NANOVEA
A Better Measure

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SURFACE FINISH INSPECTION

of

WOOD FLOORING

Prepared by

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Introduction

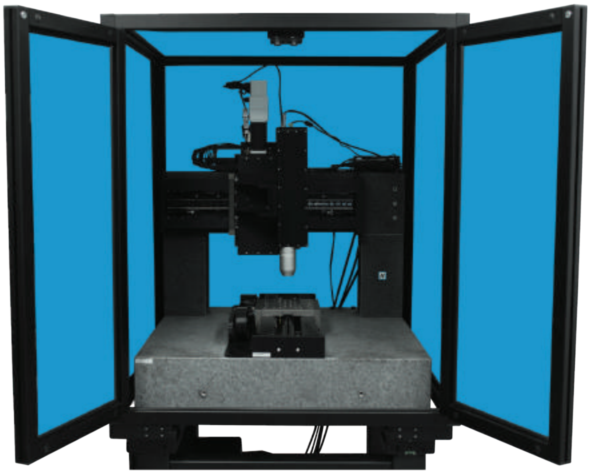
In various industries, the purpose of a wood finish is to protect the wooden surface from various types of damage such as chemical, mechanical or biological and/or provide a specific visual aesthetic. For manufacturers and buyers alike, quantifying surface characteristics of their wood finishes can be vital to the quality control or optimization of finishing processes for wood. In this application, we will explore the various surface features that can be quantified using a Nanovea 3D Non-Contact Profilometer.

Importance of Profiling Wood Finishes

Quantifying the amount of roughness and texture that exists on a wooden surface can be essential to know in order to ensure it can meet the requirements of its application. Refining the finishing process or checking the quality of wooden surfaces based off a quantifiable, repeatable and reliable surface inspection method would allow manufacturers to create controlled surface treatments and buyers the ability to inspect and select wood materials to meet their needs.

Equipment Featured

NANOVEA HS2000



High Speed Inspection & Precision Flatness Measure

Advanced Automation

Customizable Options

High Speed

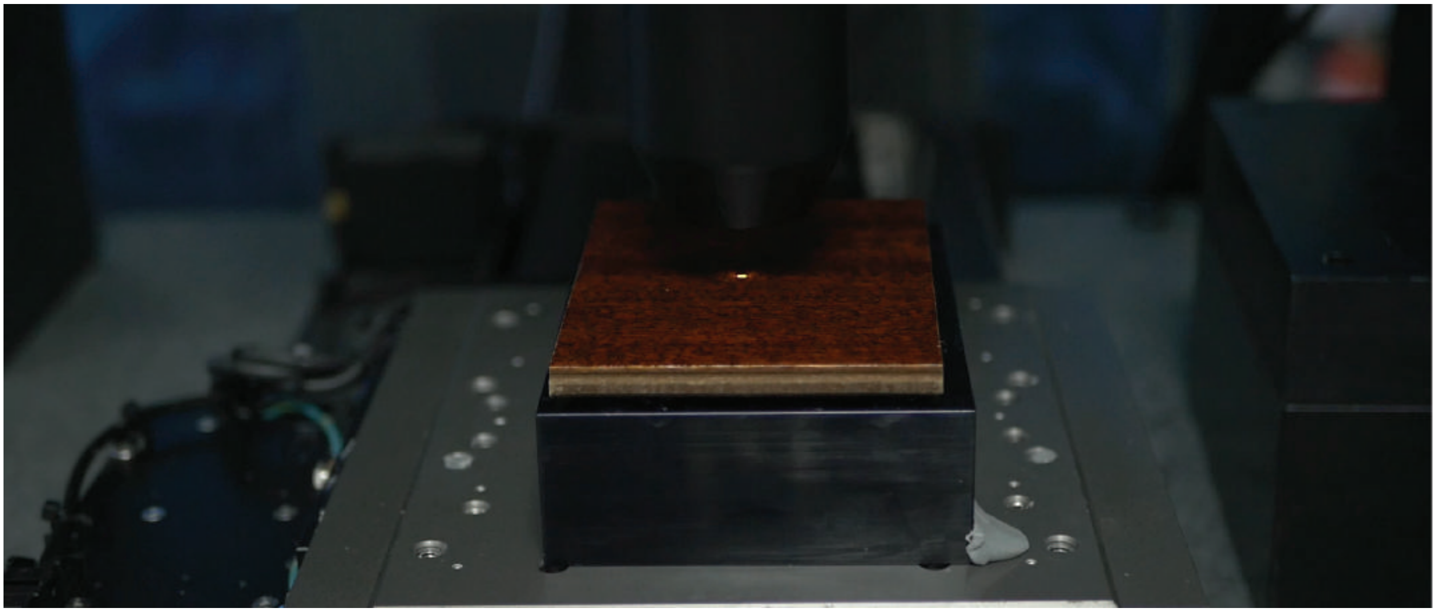
Precision Flatness Measurement

Rigid and Stable Structure

Learn More about the HS2000

Measurement Objectives

In this study, the high-speed Nanovea HS2000 platform equipped with a non-contact profiling line sensor was used to measure and compare the surface finish of three flooring samples: Antique Birch Hardwood, Courtship Grey Oak, and Santos Mahogany flooring. We showcase the capability of the Nanovea Non-Contact Profilometer in delivering both speed and precision when measuring three types of surface areas and a comprehensive in-depth analysis of the scans.



