OPTICAL 3D SURFACE METROLOGY

INFINITEFOCUS

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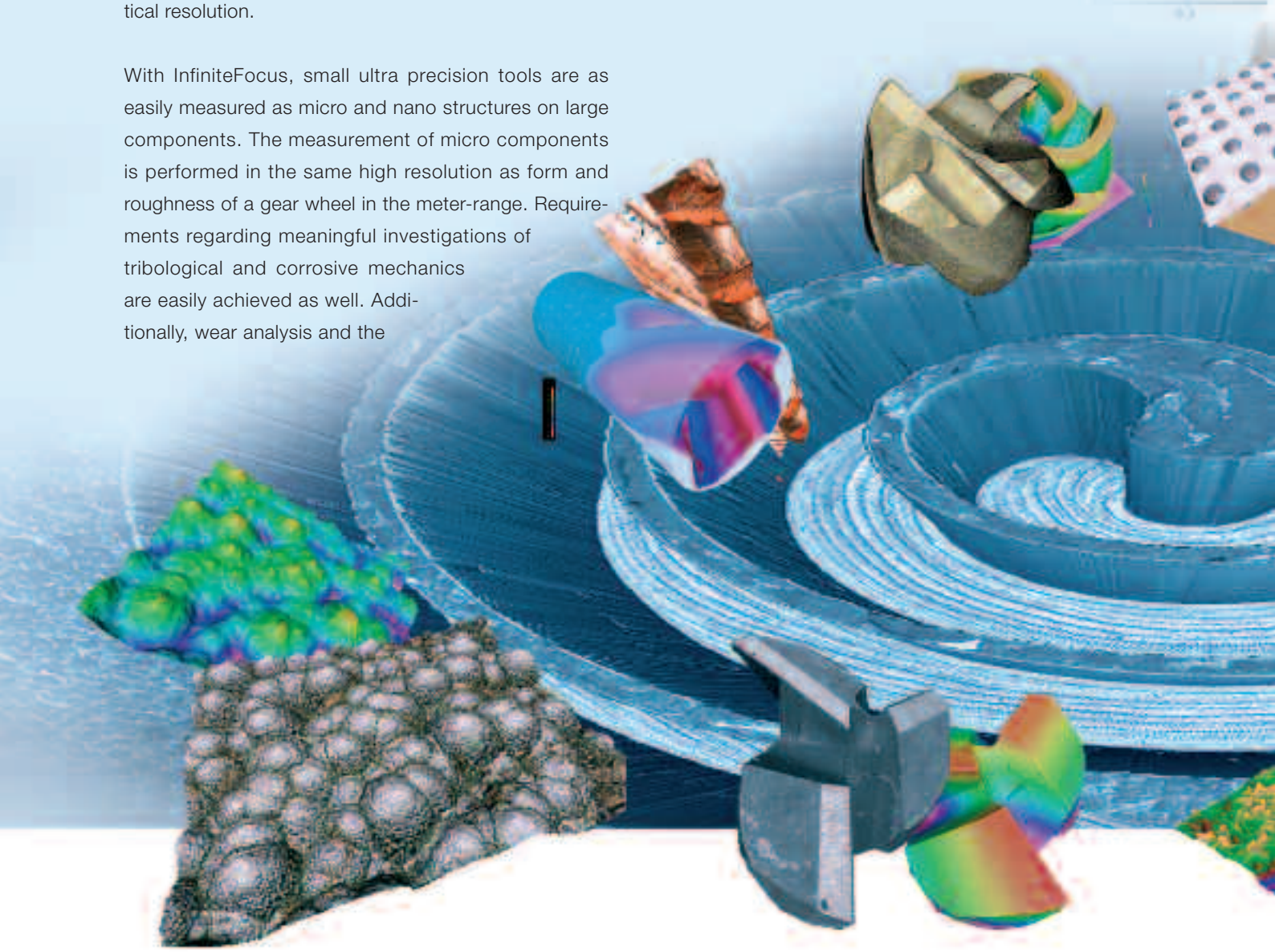
INFINITEFOCUS®

MEASURE FORM AND ROUGHNESS WITH ONE SYSTEM

InfiniteFocus is a high resolution optical 3D surface measurement device for quality assurance in the lab and in production. The system provides the functionalities of an optical profiler and a micro coordinate measurement device in one system. This allows the measurement of form and roughness plus a full range of surface characterization in a single measurement. A vertical resolution of up to 10 nm is achieved even on large vertical and lateral scanning areas. Complex forms of solid and compound material with varying reflection properties are measured in the same high vertical resolution.

With InfiniteFocus, small ultra precision tools are as easily measured as micro and nano structures on large components. The measurement of micro components is performed in the same high resolution as form and roughness of a gear wheel in the meter-range. Requirements regarding meaningful investigations of tribological and corrosive mechanics are easily achieved as well. Additionally, wear analysis and the measurement of form deviations to reference geometry or a CAD data set are other typical measures in industrial quality assurance that are provided by the system.

InfiniteFocus is based on of Focus-Variation. Its operating principle combines the small depth of focus of an optical system with vertical scanning to provide topographical and color information from the variation of focus.



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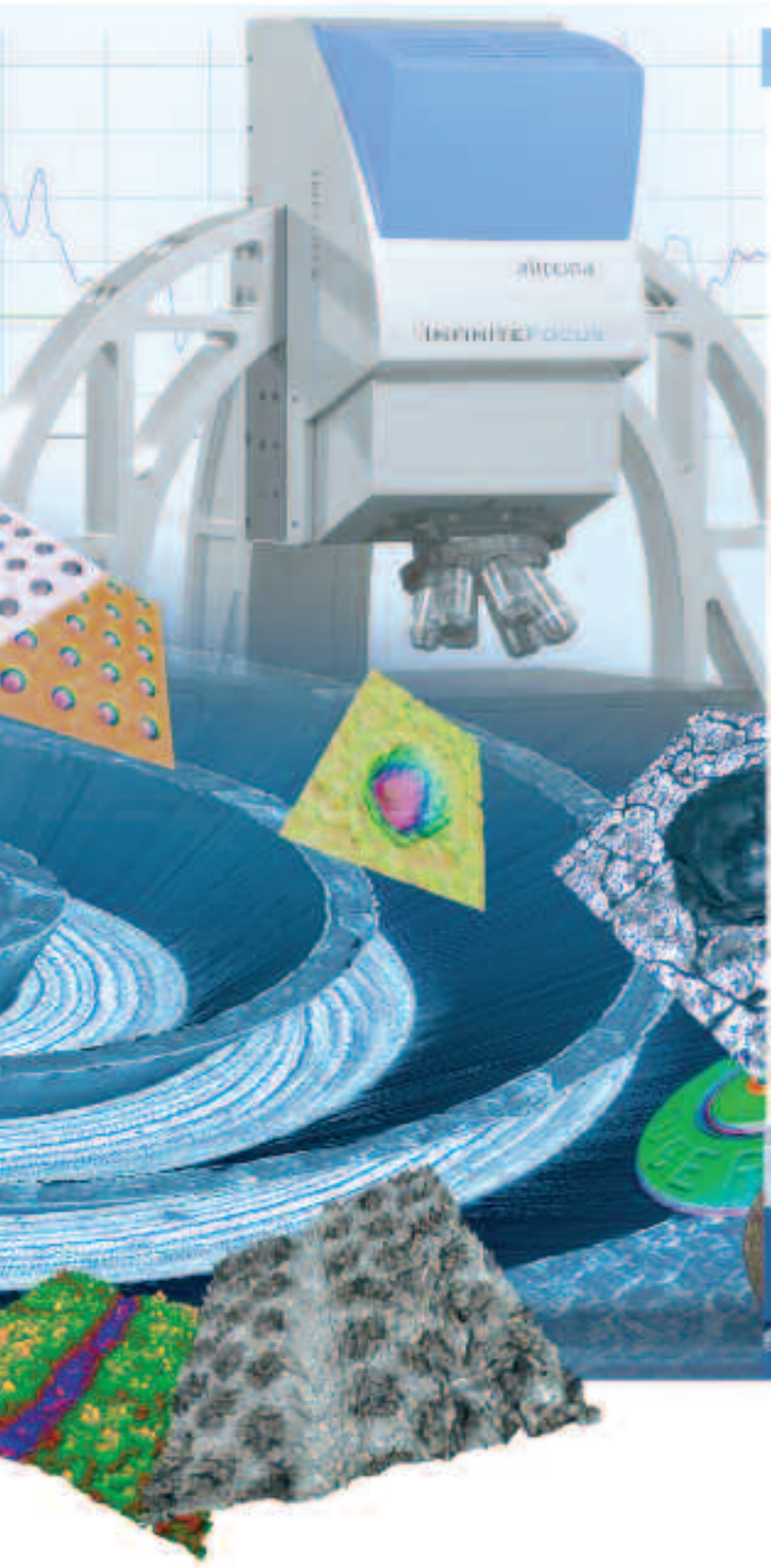
Profile



Who we are and what we offer

We are a supplier of high resolution optical 3D surface measurement for industrial quality assurance. Our key competence is the measurement of complex components showing various geometries and materials.

From the very beginning in 2001 we have made sure that optical 3D measurement achieves inline capacity. Our long term expertise and experience with special solutions in various manufacturing lines and our co-operation with a well established automation company qualifies us to implement 3D optical inline measurement, even in a rough production environment. This experience combined with our outstanding robust software enables us to meet your production requirements in terms of reliability, speed, and usability.

In addition to our Austrian headquarters in Graz, we have subsidiaries in Germany, the United Kingdom, North America, and Asia. Further expansions are planned to enhance our market position.

MORE EFFICIENCY VIA INCREASED FUNCTIONALITY AND EASE OF USE

Both form and roughness are critical to the overall quality and functionality of manufactured products. If either of these variables is out of tolerance the final product could fail.

For instance, a drill which has perfect radial clearance, but lacks chip flow due to incorrect roughness on the flute surface won't deliver perfect machining results.

An injection valve, to give another example, with smallest drilled holes, within dimensional tolerance, may still fail in use due to incorrect roughness.

