

P3 Review
Automated Roughness Measurement



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INTRODUCTION

Surface roughness is quantified by the deviations in the normal direction of a material surface from its ideal form. It plays a key role when the material interacts with the environment. For instance, the mechanical parts with a rough surface usually have a higher wear rate and coefficient of friction, compared to the ones with a smooth surface, due to the irregularities in the surface that may act as nucleation sites for cracks or corrosion. Therefore, the surface roughness tester, also known as a profilometer, is often applied as a quality control tool to evaluate the surface roughness of metal and non-metal materials after tooling processes, such as machining, grinding, or polishing.

Conventionally, roughness was measured by tracing the surface profile using a tracer tip such as a diamond stylus and the change of surface height was recorded by piezo-electric detection to calculate roughness. Such contact profilometry technology has several limitations. It may create scratches on the soft material during the measurement, and it can also miss or misrepresent the surface features if the surface has steep angle such as sharp peaks or deep pits. In comparison, Nanovea applies the white light axial chromatism technology which is a non-contact technique (details are described in Measurement Principle at the end of the app note). It is capable of measuring the widest range of materials, including metals, ceramics, thin films, biomaterials and countless others. In order to bring such high-end measurement technology to the broader market, Nanovea introduced the P3 Profilometer. With only a few touches on the screen, an operator can obtain roughness (ISO 25178) of any materials in an automated and reproducible manner. The combination of competitive price and fully-automated high-precision measurement makes P3 system an ideal tool for Quality Control.

MEASUREMENT OBJECTIVE

In this application, the Nanovea P3 Profilometer is used to measure the surface morphology and roughness of samples with different surface finish, in order to showcase the simplicity, reliability and repeatability of this non-contact 3D profilometer system.

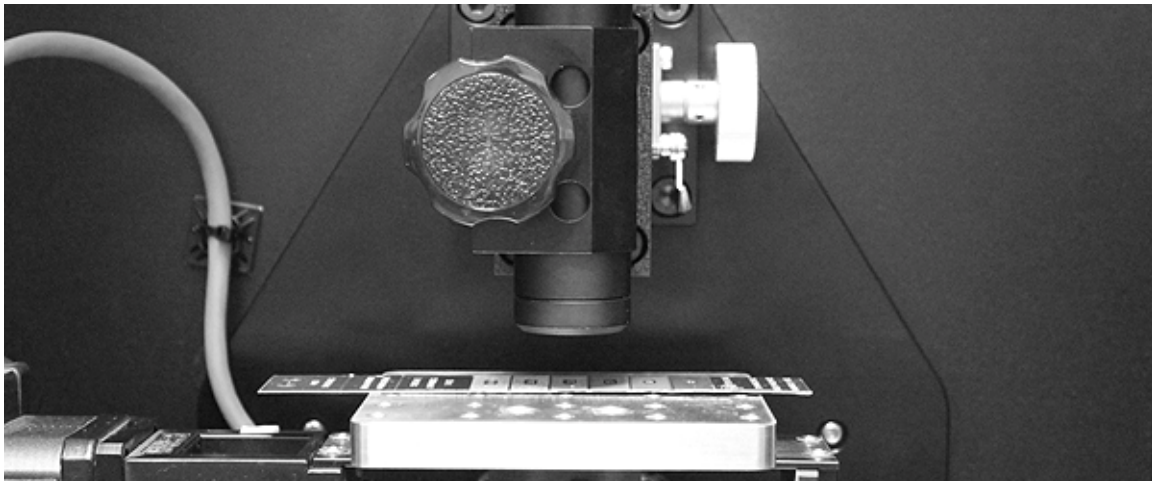


Fig. 1: Stage inside the P3 for sample measurement

TEST CONDITIONS & PROCEDURES

The surface morphology and roughness of surfaces with different finishes were evaluated using Nanovea P3 profilometer. As shown in Fig. 2, the P3 system has a clean and simple user interface for test condition setup displayed on a touchscreen. The drop-down menu allows selection of the surface reflectivity, scan area size and step size on the intended test surface on the sample. The test begins after the “START” bottom is clicked. The line-by-line surface profile will be measured and recorded. The final surface 3D profile and roughness will be automatically calculated and displayed on the touch screen. The test conditions are listed in Fig. 2.

