NANOVEA

NANOVEA.COM

INFO@NANOVEA.COM
EURO@NANOVEA.COM
MEXINFO@NANOVEA.COM

INLINE ROUGHNESS INSPECTION

USING

CHROMATIC CONFOCAL OPTICS

Prepared by

Duanjie Li, PhD., Jonathan Thomas, and Pierre Leroux

Introduction

Surface roughness and texture is vital to the end-use of a product. Fast, quantifiable, and reliable inline inspection of the product surface ensures detecting the defective products immediately so as to determine the work conditions of the production line. It not only improves productivity and efficiency, but also reduces defect rates, re-work, and waste.

Importance of Non-contact profilometer for In-line Inspection

Surface defects derive from materials processing and product manufacturing. In-line surface quality inspection ensures the tightest quality control of the end products. The Nanovea 3D Non-Contact Profilometers utilize chromatic confocal technology with a unique capability to determine the roughness of a sample without contact. Multiple profiler sensors can be installed to monitor the roughness and texture of different areas of the product at the same time. The roughness threshold calculated in real-time by the analysis software serves as a fast and reliable pass/fail tool.

MEASUREMENT OBJECTIVE

In this study, the Nanovea roughness inspection conveyor system equipped with a point sensor is used to inspect the surface roughness of the acrylic and sandpaper samples. We showcase the capacity of Nanovea non-contact profilometer in providing fast and reliable surface inspection in a production line in real-time.