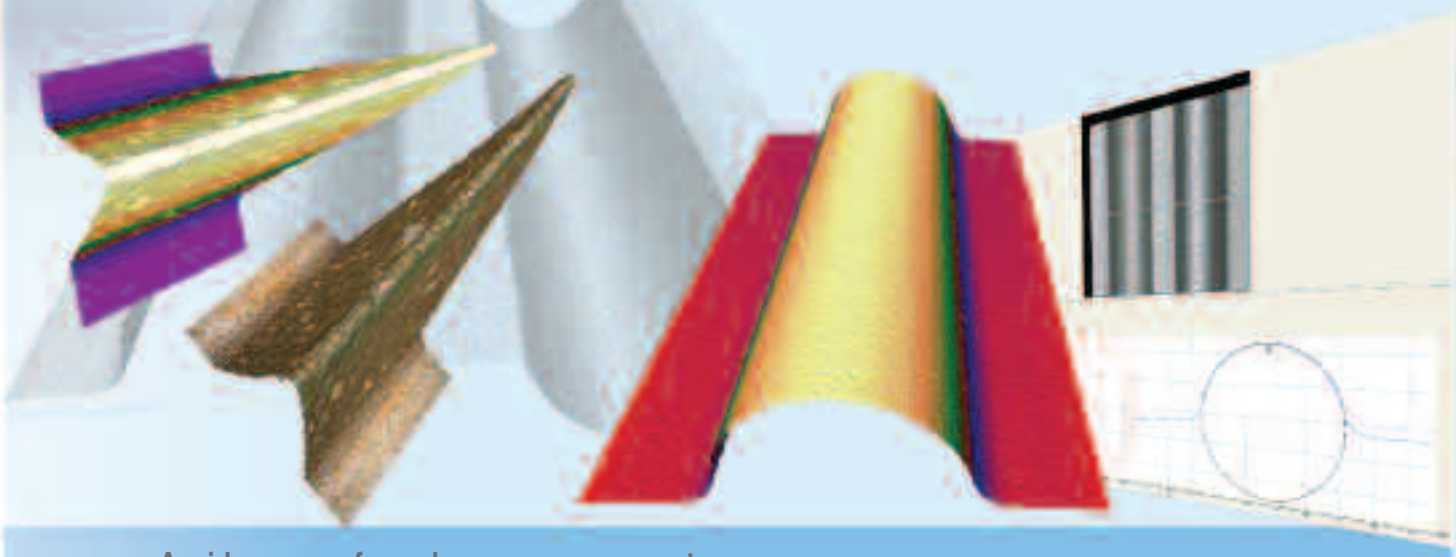
In the field of precision manufacturing there are many products where both the form and roughness have an equal effect on the performance. This has resulted in a drive within industry to achieve zero defect manufacturing which requires the measurement of form and texture.

InfiniteFocus provides this capability, in addition to many others, in a single easy-to-use instrument saving operator and instrument costs.

Complex forms – easy measurements

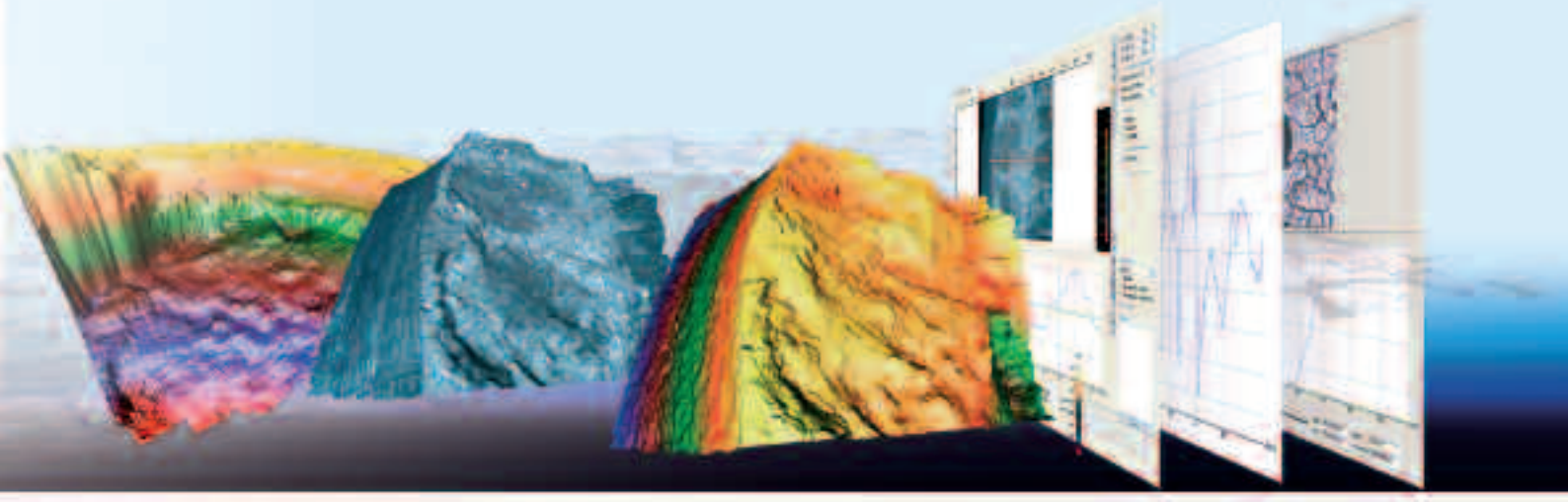
Complex forms – Steep sided flanks

Surfaces often contain steep flanks and vertical edges. These structures are difficult to measure using conventional optical methods. InfiniteFocus allows dense and robust measurements exceeding 80°. Features several millimetres deep are robustly and traceably measured. Results are able to be reproduced with a vertical resolution of up to 10nm. This turns InfiniteFocus into an essential measurement tool to quantify parameters of surfaces.



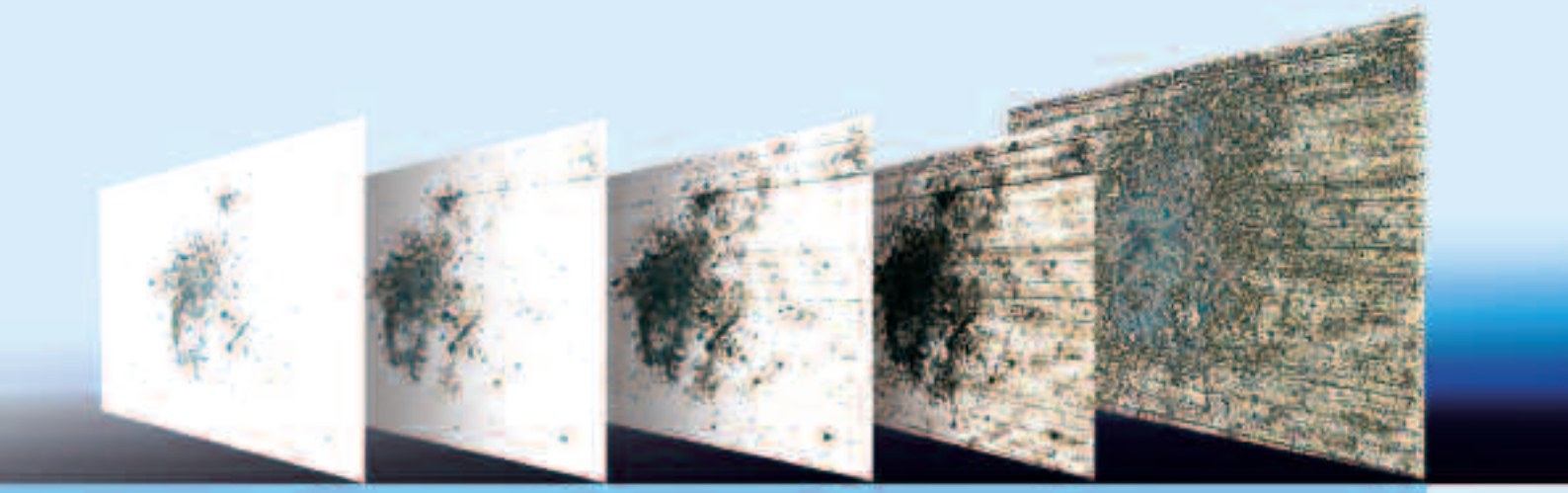
A wide range of roughness measurements

With measureable roughness from nm to µm, InfiniteFocus allows a wide spectrum of possible applications from the very rough to the very smooth. Roughness, waviness and contour measurements conform to ISO, DIN and CEN standards.
Unlike conventional optical measurement techniques InfiniteFocus achieves high resolution measurements even on surfaces with varying reflection properties. Another major benefit is that the system is non-contact. This means that no surface damage is possible and that the measurement results are far less error prone.



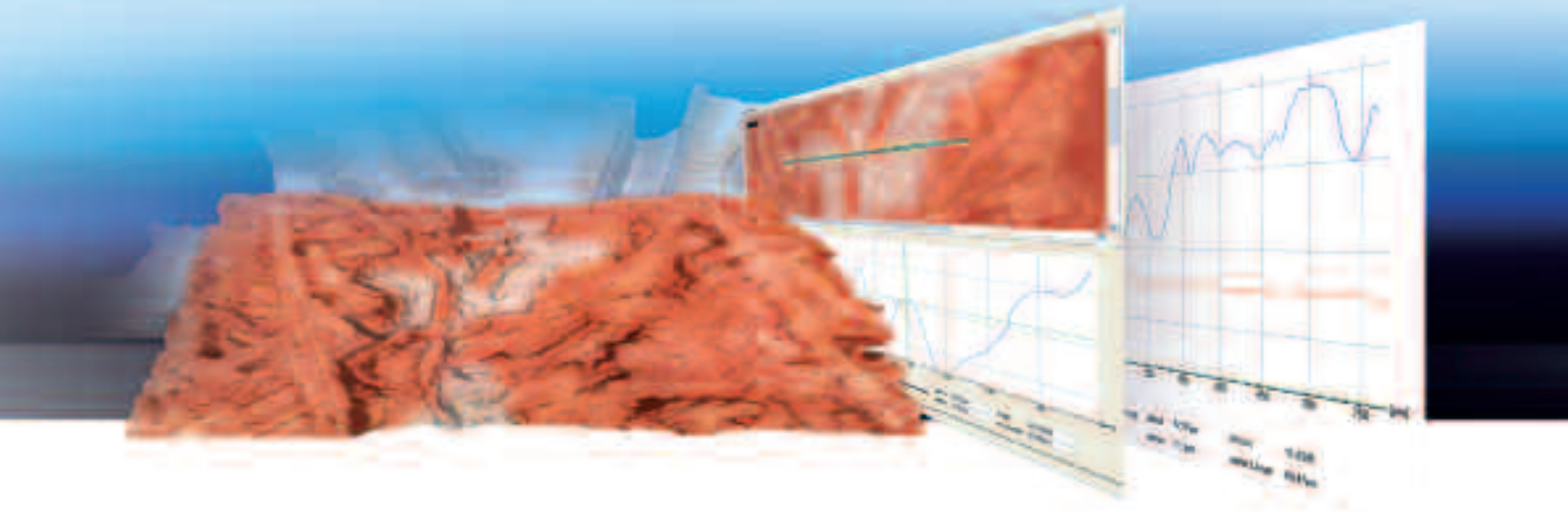
Varying and complex reflection properties

Ground or rough, matt or glossy, reflective or diffuse - regardless of surface properties and possible combinations, InfiniteFocus always achieves high resolution measurements.
The patented SmartFlash® technology ensures that the software adjusts to the reflective surface. This is especially important in industries using compound materials.