Profilometry Results

Measurement Parameters

Table 1: Test parameters for individual profilometry measurements on Antique Birch Hardwood, Courtship Grey Oak and Santos Mahogany wood samples.

Test Parameter	Value
Instrument	HS2000
Optical Sensor	LS1
Optical Sensor Height Range (µm)	200
Scan size (mm)	100mm x 80mm
Step size (µm)	100µm x 10µm
Scan time (h:m:s)	00:05:94

Samples Tested

Samples of wood tested

Results

Sample description: Courtship Grey Oak and Santos Mahogany flooring are laminate flooring types. Courtship Grey Oak is a low gloss, textured slate gray sample with an EIR finish. Santos Mahogany is a high gloss, dark burgundy sample that was prefinished. Antique Birch Hardwood has a 7-layer aluminum oxide finish, providing everyday wear and tear protection.

Below, the individual scans of each wood flooring sample can be observed.

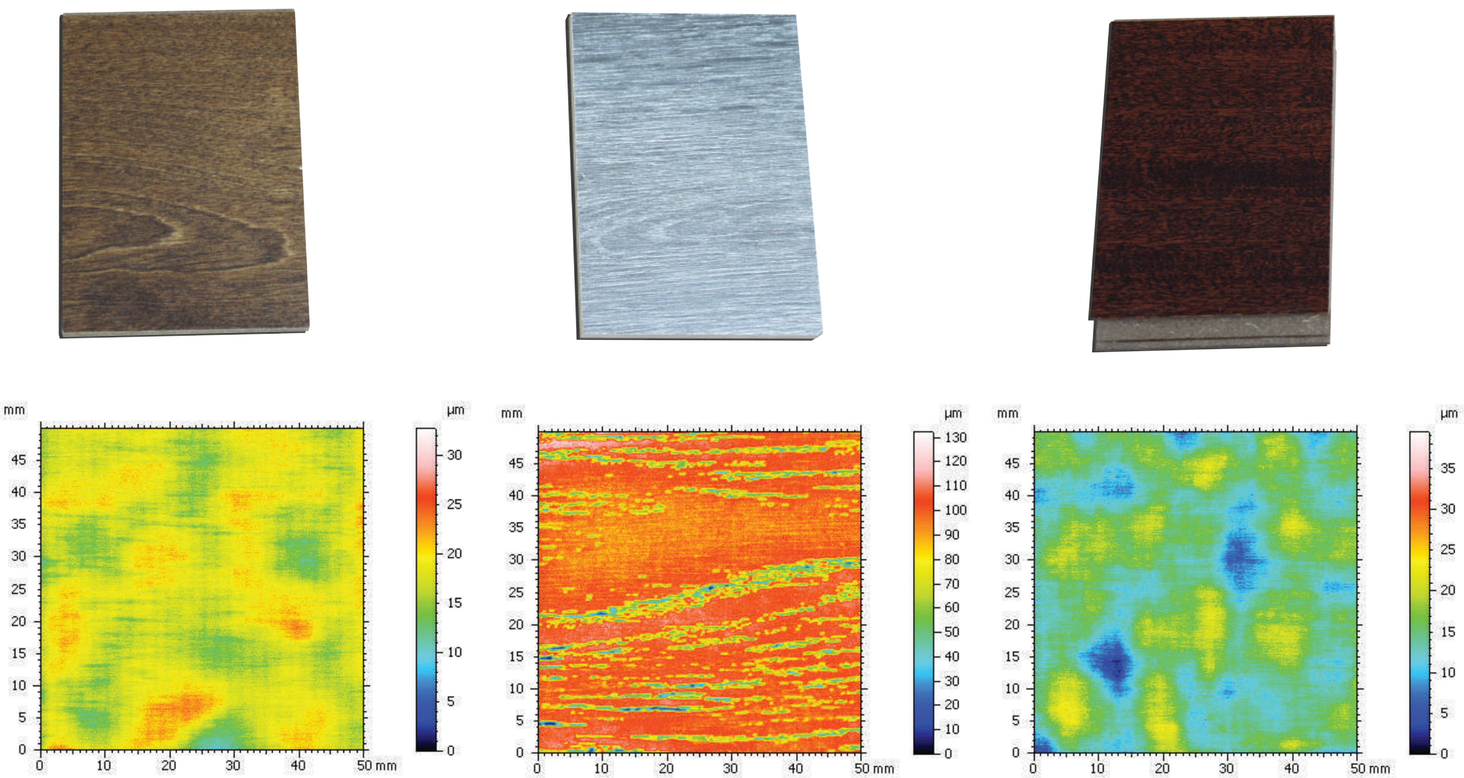
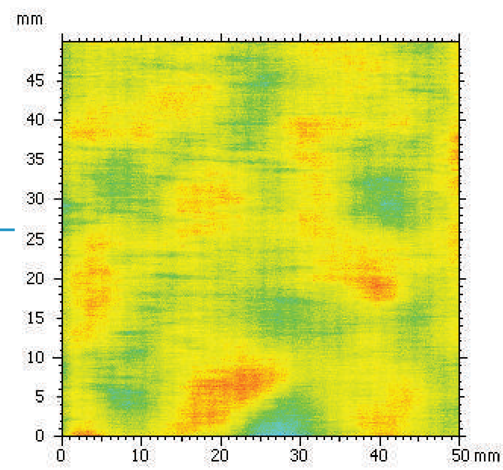