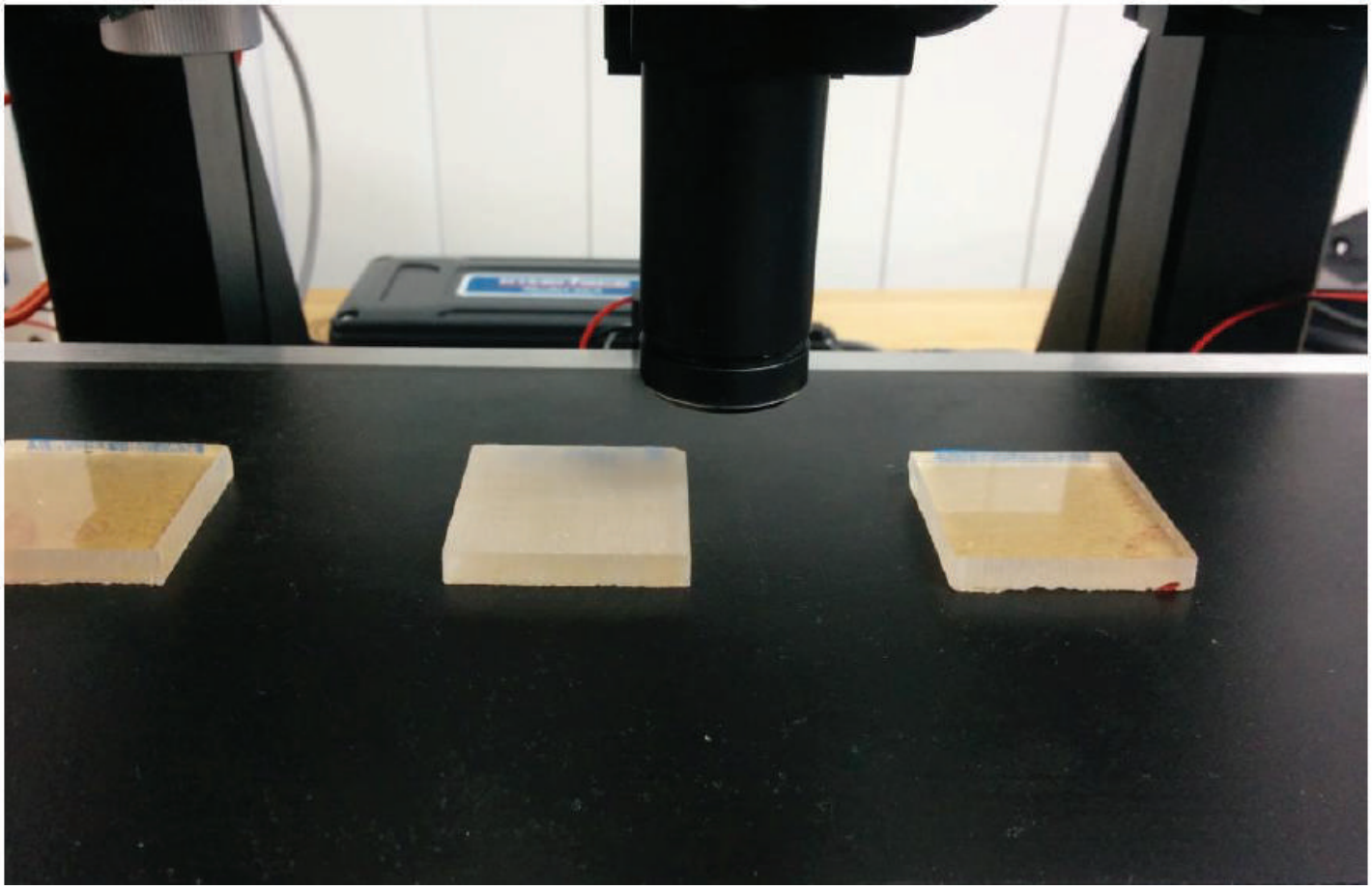


Figure 1: Optical profiler sensor scanning on the Acrylic samples.

RESULTS & DISCUSSION

The conveyor profilometer system can operate in two modes, namely Trigger Mode and Continuous Mode. As illustrated in Figure 2, the surface roughness of the samples are measured when they are passing under the optical profiler heads under the Trigger Mode. In comparison, Continuous Mode provides non-stop measurement of the surface roughness on the continuous sample, such as metal sheet and fabric. Multiple optical profiler sensors can be installed to monitor and record the roughness of different sample areas.

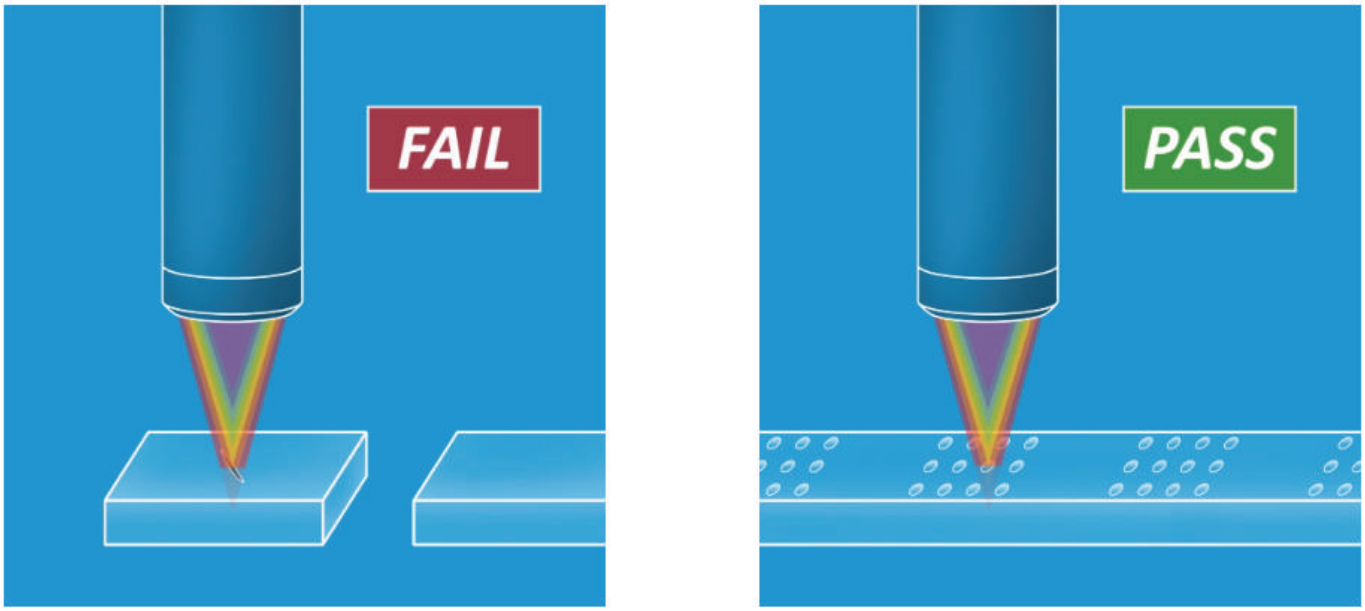


Figure 2: Inspection modes of the conveyor profilometer system.

During the real-time roughness inspection measurement, the pass and fail alerts are displayed on the software windows as shown in Figure 4 and Figure 5. When the roughness value is within the given thresholds, the measured roughness is highlighted in green color. However, the highlight turns red when the measured surface roughness is out of the range of the set threshold values. This provides a tool for the user to determine the quality of a product's surface finish.