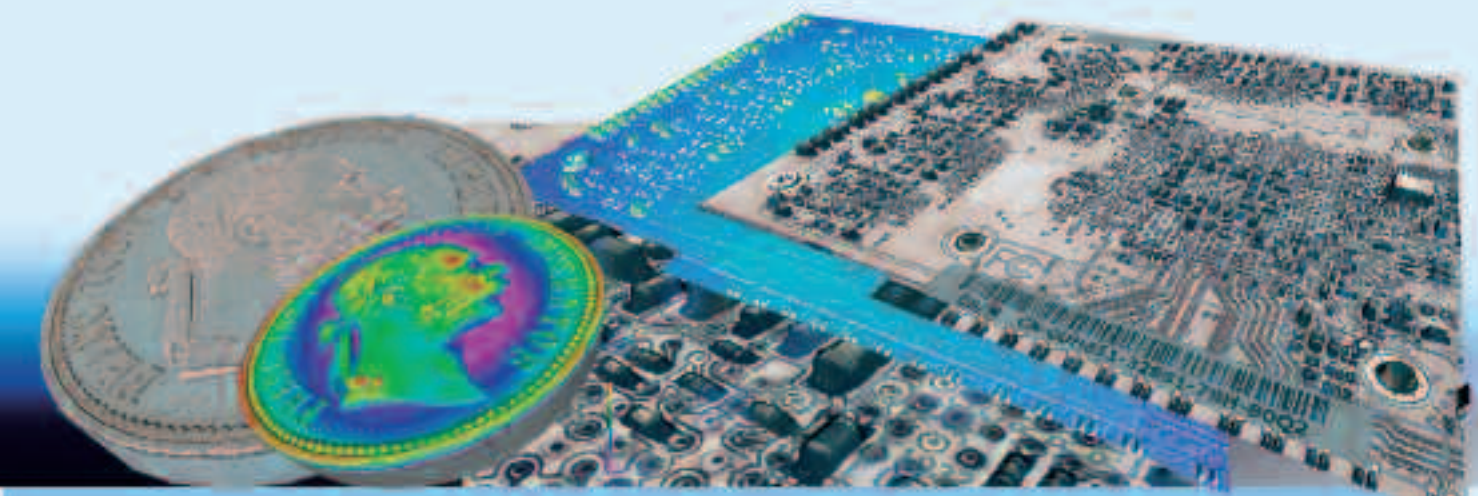
Registered true color information

InfiniteFocus is the only 3D measurement device that simultaneously captures the surface topographic information with its true colour information. Both the topographic and color data are registered to the 3D data set. This visual correlation between the color optical image and 3D data provides invaluable information for many applications. One example is the paper industry where the true color enables precise location of faulty print. Also, when used in corrosion studies, surface defects can be quickly and readily identified.



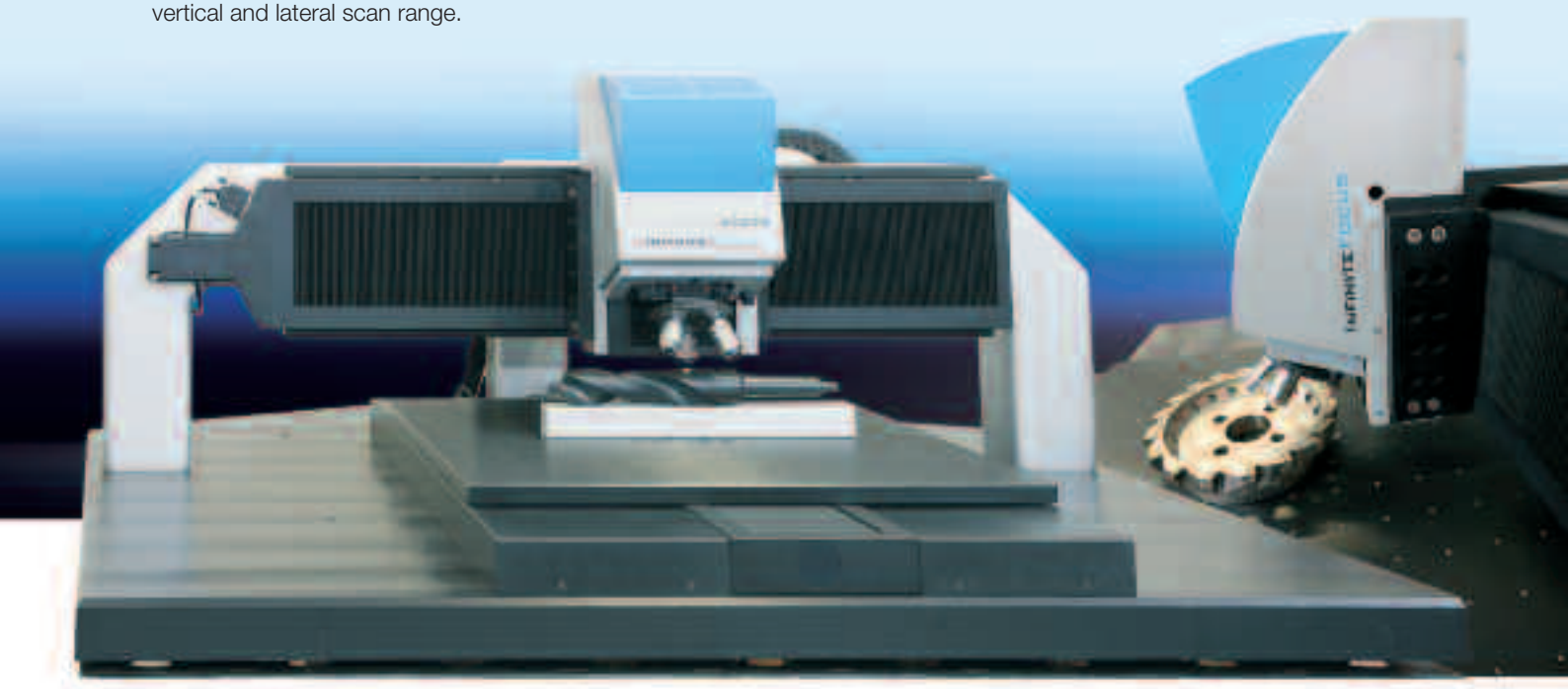
The measurements of large geometries

InfiniteFocus provides a vertical resolution of up to 10nm even at scan heights up to several mm and a measurement field of up to 10 x 10cm. Each measurement produces 100 Mio measurement points guaranteeing high resolution measurement across large vertical and lateral scan ranges and easy usability at a high working distance.



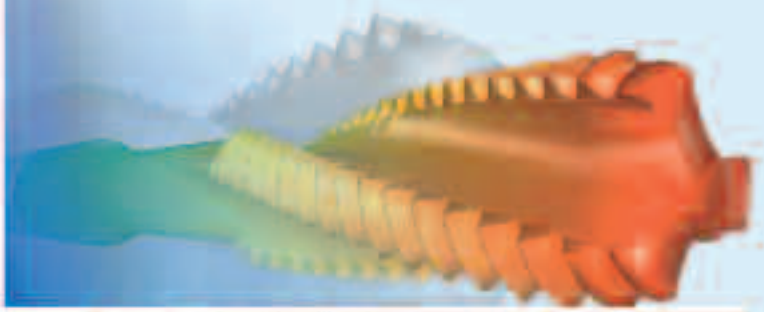
The measurement of geometries larger 10cm x 10cm

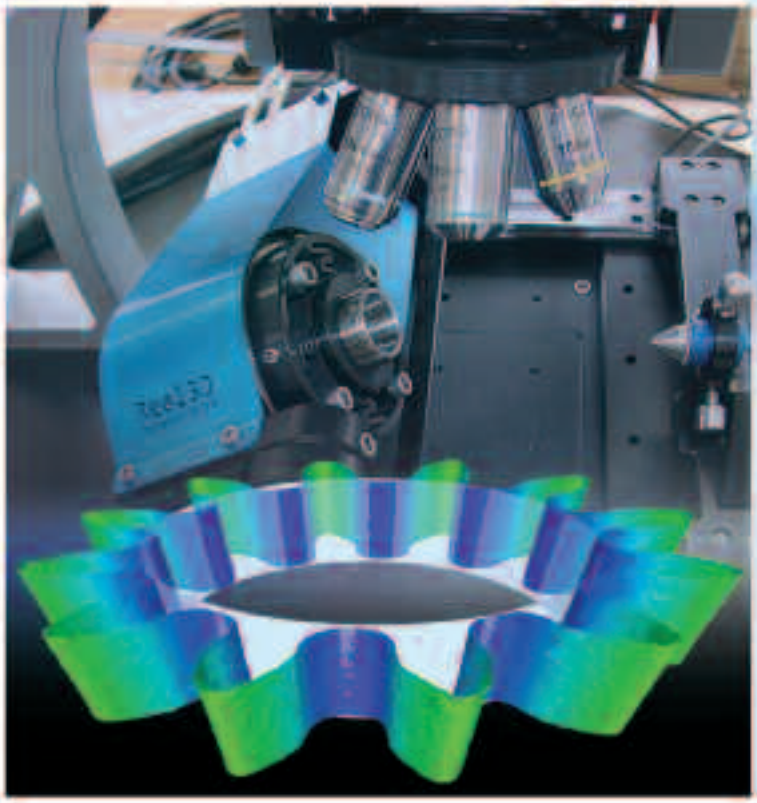
Special measurement tasks demand special solutions. This is why we also provide special solutions to offer quality assurance for larger geometries with extended travel ranges or scan heights. Again, the high vertical resolution is given across the entire vertical and lateral scan range.



HIGH SURFACE FINISH AND DIMENSIONAL ACCURACY VIA 360° MEASUREMENT

There are about 60 surface parameters with small tolerances that determine durability, speed and machining results of drills, mills and other cutting tools.
To perform full form measurement it is essential to measure the form of tools and micro precision components as a whole. This is achieved with InfiniteFocus Real3D. The component is rotated by 360° which enables the measurement of various crucial parameters.

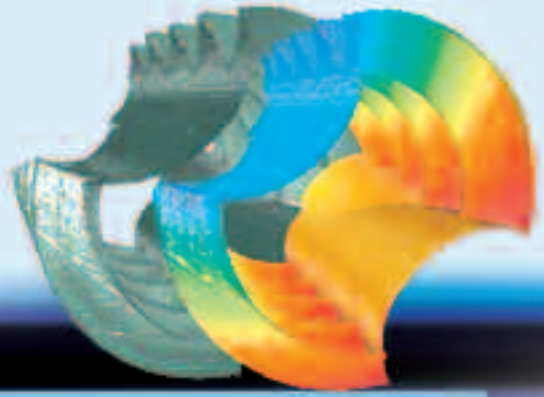




Full form and roughness measurement

360° measurement of micro precision components

InfiniteFocus Real3D provides the full form measurement of both simple geometric shapes and complex forms from a different perspective. Using Real3D it is possible to measure roundness, radii, angles, and roughness exactly where it is needed. From a single measurement a full 3D data set is obtained, providing the full form of precision tools such as drills and injection valves, micro gear wheels, casting molds, spherical calottes, micro forming tools etc. This feature makes InfiniteFocus the most advanced measurement system in its league.



