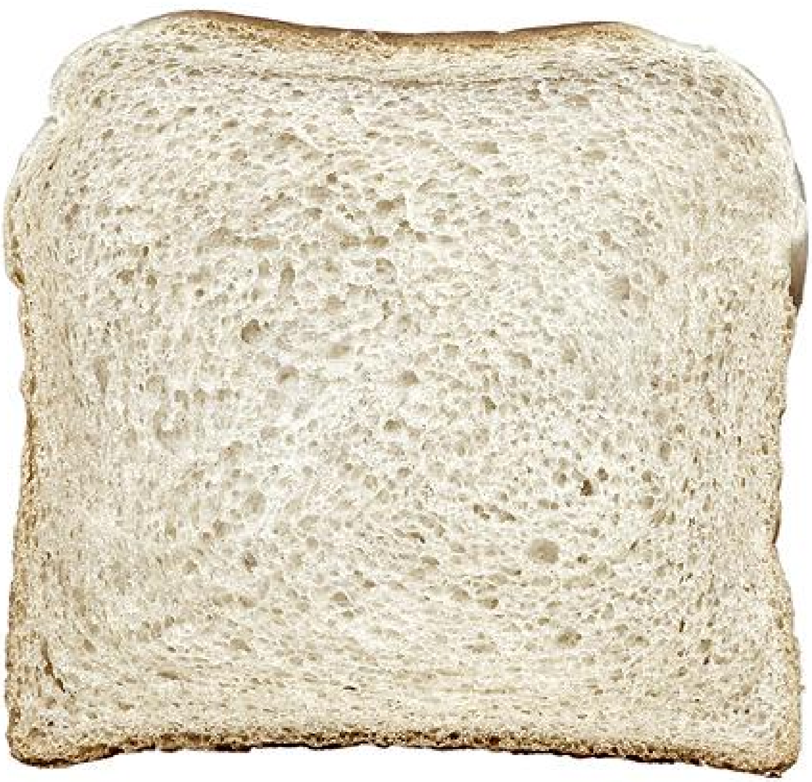
FOOD SURFACE TOPOGRAPHY USING 3D PROFILOMETRY



Prepared by
Craig Leising

6 Morgan, Ste156, Irvine CA 92618 · P: 949.461.9292 · F: 949.461.9232 · nanovea.com

Today's standard for tomorrow's materials.

INTRO:

Reliable surface measurement in applied sciences, including food technology is quickly becoming crucial to quality assurance and presentation. Food surface complexities of texture and surface topography have posed to be problematic for most measurement solutions therefore requiring the need for reliable non-contact technique. With the rise in the use of Nanotechnology instrumentation the 3D Non-Contact Profilometer proves its validity and speed to accurately measure food surfaces in an effort to understand and improve food processing and quality. Understanding food surface characteristics may also prove to be vital to identifying unsafe bacteria due to their roughness levels on food surfaces. The 3D non-contact technique is not only crucial to the study of food surface characterization but also for full online or inline quality control inspection.

IMPORTANCE OF SURFACE METROLOGY INSPECTION FOR QUALITY CONTROL

As noted above, food surface characterization has become of high interest with the rise of Nanotechnology instrumentation. Specifically, the 3D non-contact technique provides superior accuracy and speed at nano-micro range. The diverse and challenging surfaces found with food highlight the 3D non-contact techniques superior capability and broad use.

MEASUREMENT OBJECTIVE

In this application, the Nanovea ST400 is used to obtain challenging measurement of bread surface roughness. The surface of bread presents a challenging application due to its porous surface, which creates steep angles and low reflectivity. For this reason many instrument techniques are incapable of providing broad and reliable measurements of food surfaces.

Probe Specifications

Measurement Range	12mm
Z Resolution (nm)	280
Z Accuracy (nm)	900
Lateral Resolution (µm)	8

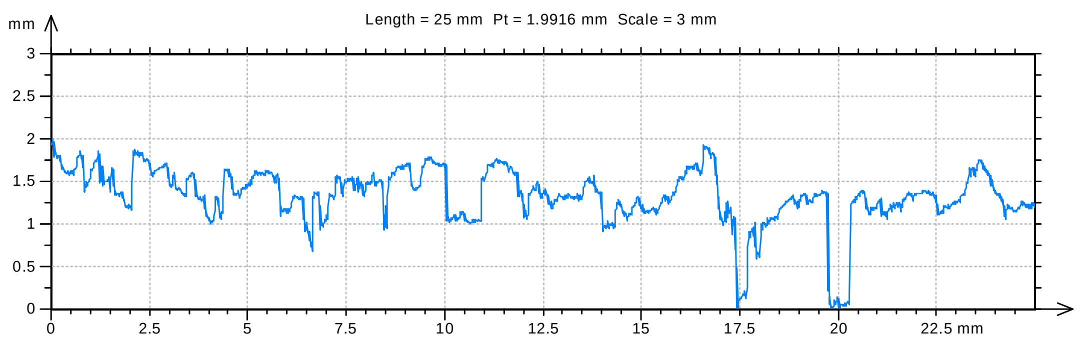
Measurement Parameters

	Bread
Probe	12mm
Acquisition rate	30 Hz
Averaging	1
Measured surface	25mm x 25mm
Step size	10µm x 10µm
Scanning Mode	Constant speed