In the following sections, two types of samples, e.g. Acrylic and Sandpaper are used to demonstrate the Trigger and Continous Modes of the Inspection system.

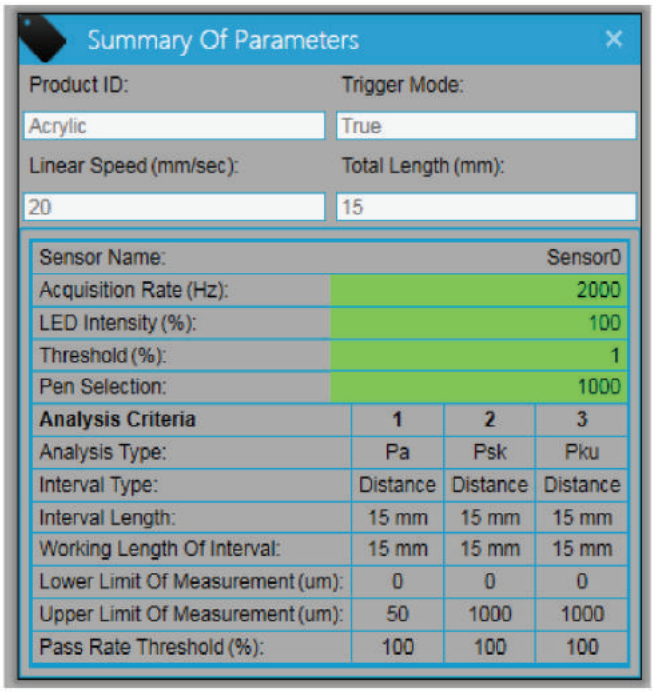


Figure 3: Parameter setup screen.

Height Parameter		Definition
Pa	Arithmetical Mean Height	Mean surface roughness.
Pq	Root Mean Square Height	Standard deviation of the height distribution, or RMS surface roughness.
Pp	Maximum Peak Height	Height between the highest peak and the mean plane.
Pv	Maximum Pit Height	Depth between the mean plane and the deepest valley.
Pz	Maximum Height	Height between the highest peak and the deepest valley.
Psk	Skewness	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
Pku	Kurtosis	Kurtosis qualifies the flatness of the height distribution.
Ppar	Projected Area	Projected surface area.
Pdar	Developed Area	Developed surface area.

Table 1: Options of the roughness values for the pass/fail threshold

Figure 4: Pass/Fail alert screen based on the roughness value thresholds.

LIVE RESULT VIEW

View: Sensor 2

Last 5 Failed Results:

INTERVAL NO	ANALYSIS TYPE	VALUE	RESULT	PASS RATE	THRESHOLD	STEP SIZE	START POINT	STOP POINT	TIME
78	Pa	101.7782	Fail	73.42	85.00	0.0200	1560.0000	1579.9800	20170721103822
77	Pa	122.0446	Fail	74.36	85.00	0.0200	1540.0000	1559.9800	20170721103821
68	Pa	116.1147	Fail	72.46	85.00	0.0200	1360.0000	1379.9800	20170721103812
67	Pa	117.8736	Fail	73.53	85.00	0.0200	1340.0000	1359.9800	20170721103811
66	Pa	247.3996	Fail	74.63	85.00	0.0200	1320.0000	1339.9800	20170721103810

Last 10 Results:

INTERVAL NO	ANALYSIS TYPE	VALUE	RESULT	PASS RATE	THRESHOLD	STEP SIZE	START POINT	STOP POINT	TIME
79	Pa	71.1138	Pass	73.75	85.00	0.0200	79000.0000	79999.0000	20170721103823
78	Pa	101.7782	Fail	73.42	85.00	0.0200	78000.0000	78999.0000	20170721103822
77	Pa	122.0446	Fail	74.36	85.00	0.0200	77000.0000	77999.0000	20170721103821
76	Pa	44.8155	Pass	75.32	85.00	0.0200	76000.0000	76999.0000	20170721103820
75	Pa	90.3276	Pass	75.00	85.00	0.0200	75000.0000	75999.0000	20170721103819
74	Pa	74.7016	Pass	74.67	85.00	0.0200	74000.0000	74999.0000	20170721103818
73	Pa	87.0616	Pass	74.32	85.00	0.0200	73000.0000	73999.0000	20170721103817
72	Pa	66.9413	Pass	73.97	85.00	0.0200	72000.0000	72999.0000	20170721103816
71	Pa	86.1839	Pass	73.61	85.00	0.0200	71000.0000	71999.0000	20170721103815
70	Pa	67.7635	Pass	73.24	85.00	0.0200	70000.0000	70999.0000	20170721103814

Figure 5: Real-time record of the recent pass and fail alerts.