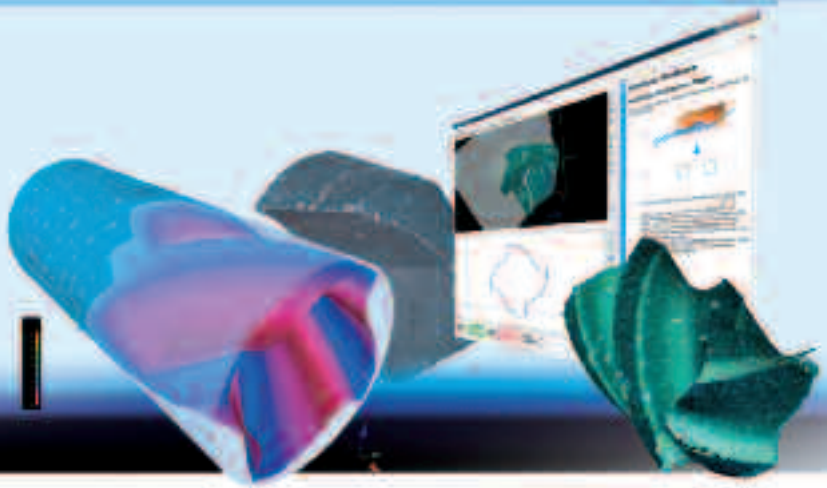
Full form measurement of drills, mills and tap tools via contour measurement

Using the contour measurement module it is easily possible to measure chamfers, threads, cutting edges, and flutes. On the full color data set simply extract a path to define the measurement position and profile data is displayed. The measurement of the form is performed via fitting of circles, angles, and lines enabling the numerical verification of additional crucial parameters such as radial clearance, radius or tap major diameter.

Benefits of 360° measurement

Perform full form measurement and

- increase durability
- optimize machining results
- raise surface finish
- assure fitting accuracy
- boost process stability



COME CLOSER TO ZERO-DEFECT MANUFACTURING

Smallest geometries and narrow tolerances ask for high resolution measurements, also in production.
However, different manufacturing environments are subject to specific conditions requiring individual solutions. The InfiniteFocus modular sensor concept enables 3D measurement in production in various configurations.
Depending on the application the sensor can be mounted directly in the production line or on a robot to access difficult positions on a large object. Also, when necessary, we develop and produce tailor-made solutions for specific purposes.
Irrespective of the configuration chosen, InfiniteFocus provides repeatable, traceable high resolution measurements, including variable and integrated automation options.

A modular sensor concept for flexible measurements in production

The InfiniteFocus sensor in production

The core of InfiniteFocus-Inline is the robust sensor, an enclosed unit comprising all the mechanics of the 3D measurement device. This unit has a high vertical scan speed providing a high clock rate and consequently a broad spectrum of applications. This one sensor provides all the functionalities of an optical profiler and a micro coordinate measurement device. With high temperature stability and good vibration resistance, InfiniteFocus is an ideal tool for the most demanding production environment.

Measure form, position and roughness

The InfiniteFocus sensor is used for integrated production quality assurance of micro to macro components. Typical applications are form and roughness measurements as well as damage analysis of e.g engine blocks or aircraft turbines and the quality assurance of wind power stations. In precision manufacturing applications the sensor can be used for positional measurement and alignment compared to a CAD data set. This provides assurance on subsequent micromachining processes such laser drillings with small tolerances. Variance analysis, form deviation and the analysis of corrosive mechanics are further typical applications in many sectors of industry.

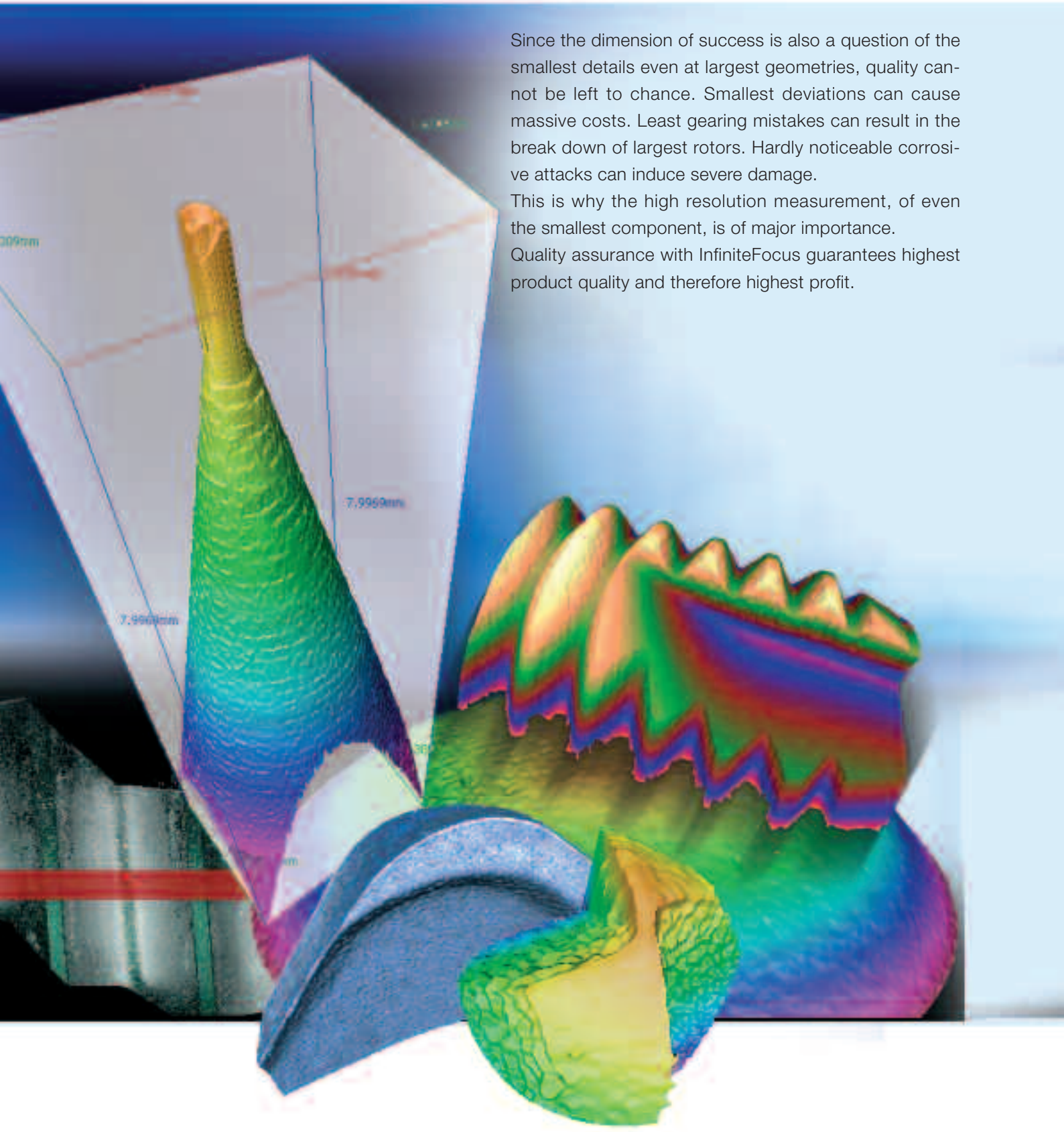
Pin-point positioning with InfiniteFocus^{Robot}

The InfiniteFocus sensor can be mounted on a robot combining the flexibility of a 6-Axis robot with the measurement capability of the sensor. This provides the ability to perform form and surface measurements at defined positions on large products.

Automate periodic measurement tasks

Whether the sensor is mounted directly in the assembly line or used as a robot based option, periodic measurement tasks can be fully automated. Cracks, fractures or corrosive spots will be detected, measured, and numerically quantified.

HIGHEST QUALITY FOR HIGHEST PROFIT

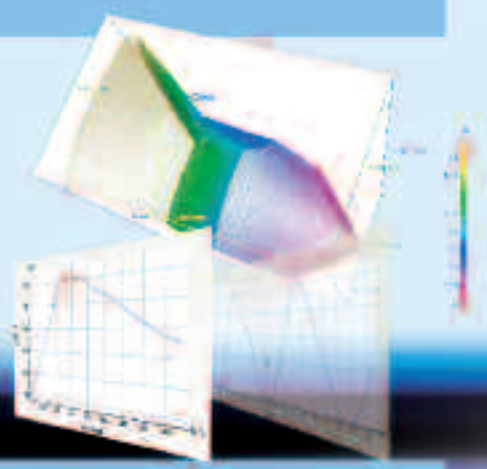


Since the dimension of success is also a question of the smallest details even at largest geometries, quality cannot be left to chance. Smallest deviations can cause massive costs. Least gearing mistakes can result in the break down of largest rotors. Hardly noticeable corrosive attacks can induce severe damage.
This is why the high resolution measurement, of even the smallest component, is of major importance.
Quality assurance with InfiniteFocus guarantees highest product quality and therefore highest profit.

Ultra precision manufacturing

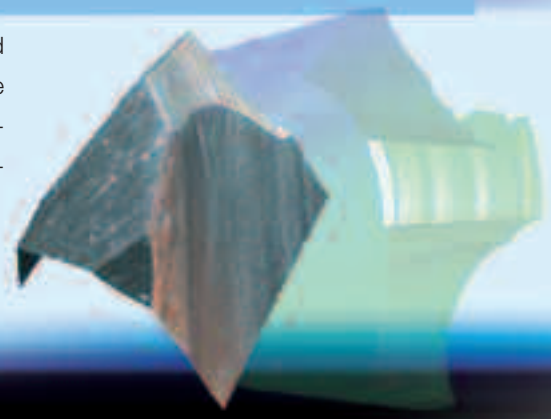
Keep in shape to keep tolerances

InfiniteFocus assures the abidance of smallest, specified tolerances. Radii are measured down to 2 µm. In addition, roughness measurements can be made at any position on the tool.
Cutting tool designers optimise tool performance by varying geometry, surface finish, and material. InfiniteFocus provides accurate measurement data of both geometry and surface finish allowing the designers to change parameters to improve performance. Cutting tool users mainly measure wear to optimise tool change periods.



Measure roughness from fine ground up to polished work pieces

During the different stages of production, cutting tools such as drills, mills and taps show different reflection properties due to the surface characteristics at the respective time of the process. InfiniteFocus provides high resolution measurements irrespective of the surface finish and its corresponding reflection properties.



