

3D Tire Measurement

Executive Summary

Optimet's ConoProbe Mark10 and ConoScan 4000 platform were used in 3D tire measurement. Fast and accurate 3D and profile measurements of tires are used for different purposes, including wear inspection, general inspection, surface roughness, tire alignment and more. Such measurements need to overcome different conditions and constraints such as dark to bright surface colors, long stand-off between the sensor and the measured surface, automatic sensor adjustment to surface reflection and surface morphology, including steep surfaces, holes and grooves, while using an eye safe laser intensity.

Optimet's new Mark 10.0 sensor with new features can perform full and accurate geometry measurement of tires, including change of surface color, deep grooves and fine details. ConoProbe Mark 10.0 maintains the other unique features and capabilities of Optimet sensors, including high accuracy down to micron level, collinear / co-axial technology, capability of measuring steep surfaces, holes and grooves, interchangeable objective lenses, capability of using narrow periscopes and other relay optics, OPS system synchronization and more.

1. Optimet's Advantages over Other Technologies:

1. Collinear and co-axial technology, enabling measurements inside holes and tunnels
2. Sampling rate of up to 9000 Hz
3. Auto-exposure feature with real time adjustment for different surface colors and reflection levels (black, white, shiny, absorbent)
4. Special sensor module which increases the sensor sensitivity, so that the laser intensity used – even on dark materials and with long stand-off distances – is eye safe (<1Mw class II FDA)

2. Application Description

3D measurement on tire (figs.1-2) using the ConoProbe Mark10 sensor (fig.3) and ConoScan 4000 platform.

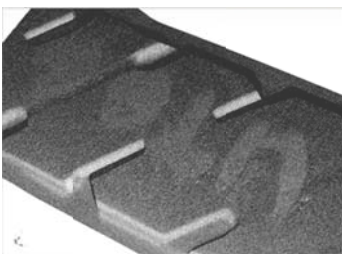


Figure 1 - Tire sample scan



Figure 2 - Tire



Figure 3 -
ConoProbe Mark10
Sensor



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2.1 Method

A tire sample with white marks was measured by ConoProbe Mark 10.0 with a 150 mm objective lens, at 9000 Hz (eye safe laser intensity) with the auto-exposure feature. All measurements were done with the same setup. Similar scans can also be done with shorter focal length objective lenses for high resolution and roughness measurements.

The scan tests described above were performed by Optimet's ConoScan 4000 3D Scanner.

Measurement setup can be seen in fig. 4.

