

Focus-Variation – for optical surface metrology

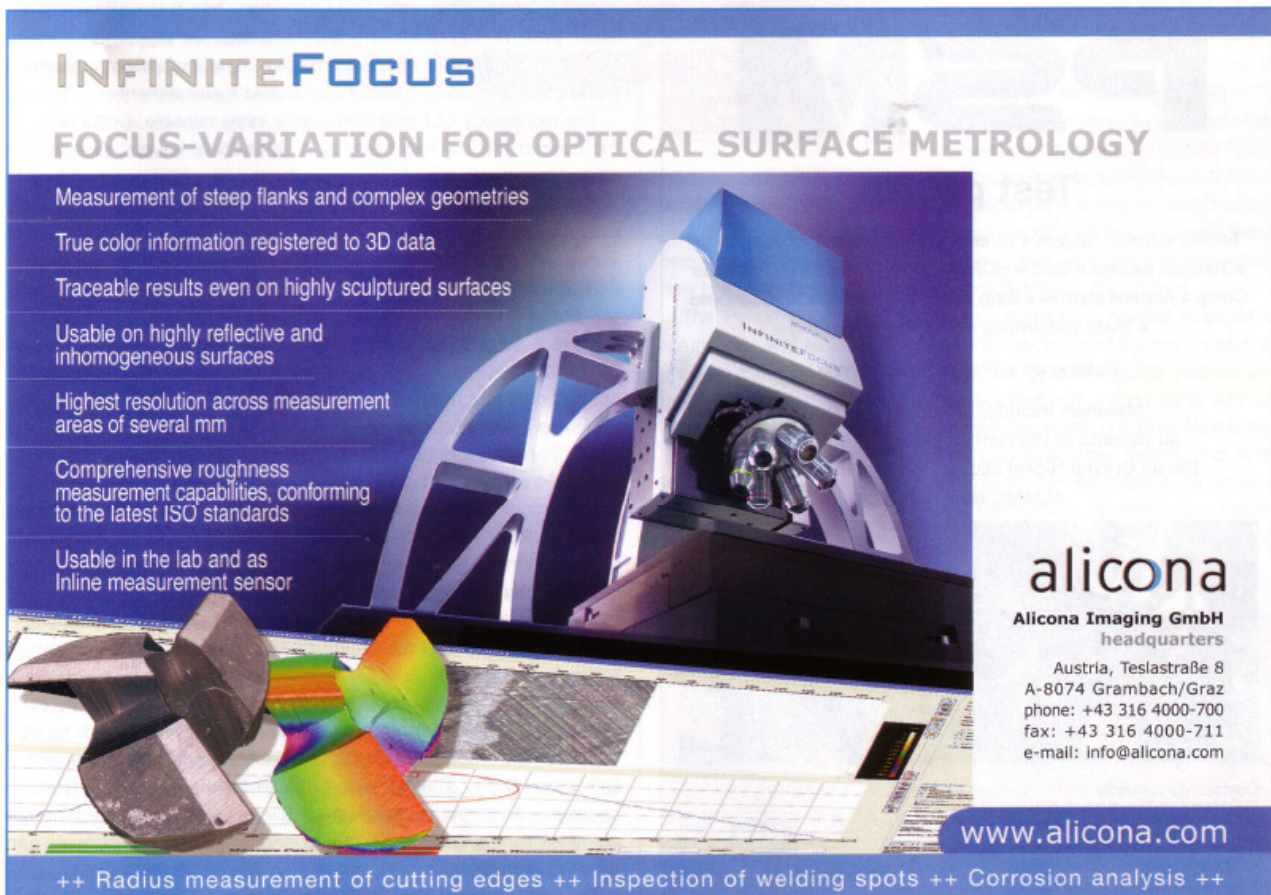
Optical surface measurement techniques are well established in research and industry, but do not offer robust 3D measurement of surfaces. Brian Kyte from Alicona UK Ltd, Kent, UK, describes the Focus-Variation technique for surface metrology.

The Focus-Variation technique from Alicona, Graz, Austria, forms the operating principle of the InfiniteFocus system, allowing advanced optical 3D metrology of surfaces including steep flanks and varying reflective properties down to a vertical resolution of 10nm. This optical technology provides detailed measurements over large areas with a density of 2-25 Mio measurement points. The technique works faster and more accurate than conventional methods, with the potential to measure over a high vertical scan range (up to 20mm) and x-y range (up to

100mm x 100mm), enabling robust measurement of relatively large components.

Robust measurement

The operating principle of Focus-Variation combines the small depth of field of an optical system with vertical scanning to provide topographical and colour information from the variation of focus. Depending on the topography of a surface, information from the variation of focus is analysed in relation to its distance to the optics.



INFINITEFOCUS

FOCUS-VARIATION FOR OPTICAL SURFACE METROLOGY

- Measurement of steep flanks and complex geometries
- True color information registered to 3D data
- Traceable results even on highly sculptured surfaces
- Usable on highly reflective and inhomogeneous surfaces
- Highest resolution across measurement areas of several mm
- Comprehensive roughness measurement capabilities, conforming to the latest ISO standards
- Usable in the lab and as inline measurement sensor

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Conventional optical measurement techniques only reach high vertical resolution with a small vertical scanning range, whereas the use of Focus-Variation yields a high vertical resolution over the entire scanning range, allowing a dynamic of 1:430,000.

This technology simultaneously captures the entire surface topographic information in combination with its true colour information. Additionally, a quality measure is determined for each measurement point.



A milled component

When operating the optical 3D measurement device InfiniteFocus, the specimen is placed onto the motorised stage and illuminated with modulated white light. The coaxial white light is provided by a light source delivered through a beam splitter to a series of selectable objectives contained in a six-place nosepiece. The specimen's reflected light is projected through the beam splitter onto a colour digital sensor.

The selection of both, vertical and lateral resolution can be realised through a simple change of objectives. The resulting image is similar to conventional light microscopy in a way that it shows limited depth of focus. As the distance between the object and objective is varied images are continuously captured. Each position in depth is differently imaged depending on the 3D structure of the specimen. For each position on the object sharpness is calculated. The variation of sharpness is now utilized for extracting depth information. A dense 3D surface representation of the object is obtained.

The operating principle, Focus-Variation, has been added to the latest draft of the upcoming ISO standard for classifying surface texture methods. ISO 25178 for the first time includes standardised parameters to classify optically area based measurements.

The technology of Focus-Variation is inline capable. Depending on the desired measurement task and application, several sensors are offered in order to provide Inline quality assurance.

The robust and compact design of the sensors also allows the operation in rough environments.

Applications

The Focus-Variation technique can be used for –

Surface Characterisation – unlike 2D analysis, this technique allows detailed characterisation of materials surfaces. In addition to conventional roughness (Ra) and profile (Pa) data it provides volume and area information, allowing studies of lubrication, porosity and wear that can be affected by detailed understanding of these parameters.

Evaluation of tolerances and wear analysis in 3D – the technique allows verification of data based on CAD models and the display and measurement of worn materials. This can be used effectively in tool making, wear on bearings and failure analysis.

Precision machining, milling and drilling, mould and tool making – this is particularly useful for surfaces with a large lateral and vertical range.

Accurate 3D measurement of micro-gear wheels – this is a typical industrial application that can be easily achieved by the measurement capabilities reached with focus-variation. Geometries with steep flanks of more than 80° can be measured accurately in seconds. Additionally, parameters such as the inner and outer diameter, flank angles and angles of angular-gear components can be computed.

For further information, visit: www.alicon.com.