A multi-functional measurement device provides efficient quality assurance

Real3D, an additional, optional unit for InfiniteFocus, makes a 360° form measurement possible for measuring further geometries such as radial clearance, radius, or tap major diameter.

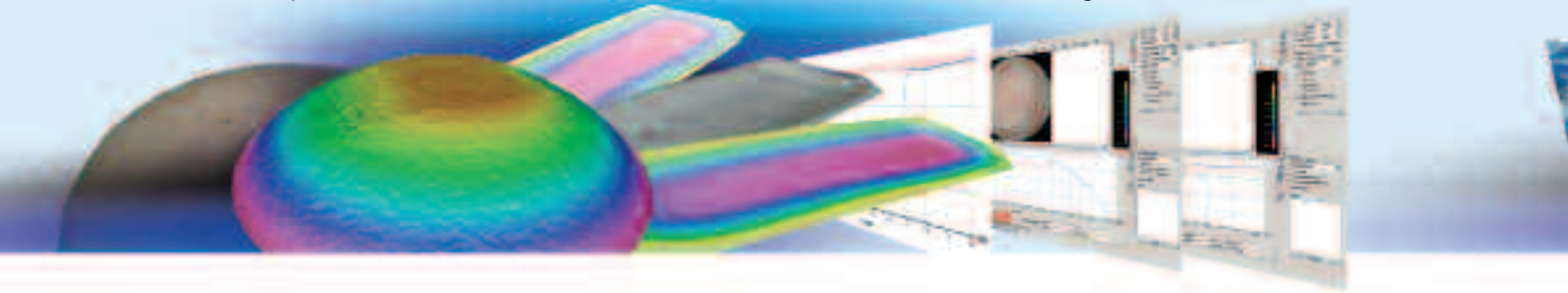
Tribology and Corrosion

Moving surfaces

Understanding tribological processes such as friction and wear analysis is essential for the optimization of many mechanical operations.
In contrast to conventional methods, which are based on the analysis of 2D data, InfiniteFocus provides numerical quantification and detailed 3D surface characterization.
For instance, in wear analysis the optical system allows easy and reliable abrasion measurement of thin coat. Depth and thickness of the coat as well as the true wear volume of artificial wear craters are measured.

Understanding of corrosive mechanics

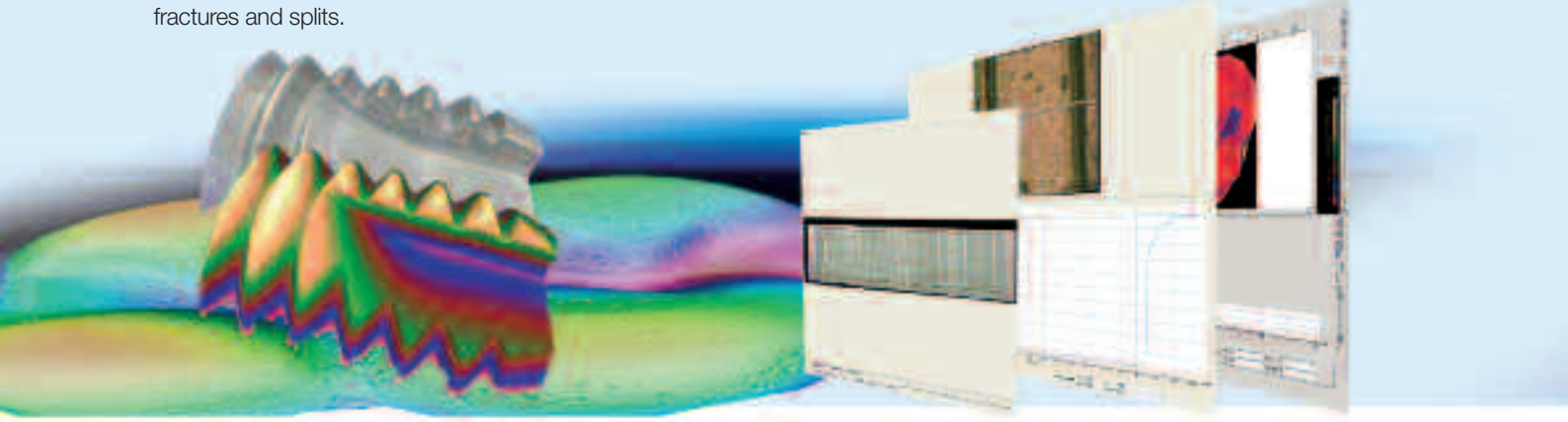
Amongst others, InfiniteFocus determines oxidation, distribution, and behaviour of corrosion. The optical system detects and measures material damage such as cracks and holes even on bar components. The optional rotation unit Real3D makes a 360° measurement possible which allows the numerical verification of each detected corrosive damage feature.



Pharmaceutics and medical device development

Quality enhancement in dentistry, surgery, and implant technology

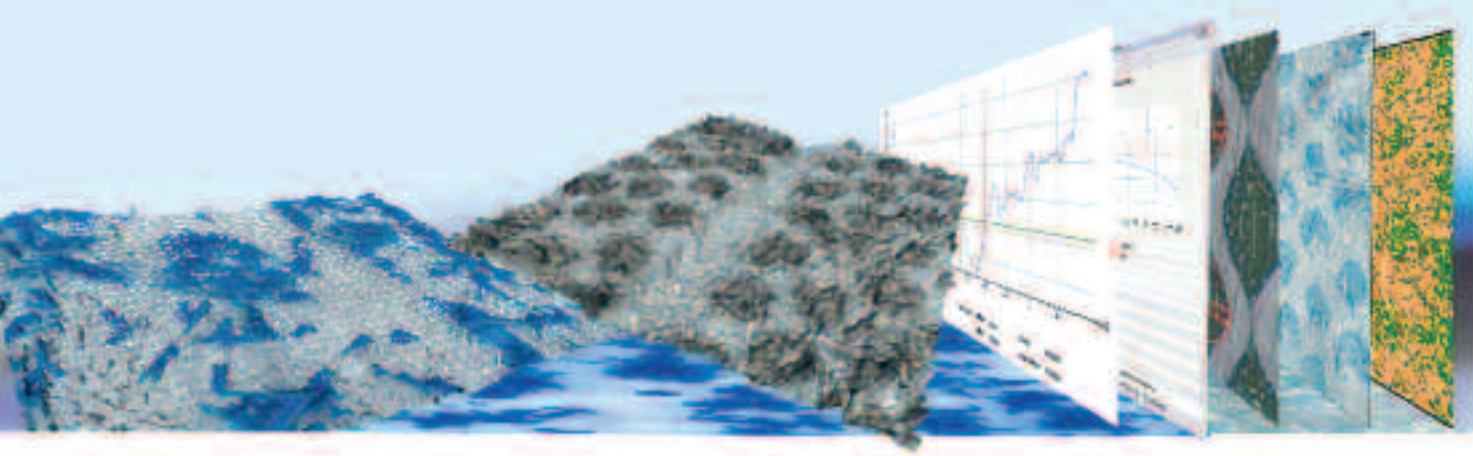
The roughness of an implant thread is crucial as it is responsible for the proper adherence of the implant to the jaw bone. InfiniteFocus measures and controls the artificial roughening of the implant. In addition, the complex and multiply curved implant geometry is compared to the respective reference geometry.
Furthermore, manufacturers of surgical instruments benefit from the measurement of cutting edges as its results help to prevent fractures and splits.



Paper and Print

Direct surface measurement in paper industry

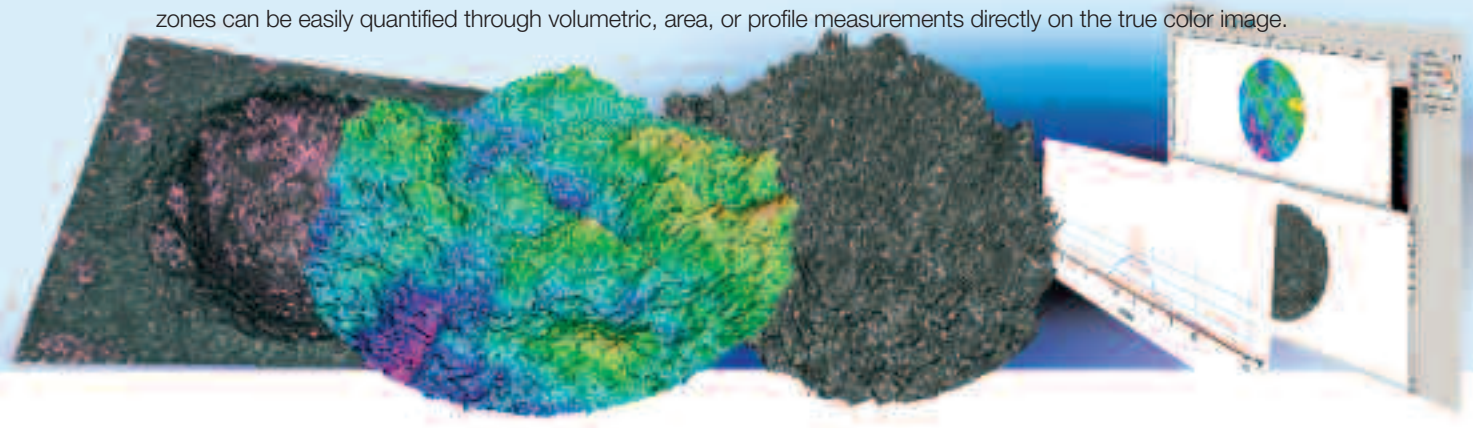
The papers' topography is one of the most important parameters and a deciding factor regarding its printability. As it is with surface parameters such as height and depth, the smoothness of the paper is decisive for a high quality print image. Conventional measurement techniques such as PPS or Bendtsen are indirect methods without any numerical information about the real surface state. InfiniteFocus is not only a direct surface measurement tool, but it also captures the entire surface topographic information registered with its true color information. So, direct correlation to its printability is provided. Various applications such as studies of poor print images showing e.g. missing dots or the evaluation of processes to increase smoothness are easily performed.



Materials Science & Failure Analysis

A breakthrough in fracture analysis

Conventional microscopy inspects the surface optically with light microscopes and is limited by the microscope's depth of focus. Quantitative surface information must be obtained by a separate 2D or 3D surface analysis instrument. Since specimens in material development often contain fractured surfaces with steep flanks or rough surface topography, InfiniteFocus offers a unique solution to document the entire surface. The analysis of the optical appearance of the surface coupled with the topographic data is directly correlated to the 3D measurement. Fatigue fracture analysis and material deformation at ductile fracture zones can be easily quantified through volumetric, area, or profile measurements directly on the true color image.