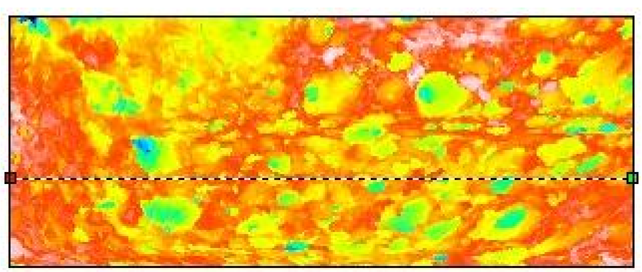
Procedures

> 3D surface generated

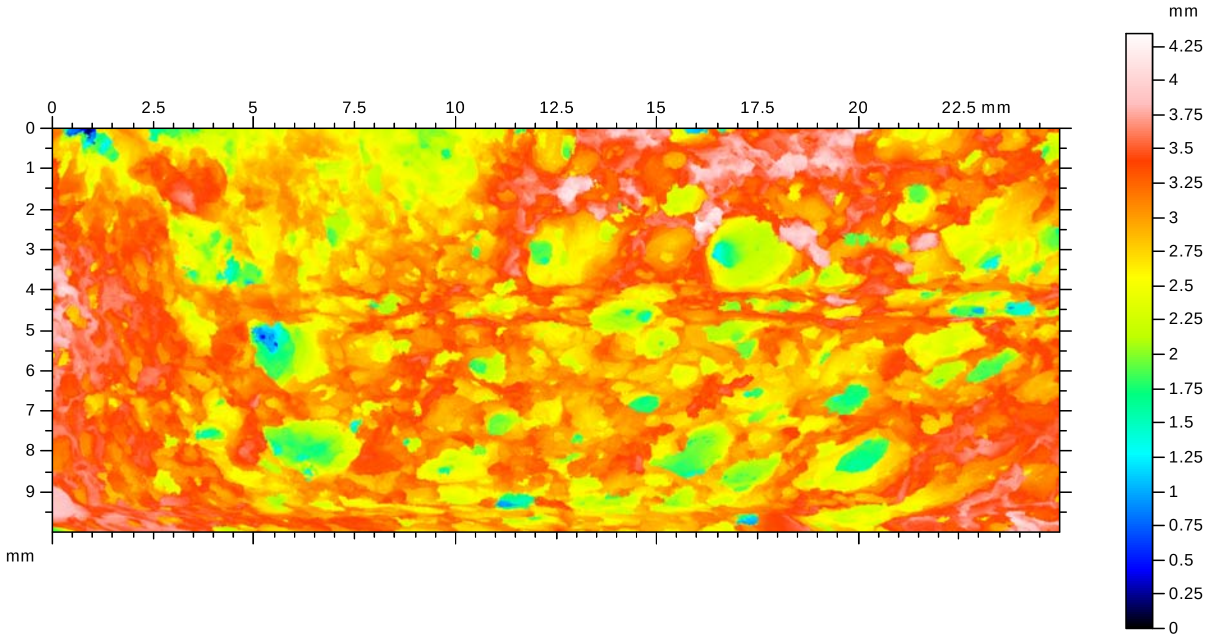
> Profile extracted



Cross-section randomly selected



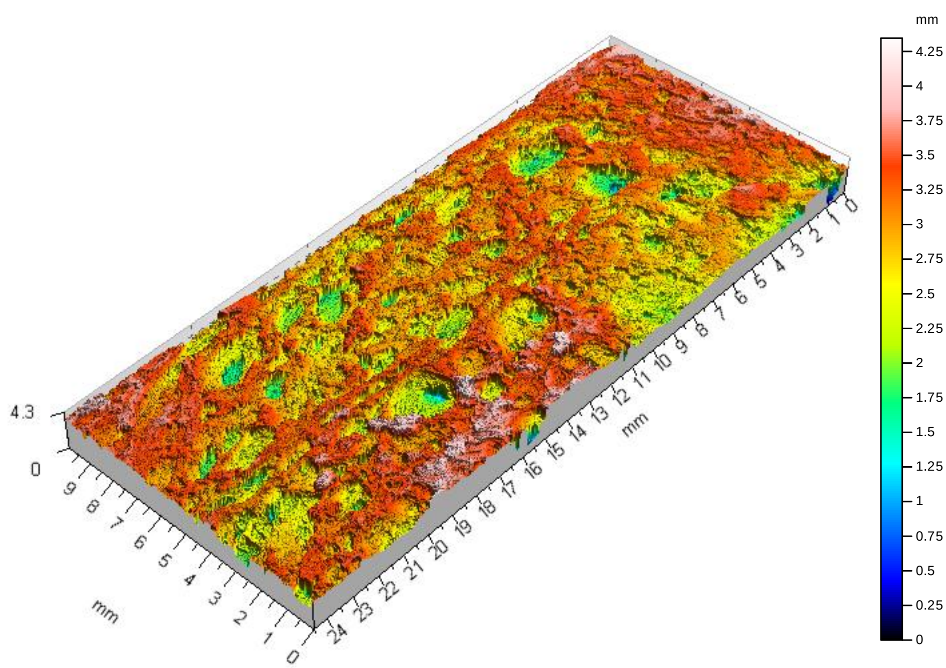
NANOVEA®
A Better Measure.



Results for Bread Sample

False color surface images

Sa	368.758 µm
Sq	472.560 µm
Sp	1.383 mm
Sv	2.958 mm
Sz	4.341 mm
Ssk	-0.70483
Sku	3.910

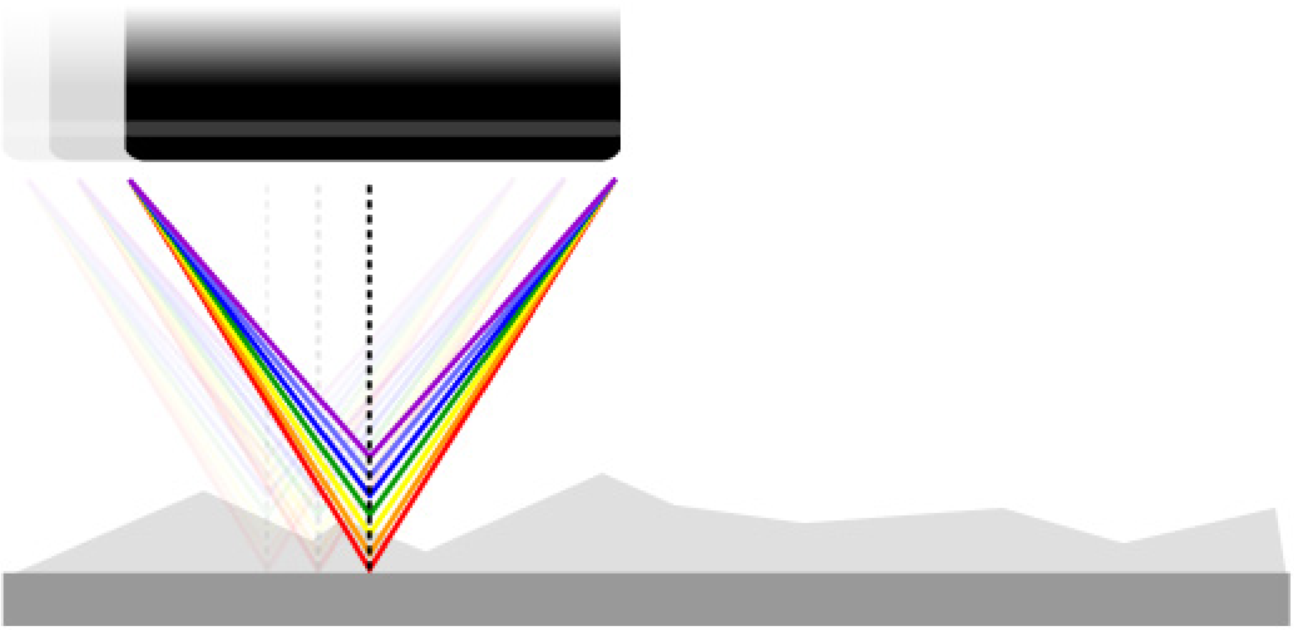


CONCLUSION:

The results show the unique and superior capability of the Nanovea ST400 to measure an extreme porous and non-reflective food surface. This particular application, bread, presents a very difficult and even impossible surface to measure for other instruments. While bread surface was of interest here, food surfaces are almost always unique and challenging topography measurements. The 3D non-contact technique proves to be of great value for its research and quality control capabilities. And because of its broad surface measurement capability, the Nanovea ST400 insures an unmatched value and results over competing alternatives.

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.