Figure 1: False color view of A) Antique Birch Hardwood B) Courtship Grey Oak C) Santos Mahogany (left to right)

Profilometry Results

Antique Birch Hardwood

Sample of Anique Birch Hardwood



ISO 25178		
Height Parameters		
Sa	1.716	µm
Sq	2.151	µm
Ssk	-0.07458	
Sku	3.127	
Sz	32.79	µm
Sp	15.01	µm
Sv	17.78	µm
Other 3D Parameters		
Miscellaneous		
Sdar	2500	mm²
Spar	2499	mm²

Figure 2: False color view and height parameters for Sample Antique Birch Hardwood

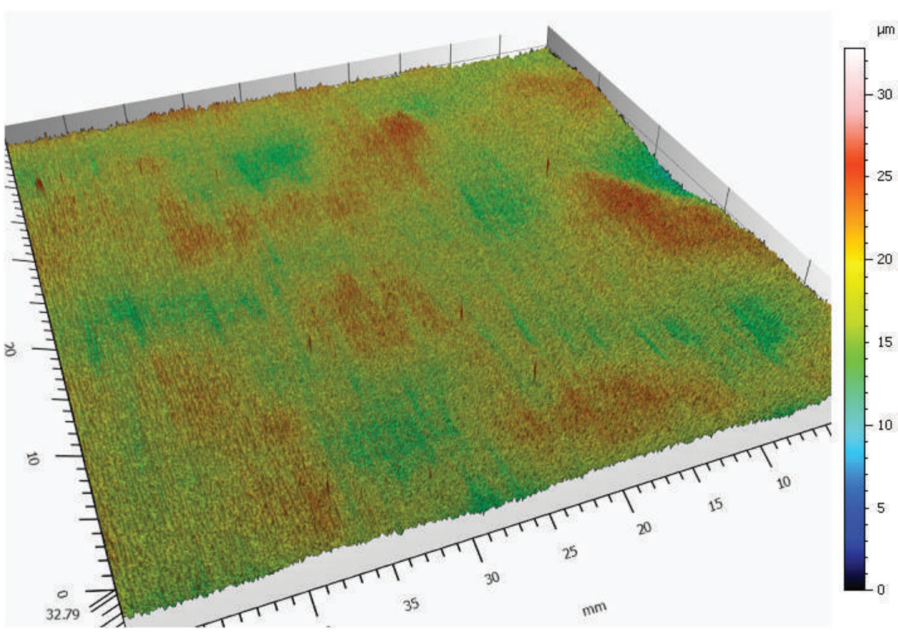
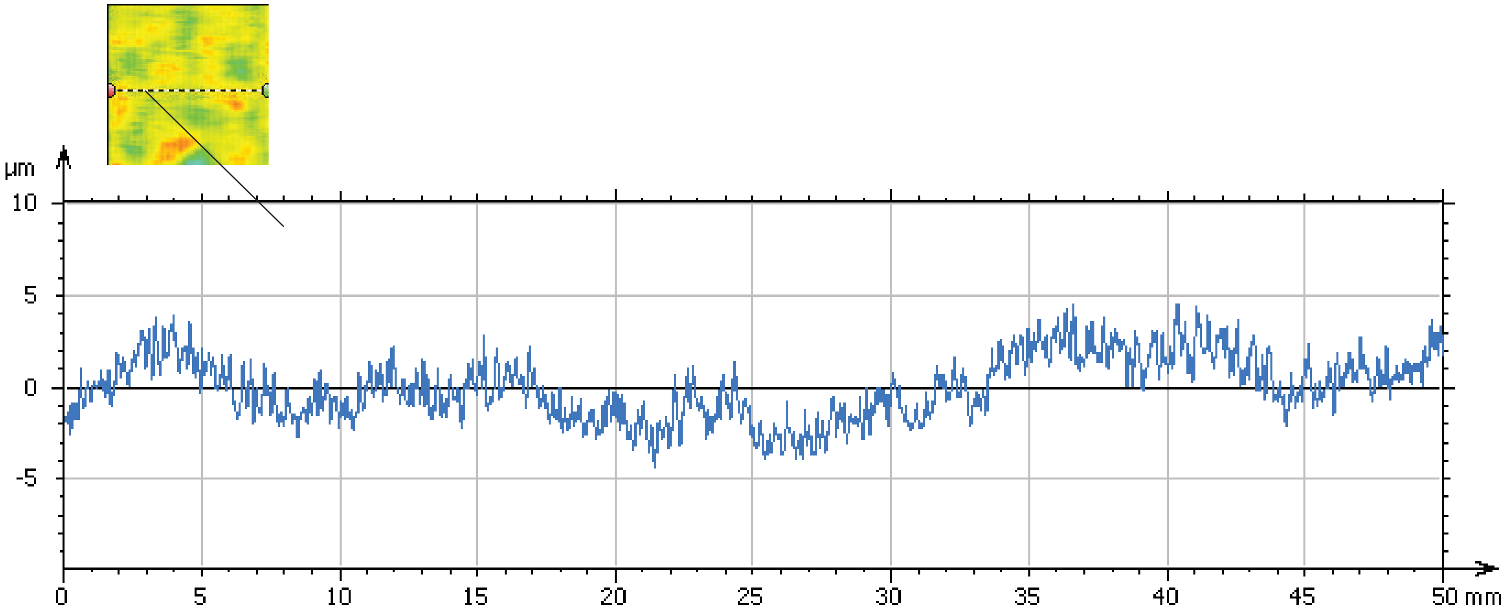