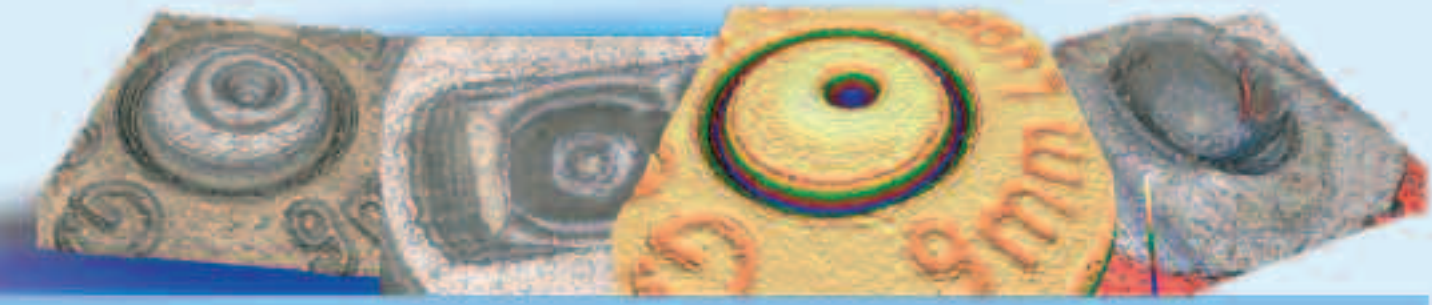
Forensics

Securing evidence

Whether it is counterfeiting money, falsifying documents, paintings or pharmaceutical tablets, a gun crime or a bank robbery – criminals generally do leave traces. As part of the criminal investigation process InfiniteFocus plays a major role due to its ability to provide 3D surface measurement.

In counterfeiting money or falsifying paintings, small differences in height can often identify fakes from originals. Counterfeits in pharmaceuticals can be identified by height and volume variations of imprints or logos. In fire arm cases the imprints made by the bullet casings can be compared and matched.

The 3D capabilities of InfiniteFocus allow these measurements to be performed easily and with quantification.



Emerging Markets

Improve efficiency of wind power stations

Unforeseen gear break-downs of wind power stations can often be traced back to faulty gearing or defect rolling bearings. InfiniteFocus measures the components that keep wind power stations running in order to prevent interferences and break-downs. 3D measurement with InfiniteFocus guarantees leak-tightness and verifies surface finish processes. As a result wear is reduced and optimal tribological conditions are secured. Furthermore, the optical profiler makes sure that form is kept within given tolerances and that all requirements regarding surface finish of gears are met.

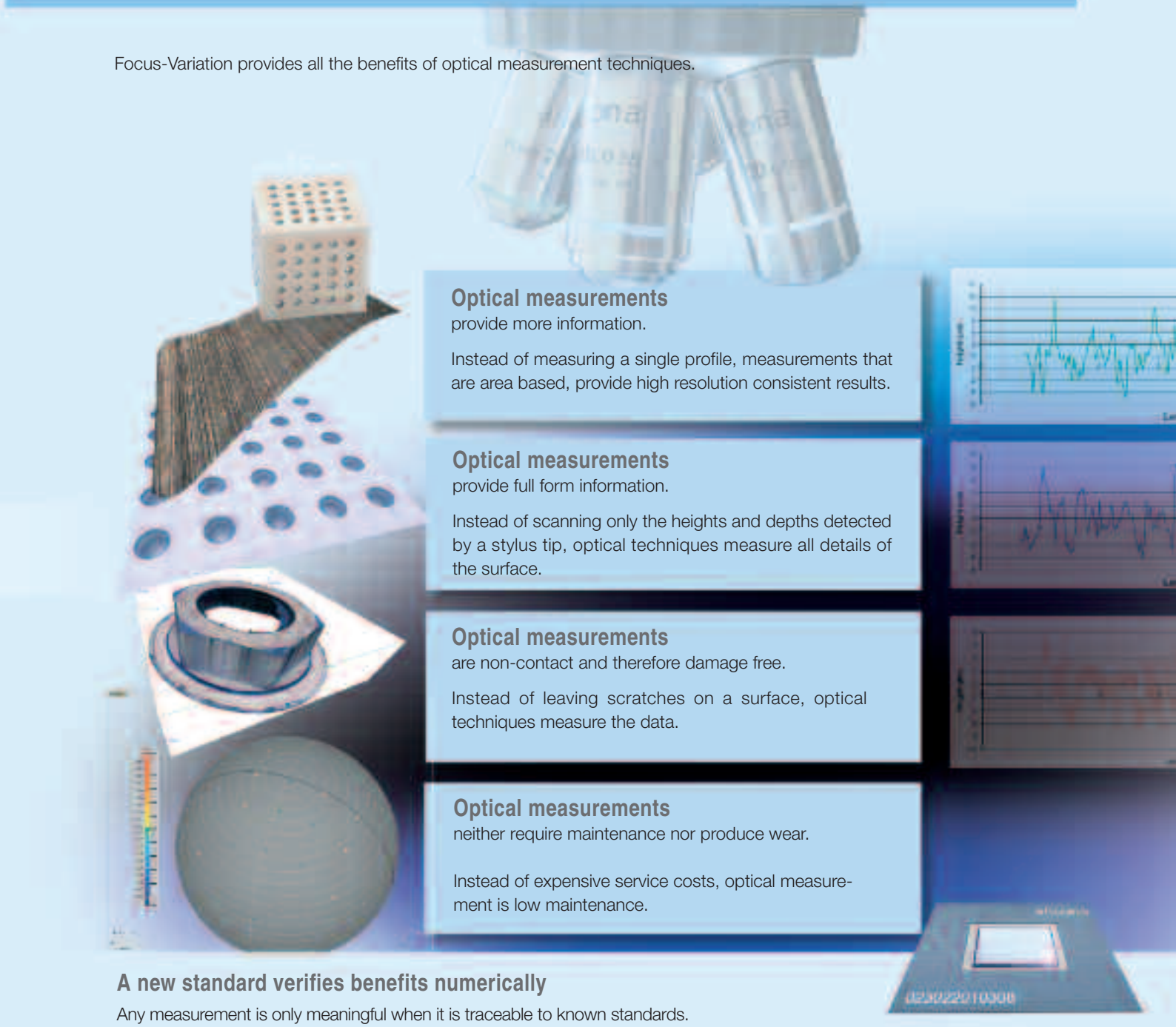
As far as the efficiency of power generation is concerned, the surface roughness of the rotor blade is of major importance. Specific micro structure features of only a few µm, called riblets and either applied by laser or attached via foil, can reduce air resistance and thereby create efficiency as the overall aerodynamic characteristics of a wind power station are improved.

Since an exact geometry demands exact measurement, InfiniteFocus is a most valuable tool when it comes to performing a meaningful form and roughness measurement of the blades.

Focus-Variation does not scratch the surface. It reveals the smallest details.

Higher resolution and higher accuracy measurement in shorter measurement times

Focus-Variation provides all the benefits of optical measurement techniques.



Optical measurements
provide more information.

Instead of measuring a single profile, measurements that are area based, provide high resolution consistent results.

Optical measurements
provide full form information.

Instead of scanning only the heights and depths detected by a stylus tip, optical techniques measure all details of the surface.

Optical measurements
are non-contact and therefore damage free.

Instead of leaving scratches on a surface, optical techniques measure the data.

Optical measurements
neither require maintenance nor produce wear.

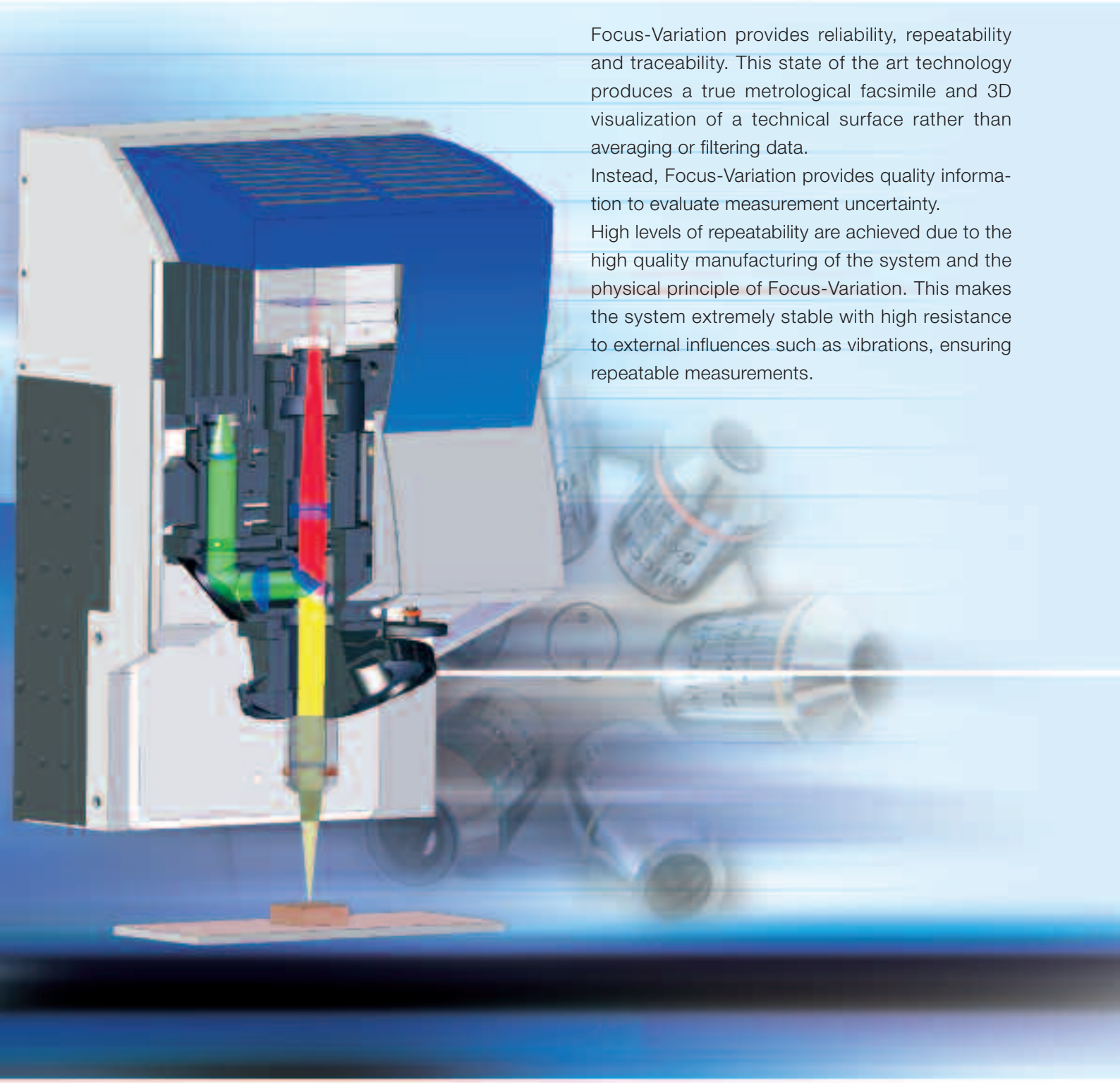
Instead of expensive service costs, optical measurement is low maintenance.