Trigger Mode: Surface inspection of the Acrylic Sample

A series of Acrylic samples are aligned on the conveyor belt and move under the optical profiler head as shown in Figure 1. The false color view in Figure 6 shows the change of the surface height. Some of the mirror-like finished Acrylic samples had been sanded to create a rough surface texture as shown in Figure 6b.

As the Acrylic samples move at a constant speed under the optical profiler head, the surface profile is measured as shown in Figure 7 and Figure 8. The roughness value of the measured profile is calculated at the same time and compared to the threshold values. The red fail alert is launched when the roughness value is over the set threshold, allowing users to immediately detect and locate the defective product on the production line.

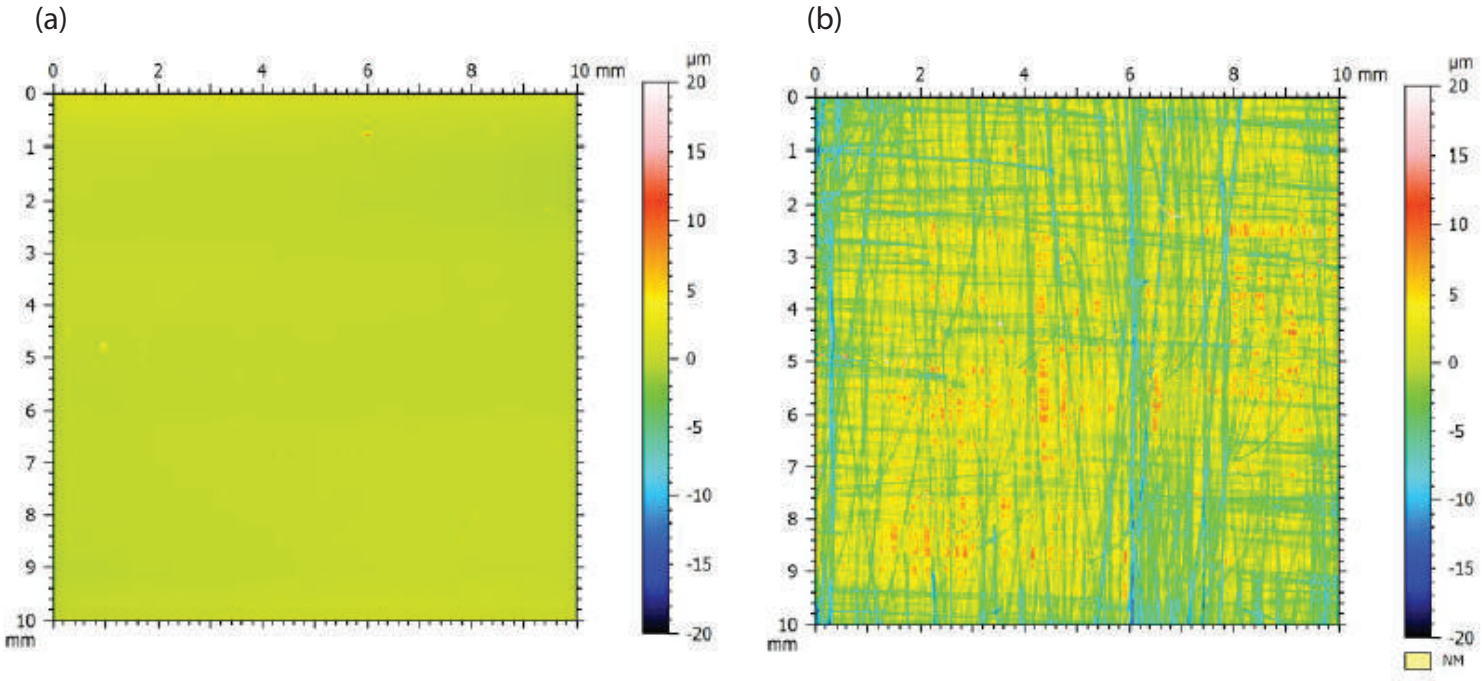


Figure 6: Surface texture of the Pass and Fail acrylic samples.