Figure 3: 3D view for Sample Antique Birch Hardwood

Antique Birch Hardwood

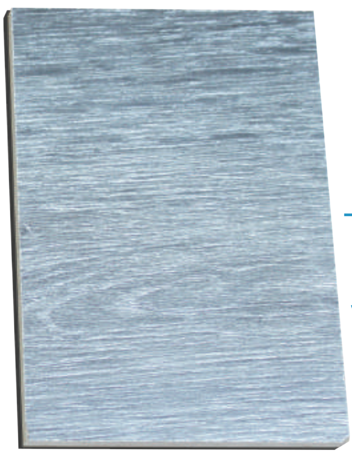


ISO 4287				
Amplitude parameters - Primary profile				
Pa	1.412	µm		*Arithmetic Mean Deviation of the raw profile.*
Pq	1.701	µm		*Root-mean-square (RMS) Deviation of the raw profile.*
Pz	8.910	µm		*Maximum height of the raw profile.*
Pp	4.590	µm		*Maximum peak height of the raw profile.*
Pv	4.320	µm		*Maximum valley depth of the raw profile.*
Pt	8.910	µm		*Total height of raw profile.*
Pc	2.735	µm	*ISO 4287 w/o amendment 2*	*Mean height of the raw profile elements.*
Amplitude parameters - Roughness profile				
Ra	0.5131	µm	*Gaussian filter, 0.8 mm*	*Arithmetic mean deviation of the roughness profile.*
Rq	0.6252	µm	*Gaussian filter, 0.8 mm*	*Root-mean-square (RMS) deviation of the roughness profile.*
Rz	2.573	µm	*Gaussian filter, 0.8 mm*	*Maximum Height of roughness profile.*
Rp	1.430	µm	*Gaussian filter, 0.8 mm*	*Maximum peak height of the roughness profile.*
Rv	1.143	µm	*Gaussian filter, 0.8 mm*	*Maximum valley depth of the roughness profile.*
Rt	4.173	µm	*Gaussian filter, 0.8 mm*	*Total height of roughness profile.*
Rc	1.658	µm	*Gaussian filter, 0.8 mm, ISO 4287 w/o amendment 2*	*Mean height of the roughness profile elements.*

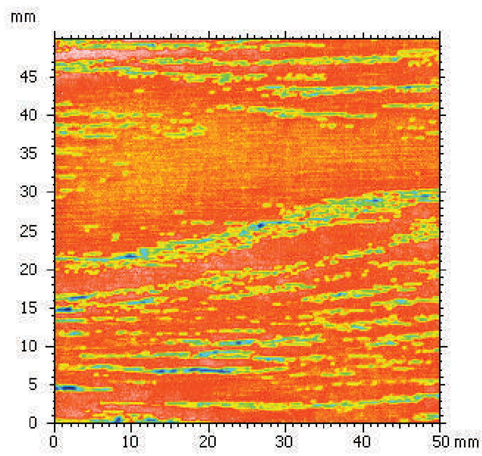
Figure 4: Profile extraction and height parameters for Sample Antique Birch Hardwood

Profilometry Results

Courtship Grey Oak



Sample of Courtship Grey Oak



ISO 25178		
Height Parameters		
Sa	11.17	µm
Sq	15.09	µm
Ssk	-1.629	
Sku	5.954	
Sz	132.3	µm
Sp	39.23	µm
Sv	93.05	µm
Other 3D Parameters		
Miscellaneous		
Sdar	2558	mm²
Spar	2499	mm²