A new standard verifies benefits numerically

Any measurement is only meaningful when it is traceable to known standards.

Both form and roughness measurements obtained with Focus-Variation can be verified to traceable standards. The new roughness standard allows verification of data between optical and tactile techniques. Complex form geometries can also be verified with a separate form traceable standard.

PERFORMING 3D MEASUREMENTS WITHOUT THE NEED TO AVERAGE RESULTS



Focus-Variation provides reliability, repeatability and traceability. This state of the art technology produces a true metrological facsimile and 3D visualization of a technical surface rather than averaging or filtering data.

Instead, Focus-Variation provides quality information to evaluate measurement uncertainty.

High levels of repeatability are achieved due to the high quality manufacturing of the system and the physical principle of Focus-Variation. This makes the system extremely stable with high resistance to external influences such as vibrations, ensuring repeatable measurements.

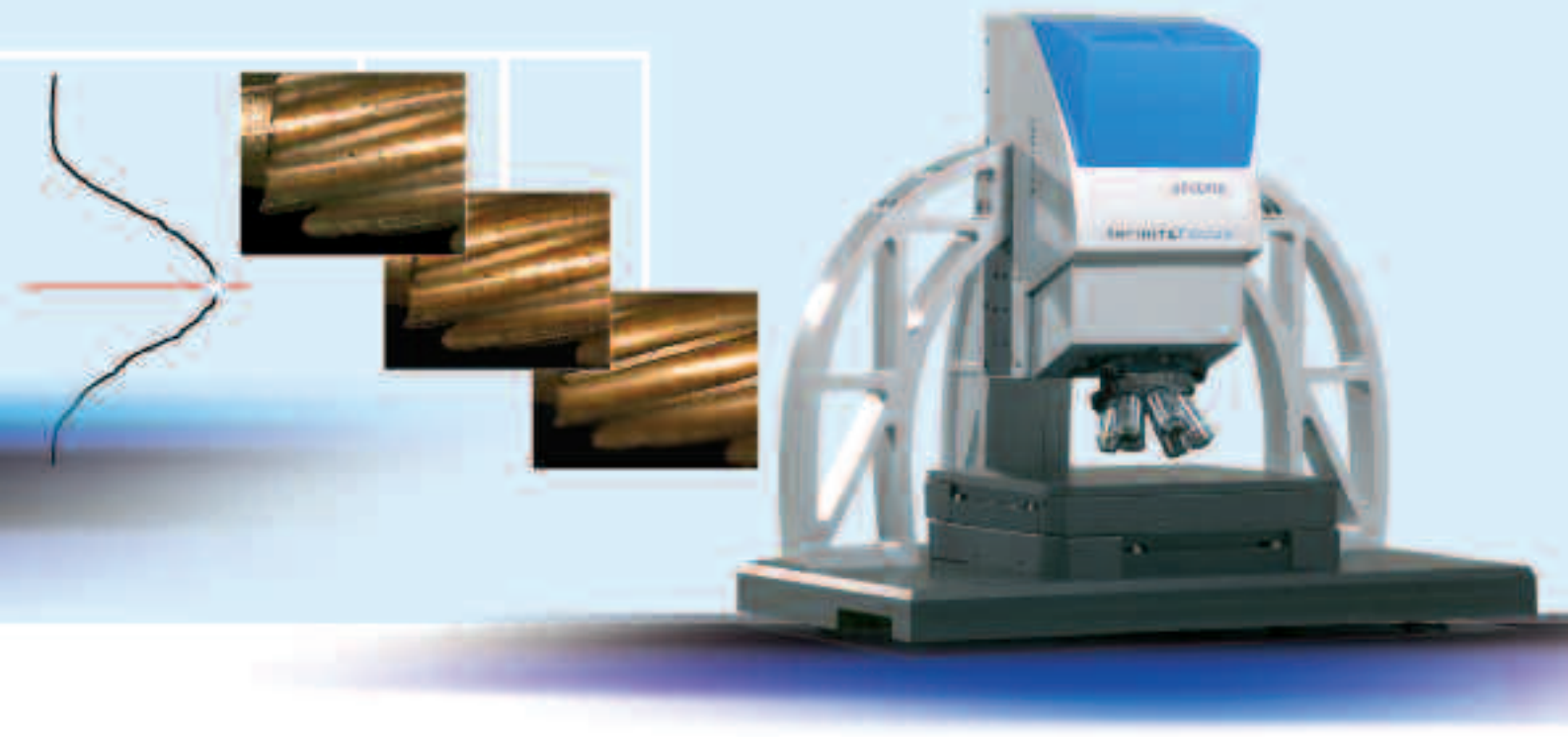
The principle of Focus-Variation

The technique of InfiniteFocus is based on Focus-Variation. Its operating principle combines the small depth of focus of an optical system with vertical scanning.

The specimen is placed onto the motorized stage and is 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, infinity-corrected objectives contained in a six-place nosepiece. The specimen's reflected light is projected through the beam splitter onto a color digital sensor.

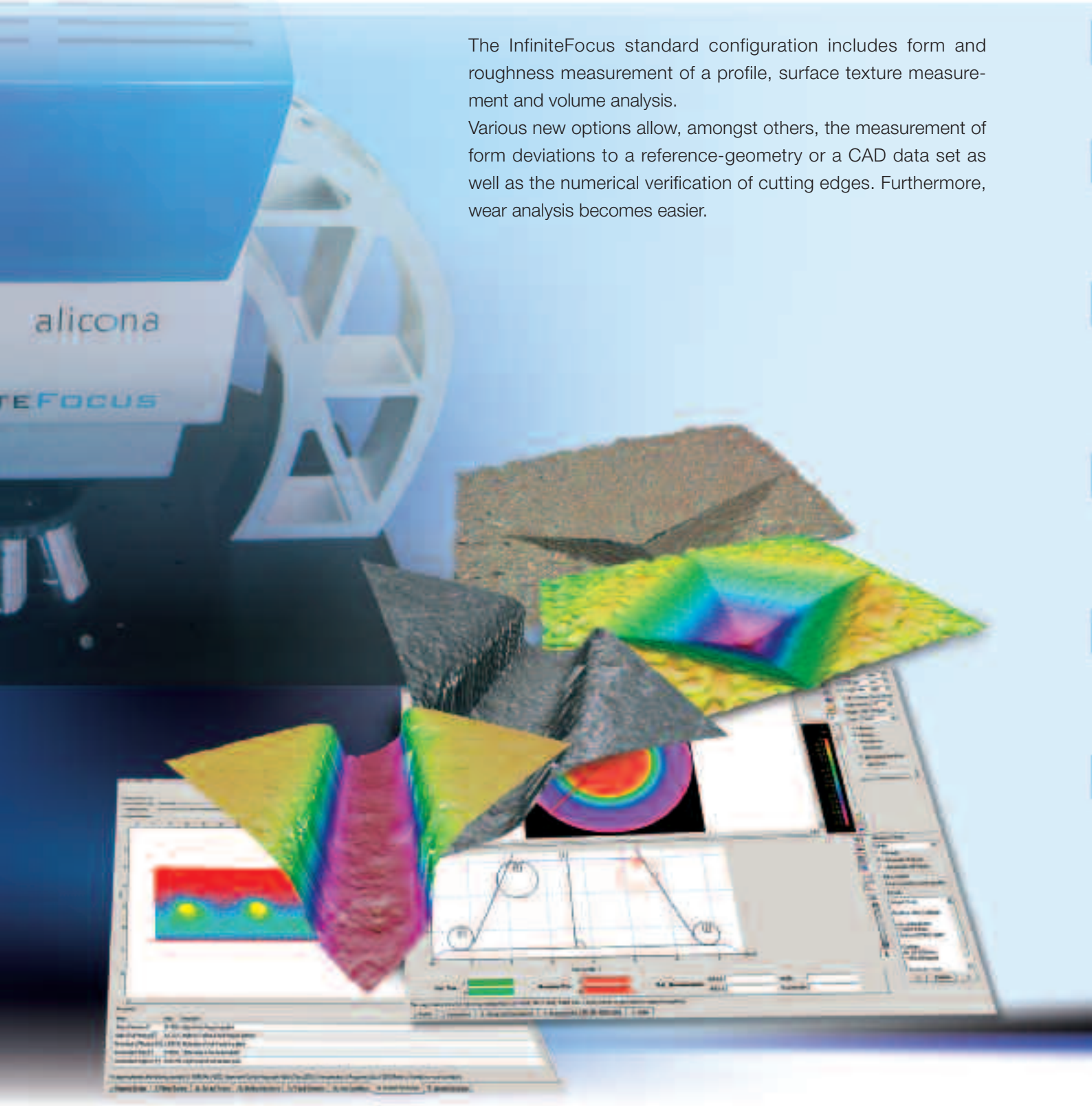
The selection of both, vertical and lateral resolution can be realized through a simple change of objectives. The resulting image is similar to conventional light microscopy in a way that it shows limited depth of focus. As the distance between the object and objective is varied images are continuously captured. Each position in depth is differently imaged depending on the 3D structure of the specimen. The harmonized interaction between modulated illumination, vertical scanning and sensor capturing is crucial for this process. The innovative Alicona SmartFlash® technology achieves this interaction. 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.

Focus-Variation has been added to the latest ISO standard for classifying surface texture methods. The new ISO standard 25178 for the first time includes standardized parameters to classify optically area based measurements. As an official member of the responsible ISO committee, Alicona contributes in defining the classifications of methods for surface measurement techniques. Further standards are in work.



THE MORE MEASUREMENTS, THE BETTER THE OVERALL QUALITY

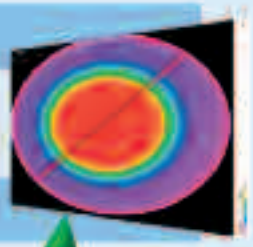
The InfiniteFocus standard configuration includes form and roughness measurement of a profile, surface texture measurement and volume analysis.
Various new options allow, amongst others, the measurement of form deviations to a reference-geometry or a CAD data set as well as the numerical verification of cutting edges. Furthermore, wear analysis becomes easier.



Today’s measurements conform to tomorrow’s EN ISO standards

Form measurement of a profile

Simply define a profile and measure radii, angles, distances and height steps either automatically or manually.

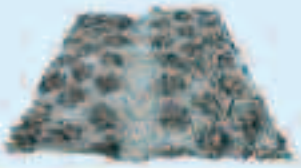


Roughness measurement of a profile

Roughness and waviness are usually measured via profile if surfaces show a preferential direction. Measurements conform to EN ISO 4287/88 which provides the comparability of the optical results to tactile measurements.