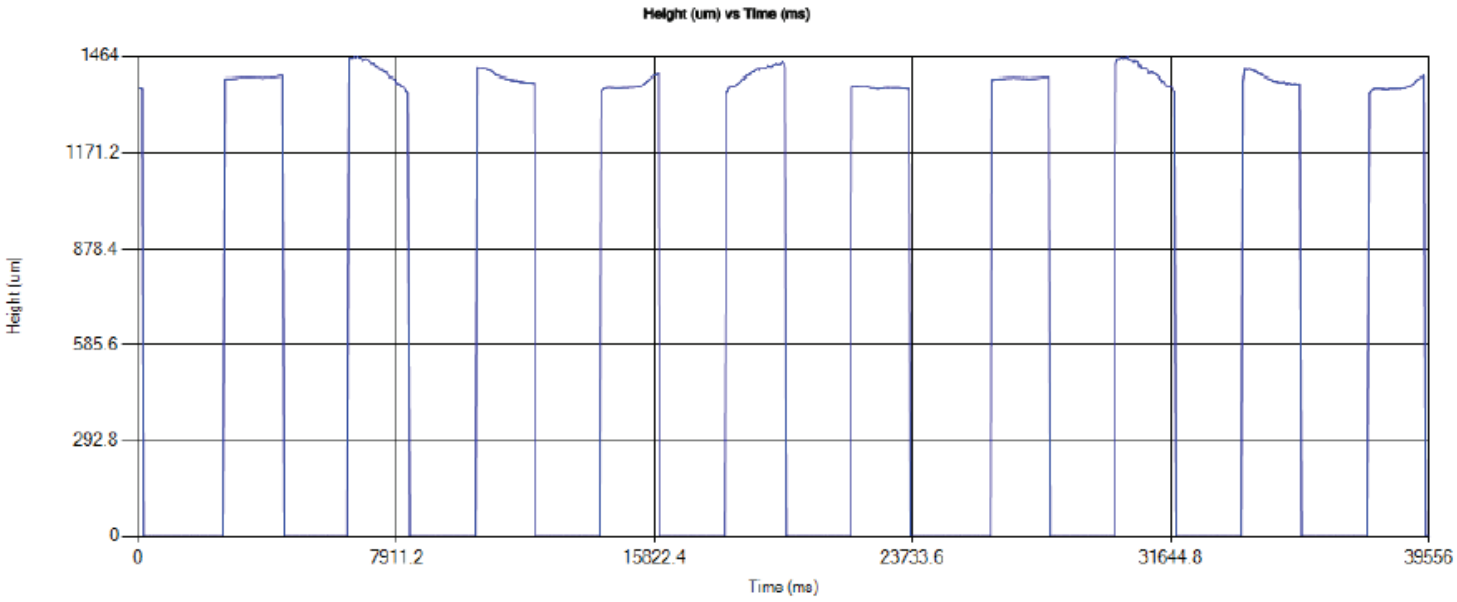


Figure 7: 2D Profile of the acrylic samples passing the inspection profilometer sensor.