Figure 5: False color view and height parameters for Sample Courtship Grey Oak

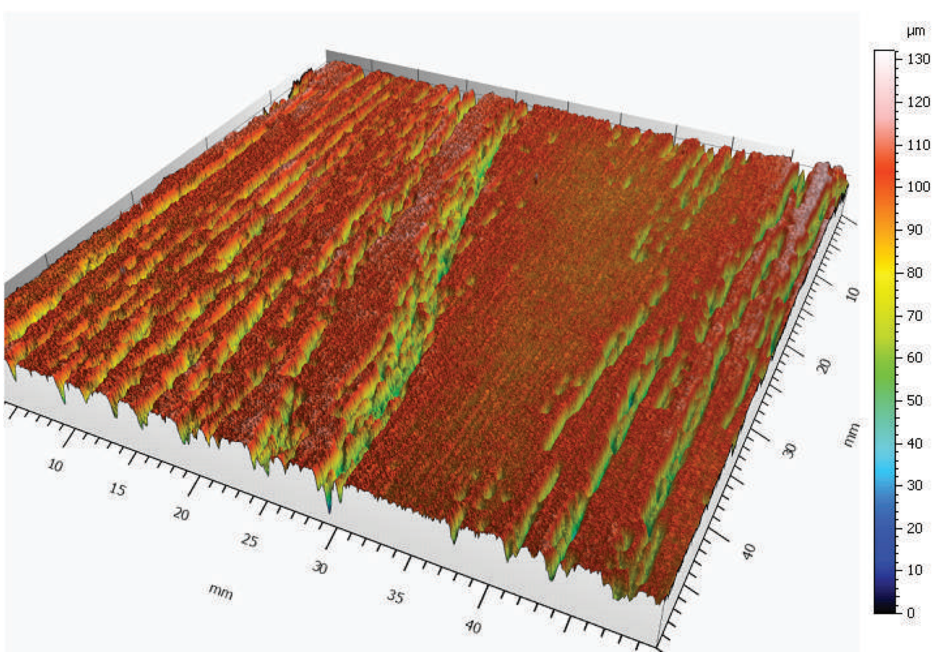
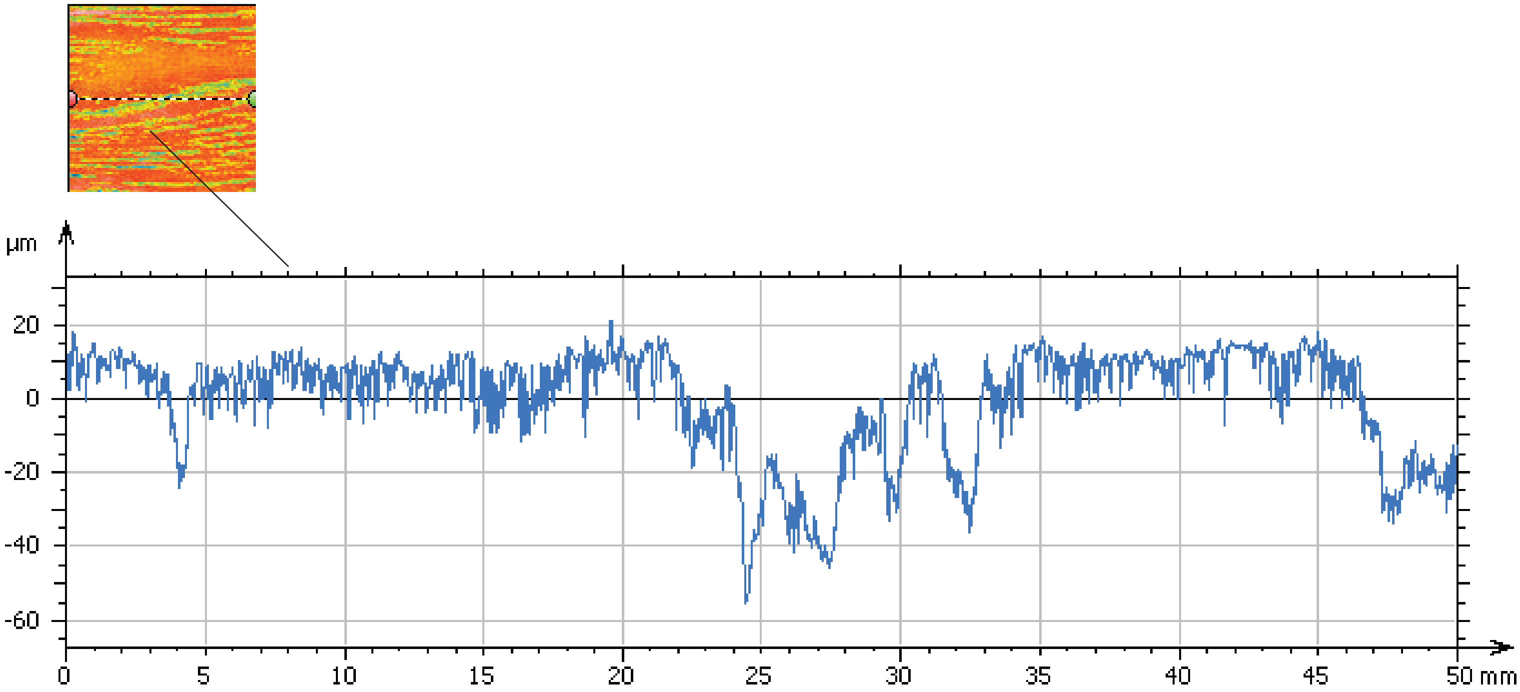