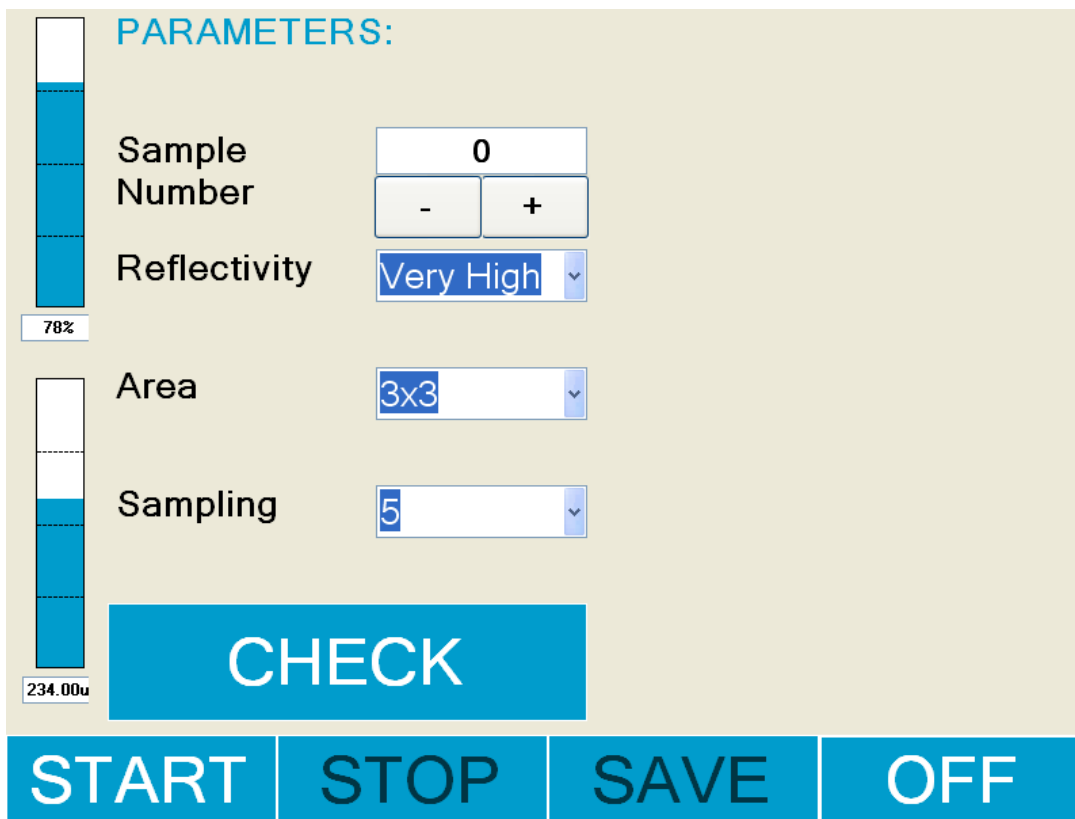
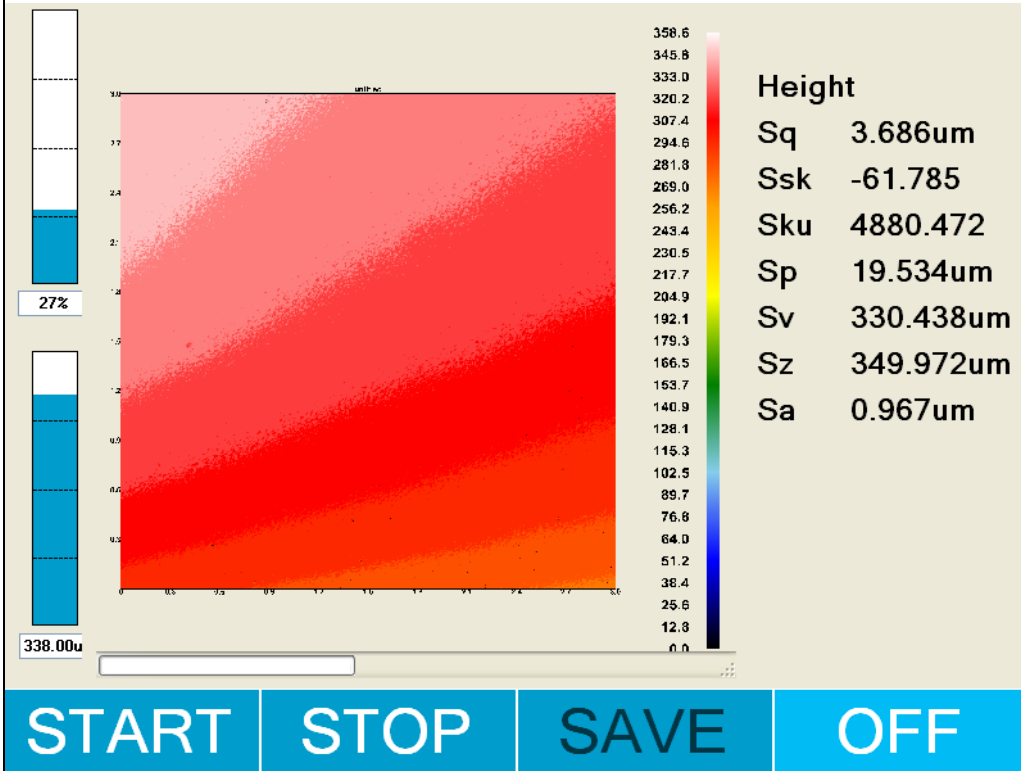