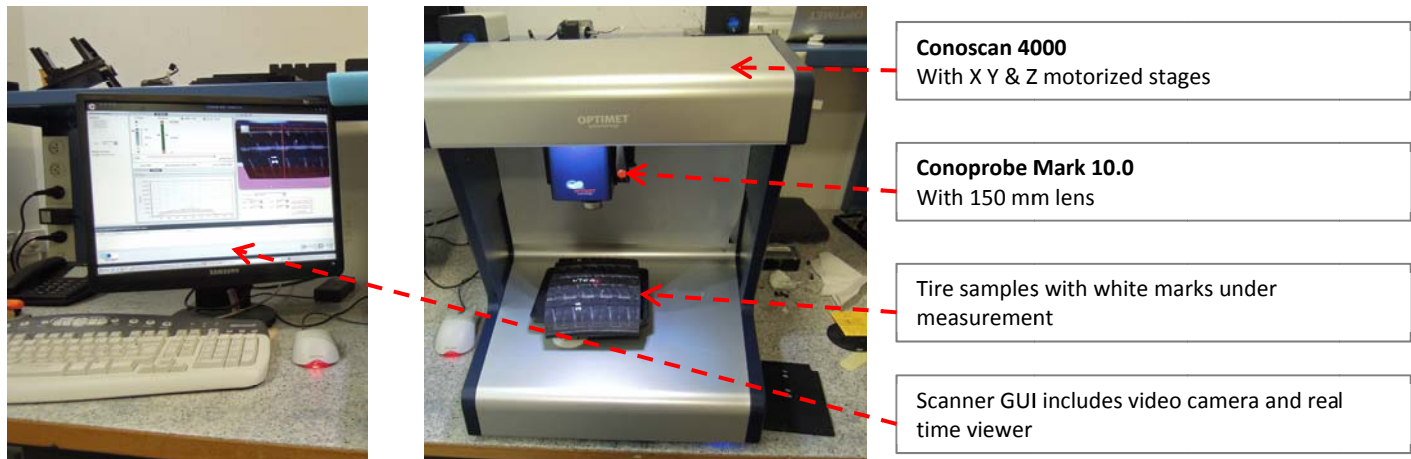


Figure 4 - Tire scan test setup - tire sample with white stains and deep grooves

Note: Measurements are performed with the ConoProbe Mark 10 which is a fast point sensor.

3. Results and Observations

Tire sample



Figure 5 - Tire sample



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Scan results (cloud of points) of the two regions (one with white marks)

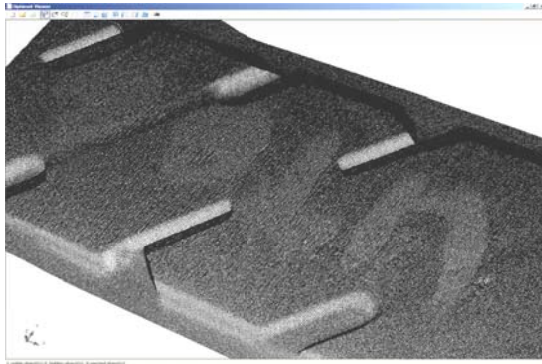


Figure 6 - Region A 3D scan

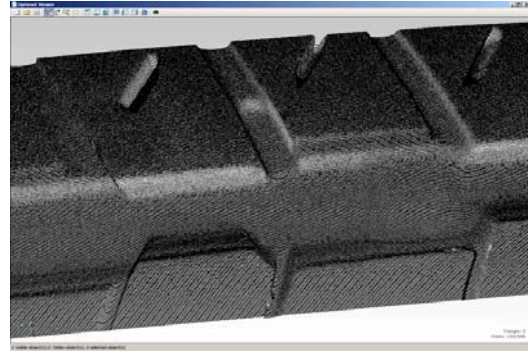


Figure 7 - Region B 3D scan



Figure 8 - Scanner GUI & Conoscopic signal on the measured sample

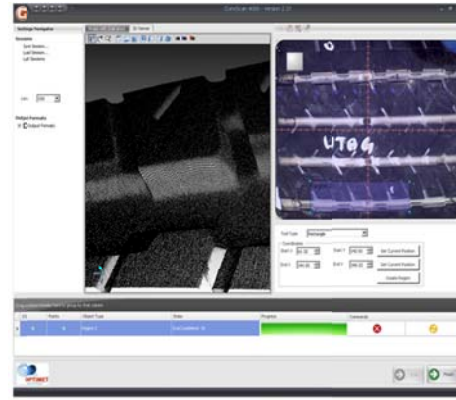


Figure 9 - Scan results on the Conoscan 4000 scanner GUI (a video snapshot on the right)