Figure 6: 3D view for Sample Courtship Grey Oak

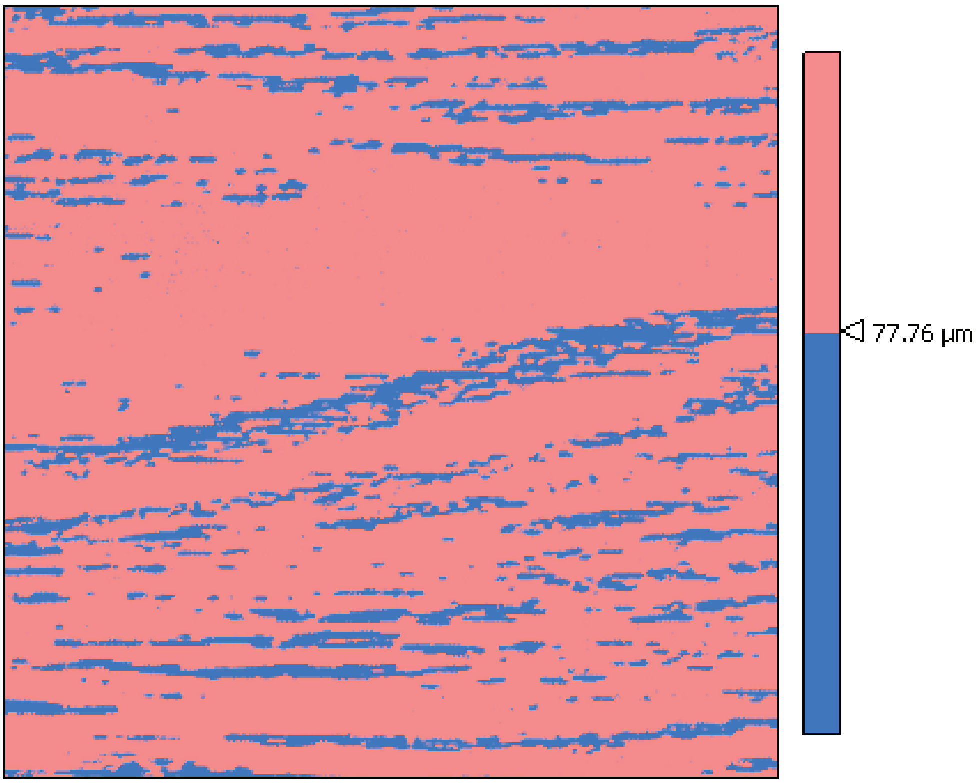
Courtship Grey Oak



ISO 4287				
Amplitude parameters - Primary profile				
Pa	11.39	µm		*Arithmetic Mean Deviation of the raw profile.*
Pq	14.42	µm		*Root-mean-square (RMS) Deviation of the raw profile.*
Pz	76.24	µm		*Maximum height of the raw profile.*
Pp	20.95	µm		*Maximum peak height of the raw profile.*
Pv	55.29	µm		*Maximum valley depth of the raw profile.*
Pt	76.24	µm		*Total height of raw profile.*
Pc	15.60	µm	*ISO 4287 w/o amendment 2*	*Mean height of the raw profile elements.*
Amplitude parameters - Roughness profile				
Ra	2.795	µm	*Gaussian filter, 0.8 mm*	*Arithmetic mean deviation of the roughness profile.*
Rq	3.523	µm	*Gaussian filter, 0.8 mm*	*Root-mean-square (RMS) deviation of the roughness profile.*
Rz	15.78	µm	*Gaussian filter, 0.8 mm*	*Maximum Height of roughness profile.*
Rp	5.811	µm	*Gaussian filter, 0.8 mm*	*Maximum peak height of the roughness profile.*
Rv	9.966	µm	*Gaussian filter, 0.8 mm*	*Maximum valley depth of the roughness profile.*
Rt	29.09	µm	*Gaussian filter, 0.8 mm*	*Total height of roughness profile.*
Rc	9.090	µm	*Gaussian filter, 0.8 mm, ISO 4287 w/o amendment 2*	*Mean height of the roughness profile elements.*

Figure 7: Profile extraction and height parameters for Courtship Grey Oak

Courtship Grey Oak

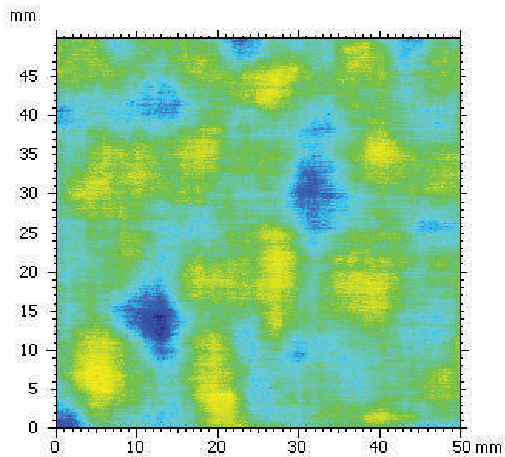


Parameters	Unit		
Projected area	%	14.70	85.30
Volume of void	%	2.792	67.98
Volume of material	%	97.21	32.02
Volume of void	µm³/mm²	2171270	37061813
Volume of material	µm³/mm²	75588985	17459746
Mean thickness of void	µm	2.171	37.06
Mean thickness of material	µm	75.59	17.46

Figure 8: Slices Analysis for Sample Courtship Grey Oak

Santos Mahogany

Sample of Santos Mahogany



ISO 25178		
Height Parameters		
Sa	2.388	µm
Sq	3.050	µm
Ssk	-0.2882	
Sku	3.528	
Sz	39.50	µm
Sp	24.62	µm
Sv	14.88	µm
Other 3D Parameters		
Miscellaneous		
Sdar	2500	mm²
Spar	2499	mm²