Fig. 2: Test parameters shown on the user interface of the touchscreen.

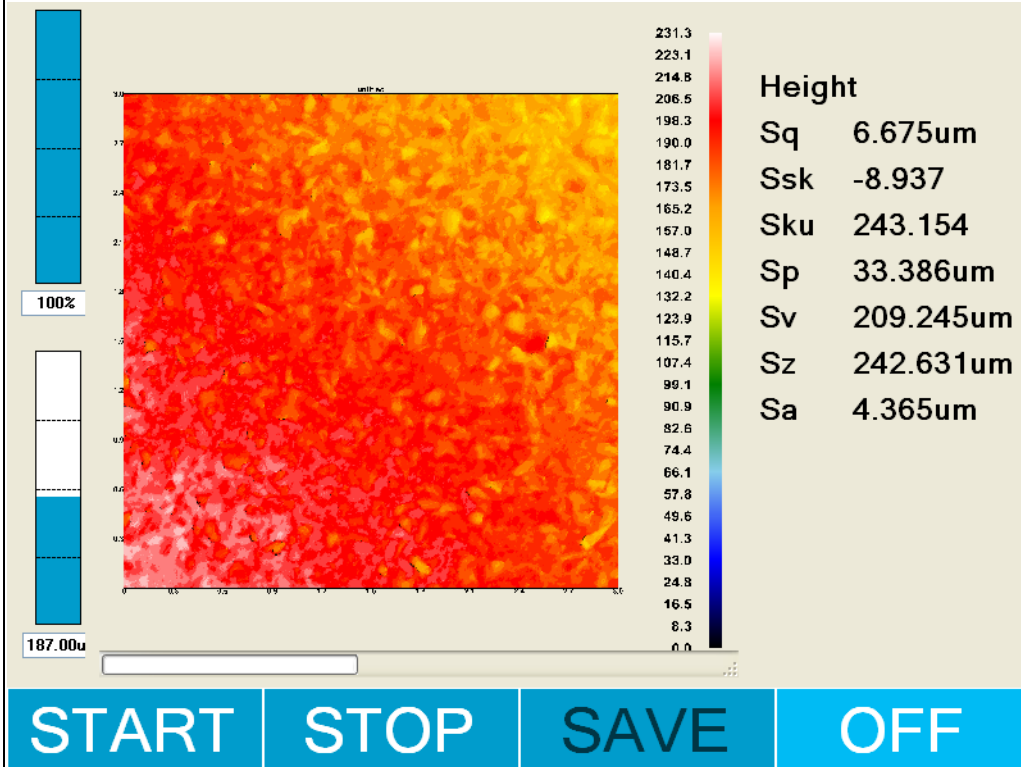
RESULTS AND DISCUSSION

The false-color surface morphology and roughness values of the three sample surfaces were automatically calculated and displayed on the touchscreen as shown in Fig. 3. Among the test samples, Surface 1 exhibits the lowest average roughness $S_a = 0.967 \mu\text{m}$, compared to $S_a = 4.365$ and $9.426 \mu\text{m}$, respectively, for Surface 2 and Surface 3. Other than the average roughness S_a , other roughness values calculated using different formulas are also provided.