Cross Section Profiles

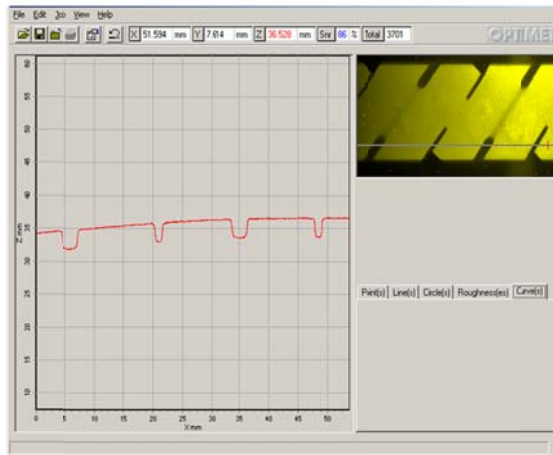


Figure 10 - Cross section profile on region A

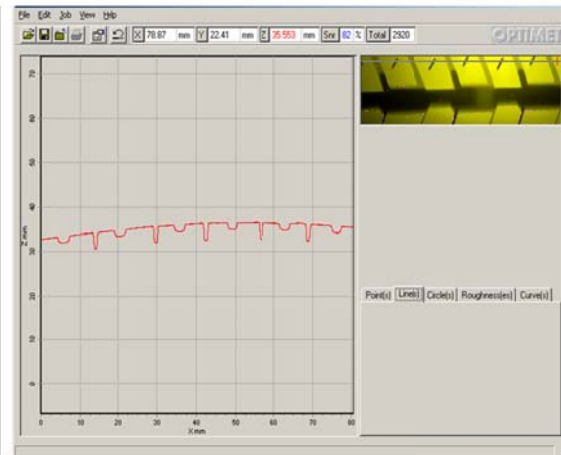


Figure 11 - Cross section profile on region B

Note - The cross section profiles are performed by Optimet analysis viewer and show the surface grooves.

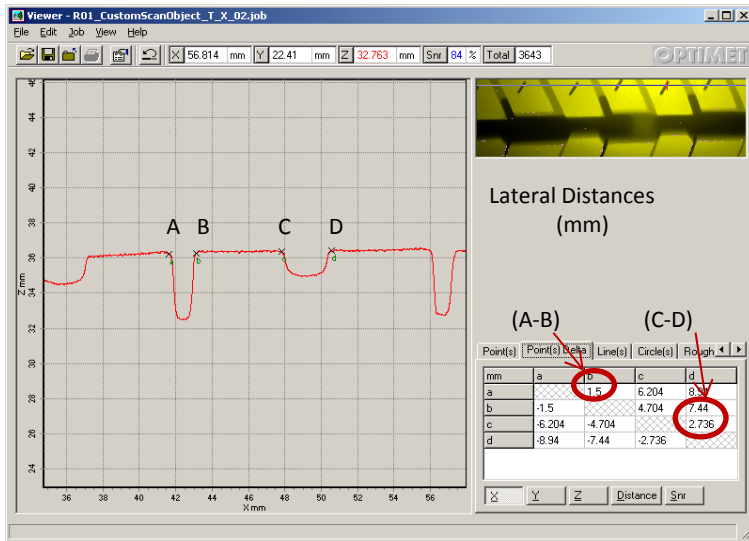


Figure 12 - Cross section profile on region B – lateral distances

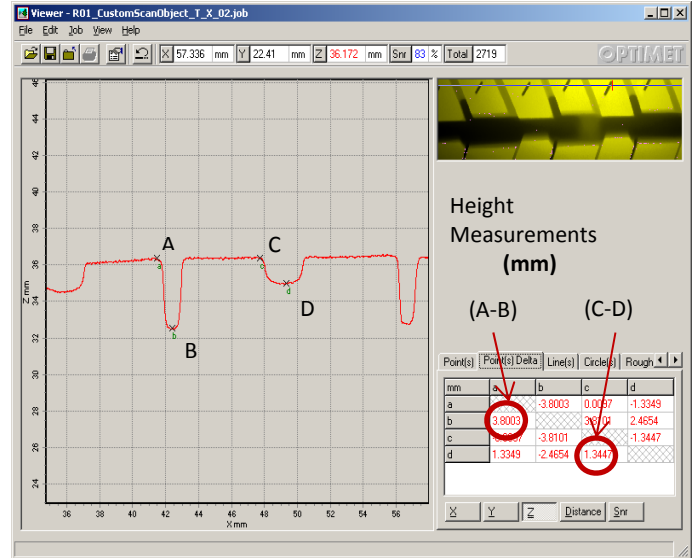


Figure 13 - Cross section profile on region B – height measurements

Note: All scans were performed in one setup and cover the different surface colors and morphologies.

4. Data

Parameter	Value
Reflective/Diffusive/Transparent/Translucent	Diffusive
Lens focal length(mm)	150
Working Range (mm)	70
Precision (μm)	25
Stand Off (mm)	145
Max. Data Rate (KHz)	9
Lateral Resolution	-
Z Resolution	-
Application Category	-

Note: the values specified in the table above depend on the lens chosen by the customer.