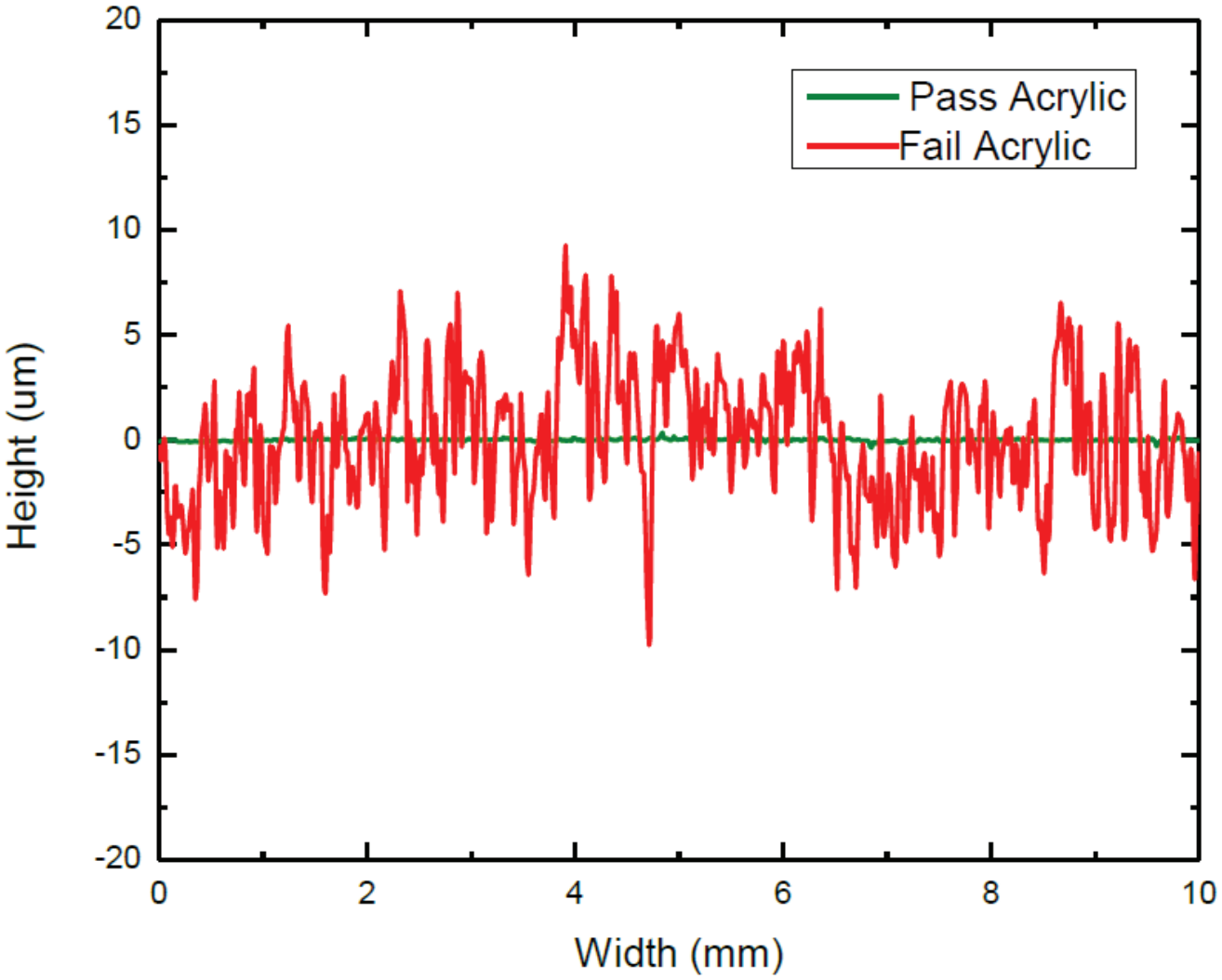


Figure 8: 2D profiles of the Pass and Fail Acrylic samples.

Continuous Mode: Surface Inspection of the sandpaper sample

Surface Height Map, Roughness Distribution Map, and Pass / Fail Roughness Threshold Map of the sandpaper sample surface as shown in Figure 9. The sandpaper sample has a couple of higher peaks in the used part as shown in the surface height map. The different colors in the pallet of Figure 9C represent the roughness value of the local surface. The Roughness Map exhibits a homogenous roughness in the intact area of the sandpaper sample, while the used area is highlighted in dark blue color, indicating the reduced roughness value in this region. A Pass/Fail roughness threshold can be set up to locate such regions as shown in Figure 9D.

As the sandpaper continuously passes under the in-line profiler sensor, the real-time local roughness value is calculated and recorded as plotted in Figure 10. The pass/fail alerts are displayed on the software screen based on the set roughness threshold values, serving as a fast and reliable tool for quality control. The product surface quality in the production line is inspected in situ to discover defective areas in time.