Figure 9: False color view and height parameters for Sample Santos Mahogany

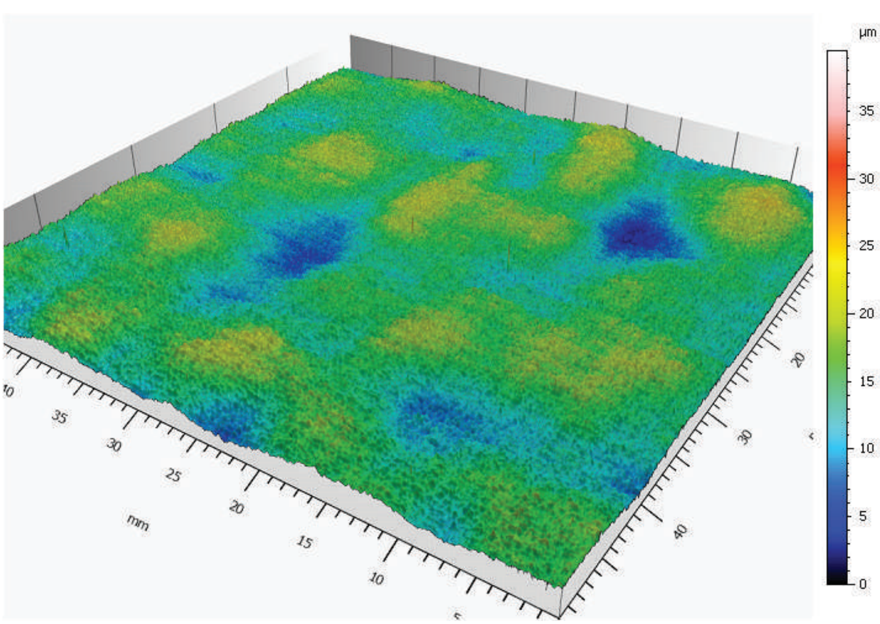
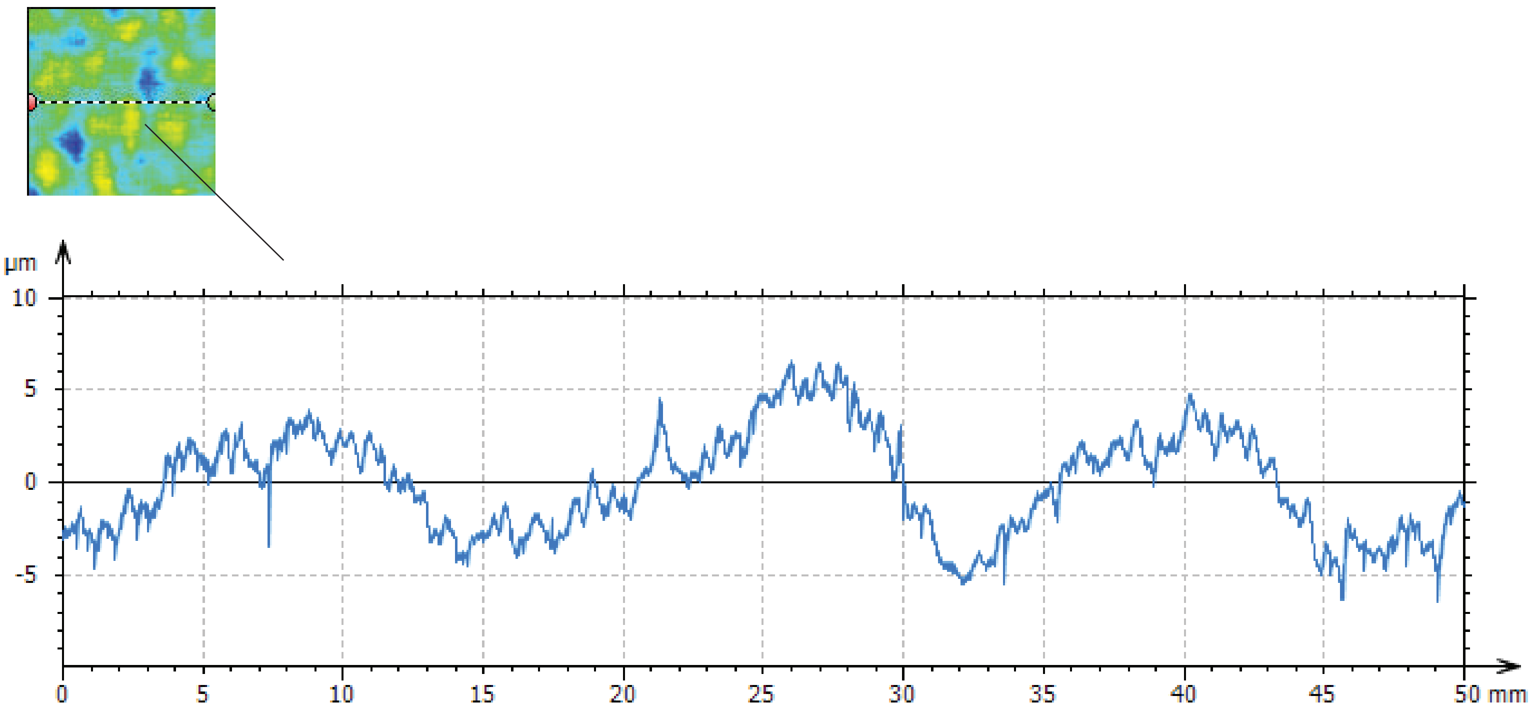


