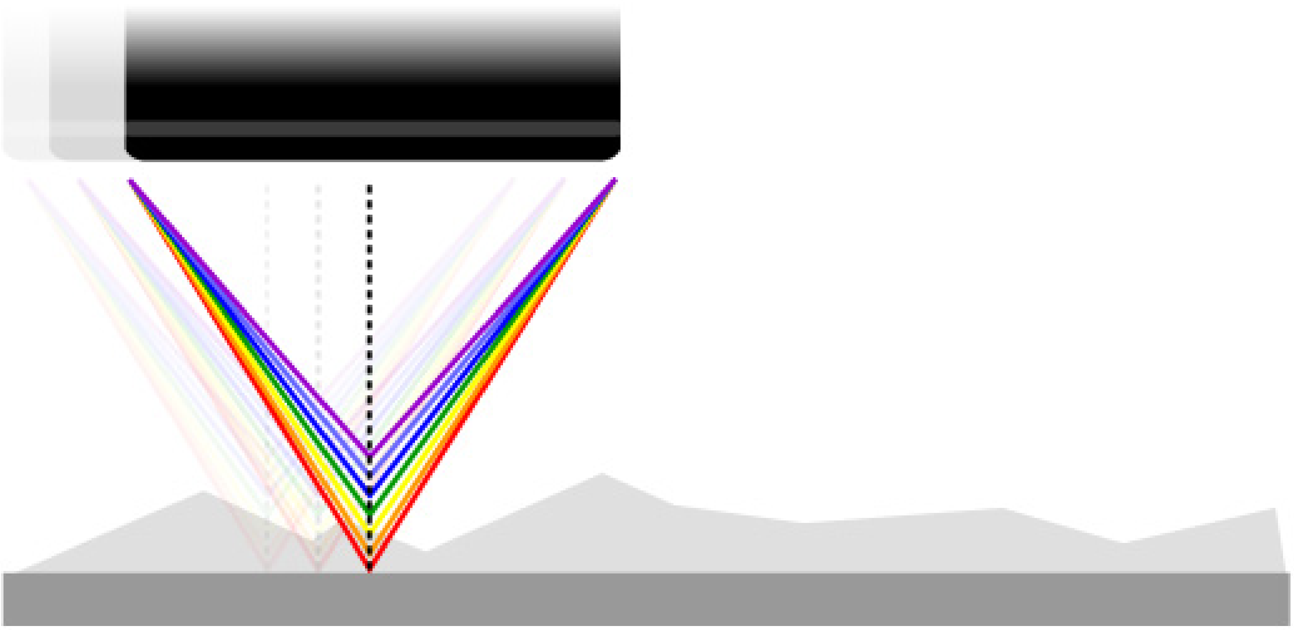
	1	2	3
Mean height	347.5 µm	310.5 µm	316.7 µm

CONCLUSION:

In this application, we have shown how the Nanovea ST400 3D Profilometer with a 3.5mm optical pen can precisely characterize both the surface/shape and the nanometer details of the Nonwoven material. From the 3D image it can be seen that nonwoven pattern is not consistent and may or may not be an important factor for its intended purpose. To further view in detail a 2D cross section can quickly be chosen to analyze, at nanometer range, step height and coplanarity among others. Nanovea 3D Profilometers speeds range from 20mm/s to 1m/s for laboratory or research to the needs of hi-speed inspection; can be built with custom size, speeds, scanning capabilities, Class 1 Clean Room compliance, with Indexing Conveyor and for Inline or online Integration

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.