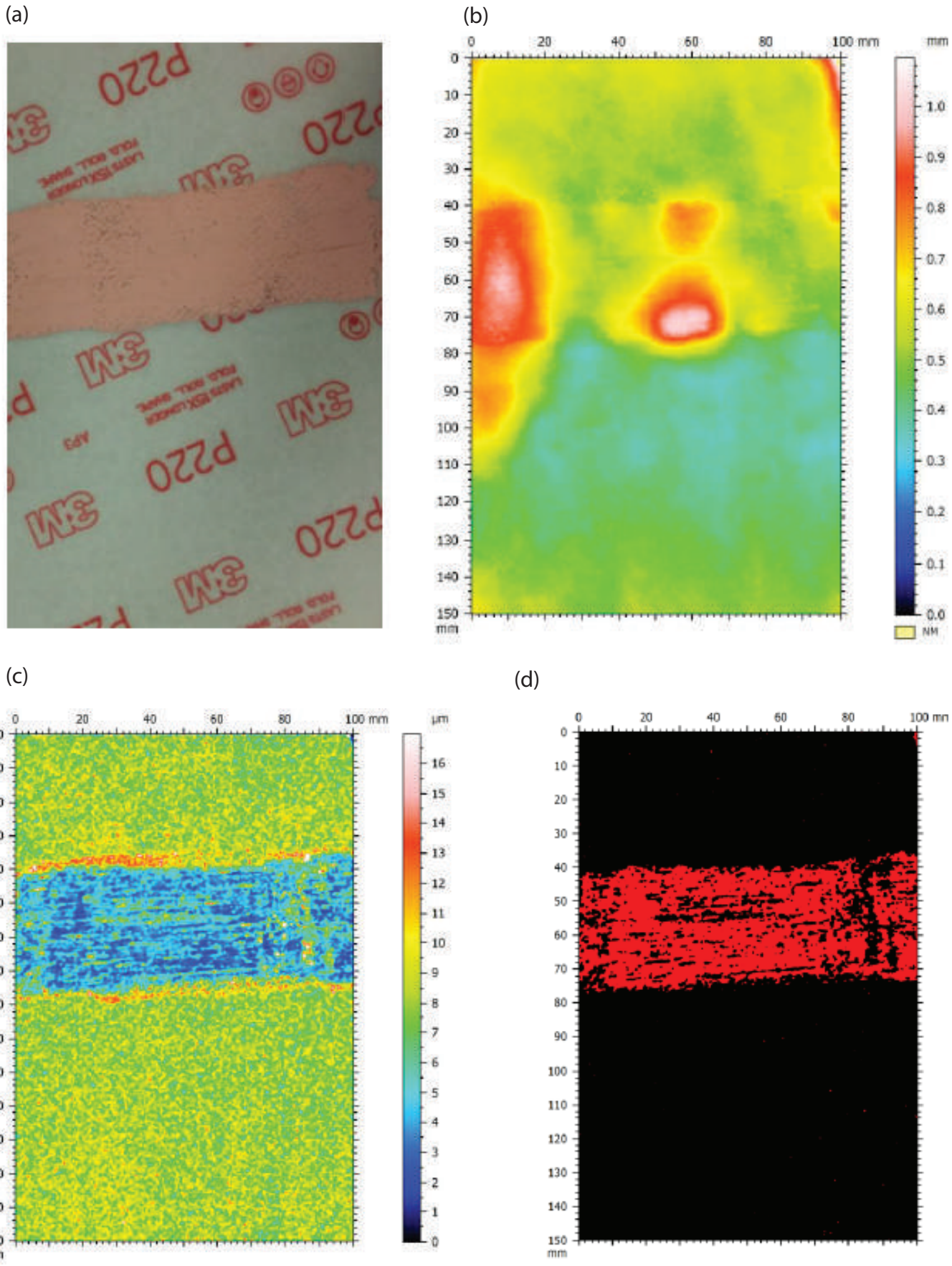


Figure 9: Sandpaper Image, Surface Height Map, Roughness Distribution Map, and Pass/Fail Roughness Threshold Map.