Figure 10: 3D view for Sample Santos Mahogany

Profilometry Results

Santos Mahogany



ISO 4287				
Amplitude parameters - Primary profile				
Pa	**2.381**	**µm**		*Arithmetic Mean Deviation of the raw profile.*
Pq	**2.764**	**µm**		*Root-mean-square (RMS) Deviation of the raw profile.*
Pz	**13.01**	**µm**		*Maximum height of the raw profile.*
Pp	**6.585**	**µm**		*Maximum peak height of the raw profile.*
Pv	**6.421**	**µm**		*Maximum valley depth of the raw profile.*
Pt	**13.01**	**µm**		*Total height of raw profile.*
Pc	**4.991**	**µm**	*ISO 4287 w/o amendment 2*	*Mean height of the raw profile elements.*
Amplitude parameters - Roughness profile				
Ra	**0.3074**	**µm**	*Gaussian filter, 0.8 mm*	*Arithmetic mean deviation of the roughness profile.*
Rq	**0.3875**	**µm**	*Gaussian filter, 0.8 mm*	*Root-mean-square (RMS) deviation of the roughness profile.*
Rz	**1.827**	**µm**	*Gaussian filter, 0.8 mm*	*Maximum Height of roughness profile.*
Rp	**0.7467**	**µm**	*Gaussian filter, 0.8 mm*	*Maximum peak height of the roughness profile.*
Rv	**1.081**	**µm**	*Gaussian filter, 0.8 mm*	*Maximum valley depth of the roughness profile.*
Rt	**6.351**	**µm**	*Gaussian filter, 0.8 mm*	*Total height of roughness profile.*
Rc	**1.132**	**µm**	*Gaussian filter, 0.8 mm, ISO 4287 w/o amendment 2*	*Mean height of the roughness profile elements.*

Figure 11: Profile extraction and height parameters for Sample Santos Mahogany

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Discussion

There is a clear distinction between all the samples' Sa value. The smoothest was Antique Birch Hardwood with a Sa of 1.716 µm, followed by Santos Mahogany with a Sa of 2.388 µm, and significantly increasing for Courtship Grey Oak with a Sa of 11.17 µm. P-values and R-values are also common roughness values that can be used to assess the roughness of specific profiles along the surface. The Courtship Grey Oak possesses a coarse texture full of crack-like features along the wood's cellular and fiber direction. Additional analysis was done on the Courtship Grey Oak sample because of its textured surface. On the Courtship Grey Oak sample, slices was used to separate and calculate the depth and volume of the cracks from the flatter uniform surface.

Conclusion

In this application, we have shown how the Nanovea HS2000 high speed profilometer can be used to inspect the surface finish of wood samples in an effective and efficient manner. Surface finish measurements can prove to be important to both manufactures and consumers of hard wood flooring in understanding how they can improve a manufacturing process or choose the appropriate product that performs best for a specific application.

Check out our full application notes library!

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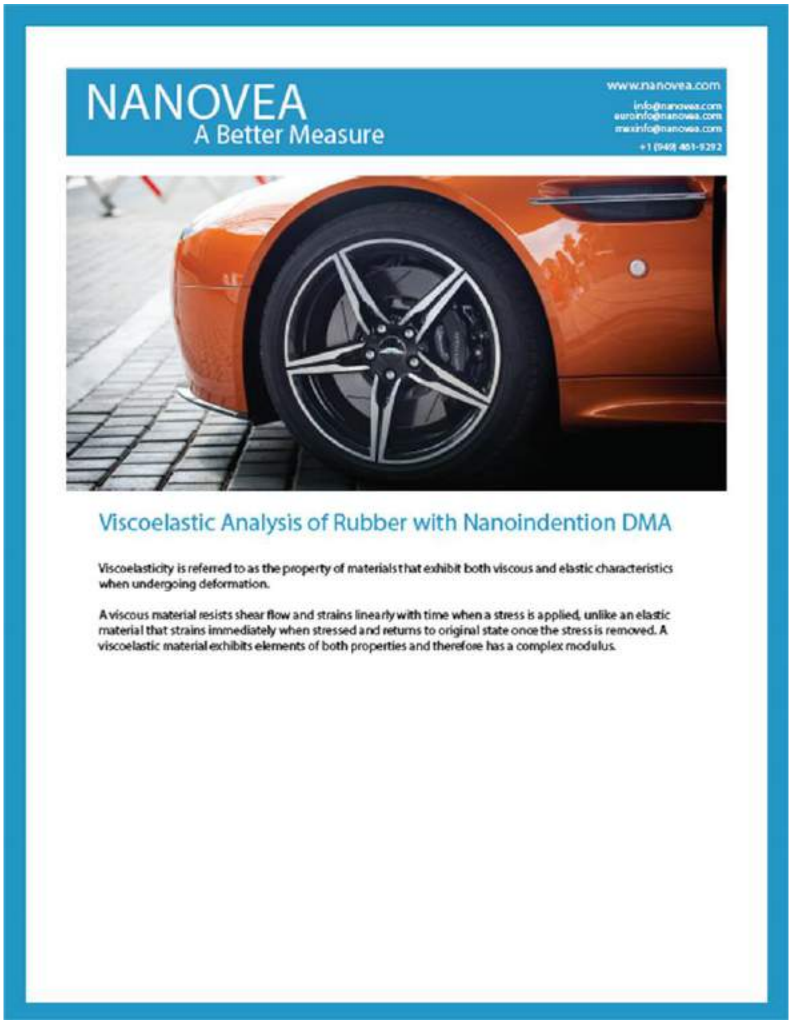
Recommended Reading

Check out our other application note where we conduct a Viscoelastic Analysis on Rubber with Nanoindentation

https://nanovea.com/viscoelastic-analysis-of-rubber/



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Viscoelastic Analysis of Rubber with Nanoindention DMA

Viscoelasticity is referred to as the property of materials that exhibit both viscous and elastic characteristics when undergoing deformation.

A viscous material resists shear flow and strains linearly with time when a stress is applied, unlike an elastic material that strains immediately when stressed and returns to original state once the stress is removed. A viscoelastic material exhibits elements of both properties and therefore has a complex modulus.