(a) Surface 1:



(b) Surface 2:



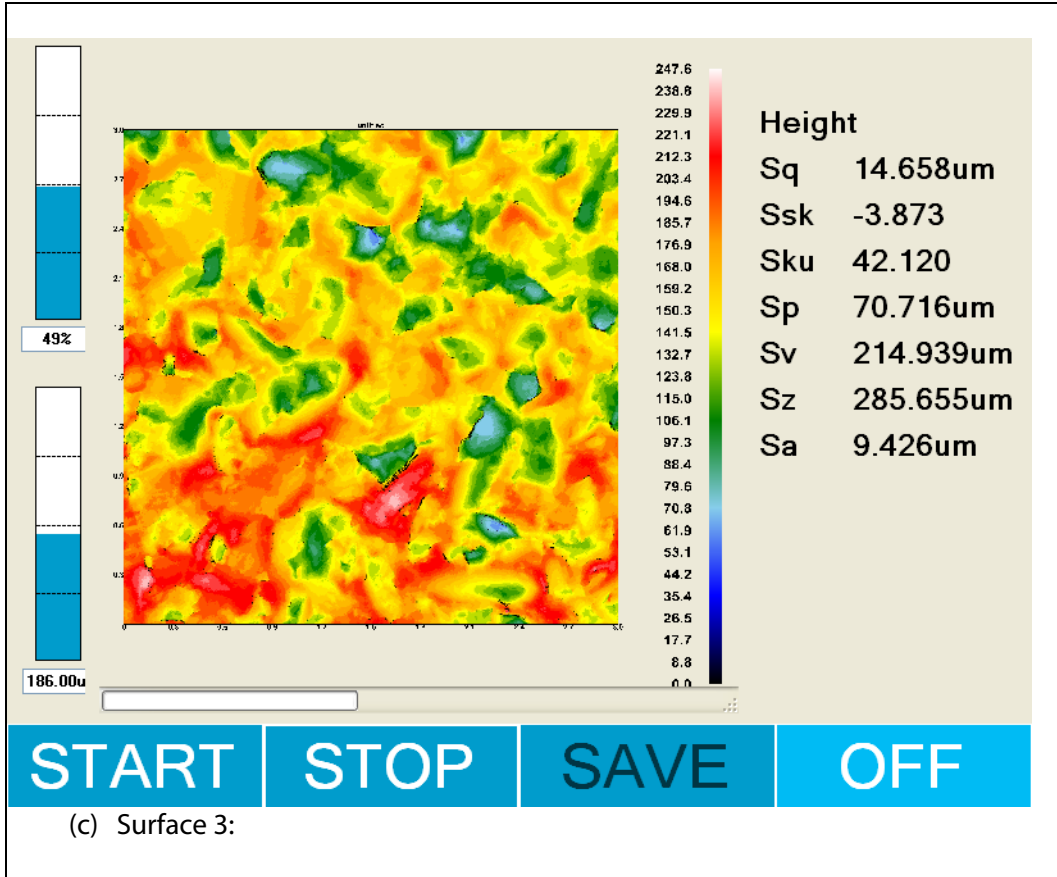


Fig. 3: Result screens of the tests on three sample surfaces.

CONCLUSION

In this study, we showcased the capacity of Nanovea P3 Profilometer in measuring 3D surface profile and roughness in an automated and reliable manner. It is designed to price in the \$20K market in order to bring high-end measurement technology to the broader market. The combination of competitive price and fully-automated high-precision measurement makes P3 system an ideal tool for Quality Control.

Nanovea P3 system provides fully automated 3D surface profile and roughness measurement while maintaining a competitive price in the range of \$20K. It makes high-end non-contact 3D profilometry technology available and affordable to the broader market such as smaller R&D units and quality control lines.

To learn more about [Nanovea P3 Profilometer](#) or [Lab Services](#).