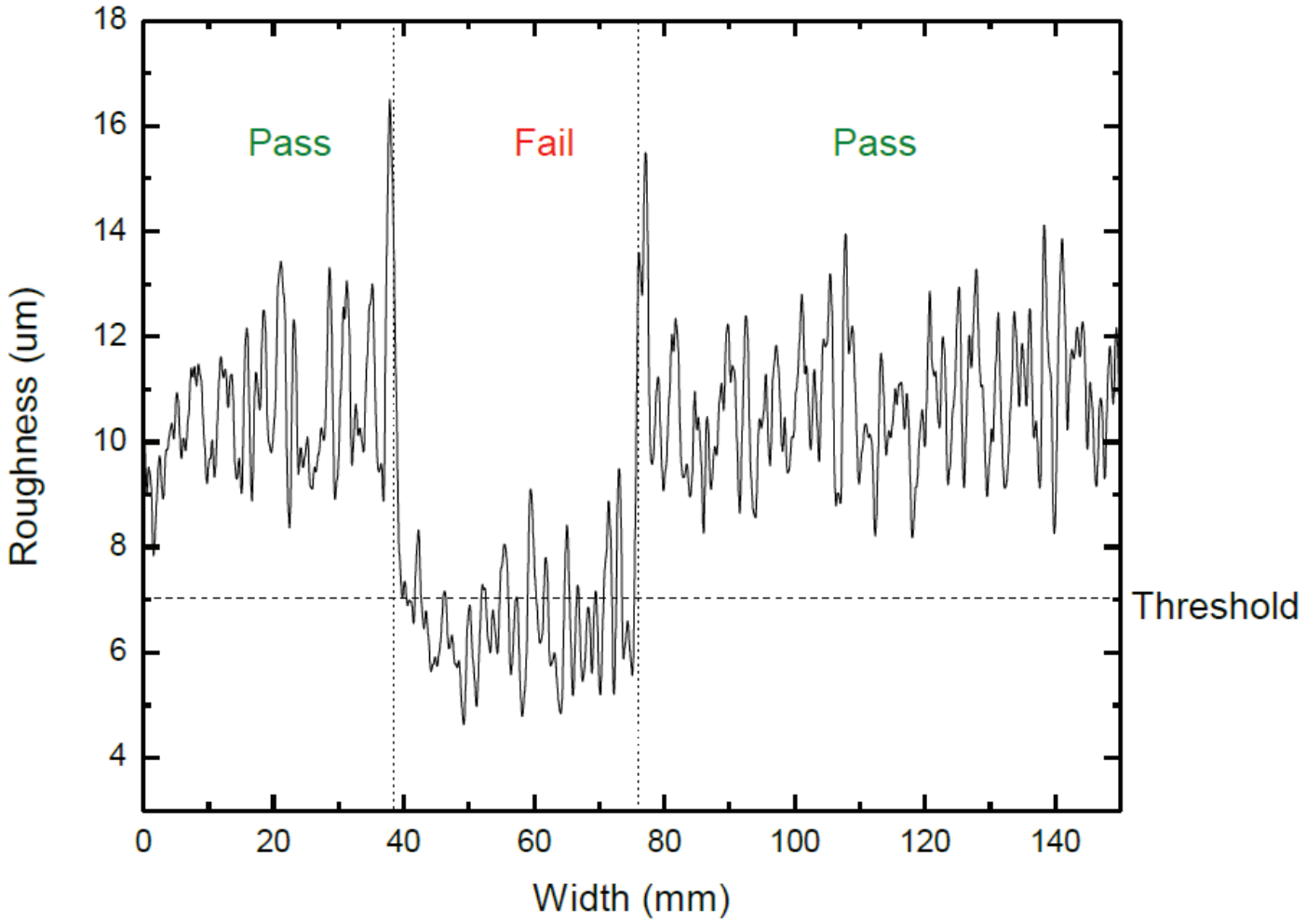


Figure 10: Pass/Fail regions of the sandpaper based on the roughness value threshold.

Conclusion

In this application, we have shown the Nanovea Conveyor Profilometer equipped with an optical non-contact profiler sensor works as a reliable in-line quality control tool effectively and efficiently.

The inspection system can be installed in the production line to monitor the surface quality of the products in situ. The roughness threshold works as a dependable criteria to determine the surface quality of the products, allowing users to notice the defective products in time. Two inspection modes, namely Trigger Mode and Continuous Mode, are provided to meet the requirement for inspection on different types of products.

The data shown here represent only a portion of the calculations available in the analysis software. Nanovea Profilometers measure virtually any surface in fields including Semiconductor, Microelectronics, Solar, Fiber, Optics, Automotive, Aerospace, Metallurgy, Machining, Coatings, Pharmaceutical, Biomedical, Environmental and many others.

This Report has been created using one of

NANOVEA

OPTICAL PROFILERS

Designed with Chromatic Light technology, which measures physical wavelength, the instruments provide the highest accuracy on any roughness, any form, any material. Transparent or opaque.

For pricing information, please contact ***sales@nanovea.com***

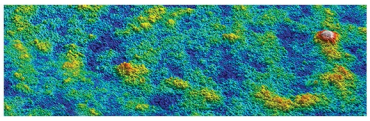
HS2000

CHROMATIC LIGHT

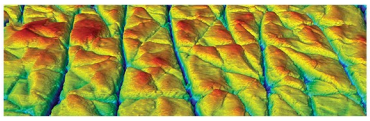
Analyze Any Surface
No Image Stitching

No Refocusing
High Speed

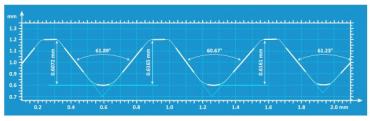
2D & 3D SURFACE MEASUREMENT



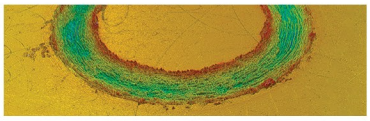
ROUGHNESS & FINISH



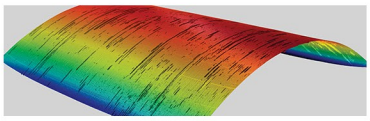
TEXTURE



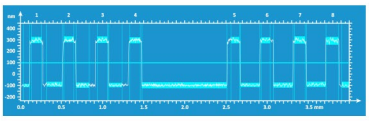
GEOMETRY & SHAPE



VOLUME & AREA



FLATNESS & WARPAGE



STEP HEIGHT & THICKNESS

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