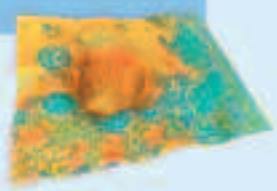
Surface texture measurement

In contrast to measuring the roughness of only a line profile, InfiniteFocus also provides area based measurements. This makes not only the measurement of larger geometries with higher repeatability possible, but also delivers results which include much more information about the real state of a surface. The measurement of areal surface parameters with InfiniteFocus conforms to the upcoming EN ISO standard 25178.



Volume measurement

A single pit or the volume of the entire surface is measured with an automatically calculated reference plane.



2D image analysis

Simple primitives are measured manually or semi automatically in 2D. Text overlays can also be entered and the easy-to-use database allows a convenient storing and transfer of data.

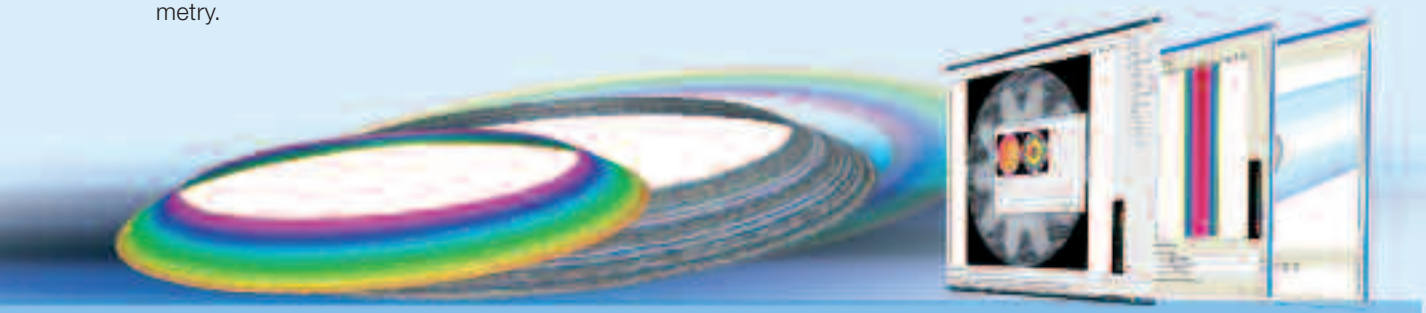
Automation of periodic measurement tasks

Periodic and complex measurements can be easily automated. With automation depths, valleys, cracks, holes and other surface features can be scanned, measured and quantified automatically.

New measurements open new possibilities

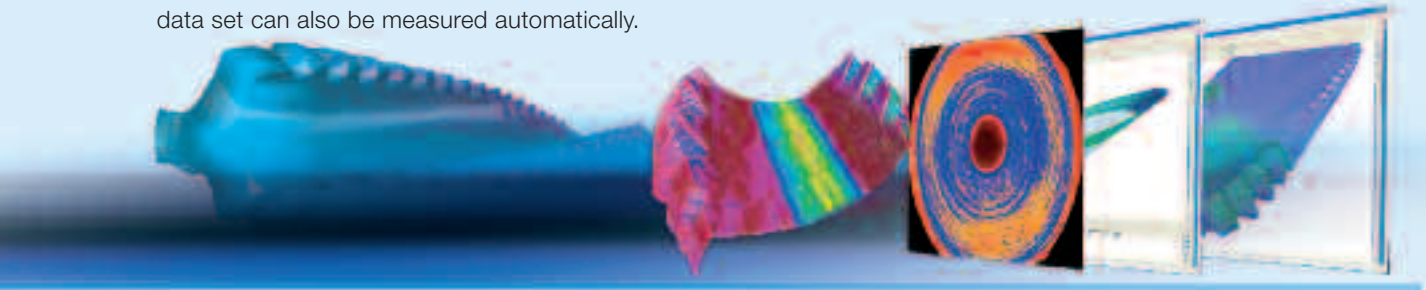
3D form measurement

The high resolution measurement of simple geometric shapes as well as curved surfaces can be achieved with the fitting of complex geometries such as spheres, cones and cylinders. InfiniteFocus also delivers deviations to reference geometry.



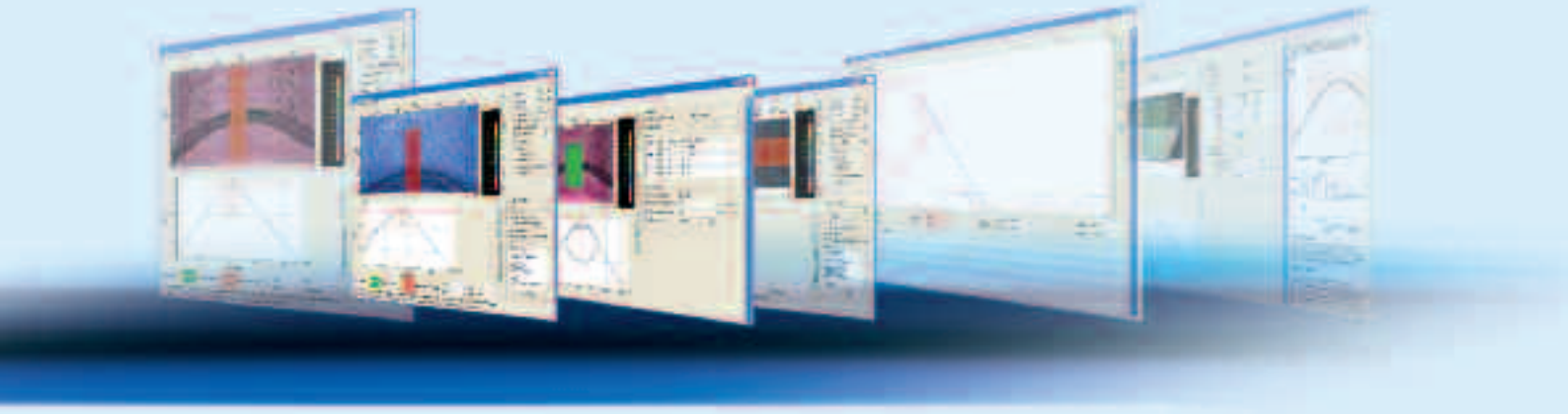
Measuring deviations to a CAD data set and differences to a reference geometry

InfiniteFocus measures wear or variance through computing the difference between the surface geometry of a component before and after use in production.
By measuring the difference of profile, area and volume of worn material is numerically verified. Deviations to a CAD data set can also be measured automatically.



Measurement of cutting tool edges

The measurement of tool parameters ensures the quality of cutting edges and consequently machining results. Radii are measured down to 2µm.



alicona

TECHNICAL SPECIFICATION

General Specification

Measurement principle	non-contact, optical, 3 dimensional, based on Focus-Variation
Measurement result	2-100mio 3D points in registered true color information (maximum is dependent on the used measurement module)
Maintenance	maintenance free
Illumination	white LED coaxial light, high power, controllable; optional: white LED ring light, controllable, polarization
Nosepiece	6 objectives manual or motorized
Travel range	X:100mm, Y:100mm, Z:100mm
Weight	95-100kg, depending on equipment
Size WxDxH	710mm x 540mm x 628mm (up to 768mm)
Temperature range	possible: 5° - 40°C, calibrated for: 18° - 22°C (other temperature ranges can be calibrated)
Temperature gradient	less than 1° per hour
Power supply	900W;110-230V~; 50-60Hz
Size ControlUnit WxDxH	540mm x 360mm x 682mm

Specimen

Specimen surface texture	surface topography Ra above 10-15nm with a Lc of 2µm, surface structure dependent*
Max. height of object	100mm up to 240mm
Max. weight of object	20kg, more on inquiry
Maximum slope angle	up to 85°
Sample preparation	none

*) This nano-roughness is necessary to measure the surface. When measuring roughness values (Ra, Rz etc.) Ra values >100nm are measured.

Objectives

Objectives		**2.5x**	**5x**	**10x**	**20x**	**50x**	**100x**
Sampling distance	µm	3.52	1.76	0.88	0.44	0.18	0.09
Optical lateral resolution	µm	5.6	2.2	1.1	0.8	0.6	0.4
Vertical resolution (low speed)*	nm	2300	410	100	50	20	10
Vertical resolution (high speed)*	nm	47100	8200	2000	1000	400	200
Scan speed (low)	µm/s	112	20	5.0	2.5	1.0	0.5
Scan speed (high)**	µm/s	2300	400	100	50	20	10
Vertical dynamic		3400	52000	160000	250000	430000	380000
Working distance	mm	8.8	23.5	17.3	13	10.1	3.5
Field of view X	µm	5716	2858	1429	715	286	143
Field of view Y	µm	4351	2175	1088	544	218	109

*) Vertical resolution can be adjusted depending on the application, this also influences the scan speed.
**) The maximum scan speed is not achieved by every application.

Resolution and Application Limits

Objectives		**2.5x**	**5x**	**10x**	**20x**	**50x**	**100x**
Min. measurable height	nm	2300	410	100	50	20	10
Max. measurable height	mm	8	22	16	12	9	3.2
Max. measureable area	mm²	10000	10000	10000	4500	700	150
Max. measurable profile length	mm	100	100	100	100	100	100
Min. repeatability	nm	800	120	30	15	8	3
Min. measurable roughness (Ra)*	nm	7000	1200	300	150	60	30
Min. measurable roughness (Sa)*	nm	3500	600	150	75	30	15
Min. measurable radius	µm	20	10	8	5	2	1
Min. measurable vertical angle	°	20	20	20	20	20	20

The entries in the table are traceable values.
*) The minimum measurable values are dependent on the structure of the specimen.

Software

Measurement modules and utilities	standard: ProfileFormMeasurement (height, angle…), ProfileRoughnessMeasurement (Ra…), SurfaceTextureMeasurement (Sa, fractale dimension…), VolumeMeasurement, 3D-Editor, FormRemoval; optional: 3DFormMeasurement, DifferenceMeasurement, ContourMeasurement, EdgeMeasurement;
Automation	IF Automation (built-in script editor), .NET Remoting interface
Visualization	2D-image and high resolution 3D visualization
Database	intuitive, graphical database
Import/Export	Simple export to STL and VRML, import of CAD-data with STL format, QDAS export, variety of reporting functionalities

We develop, manufacture, and sell high performance cutting tools. The possibility to measure form and roughness of our tools with a single device in a high resolution has convinced us. What we like about Alicona is their innovative power. This also characterizes us and is an attribute we strongly demand from our partners.

Martin Zeller,
CEO, Bass GmbH &Co.KG.

As head of the Institute for measurement and sensor technology at technical university Kaiserslautern, I am strongly engaged in optical roughness measurement. With InfiniteFocus we have upgraded our measurement lab with a latest-state-of-the-art system to measure form and roughness of our components.

Jörg Seewig,
Technical university of Kaiserlautern

We are using the Alicona to characterise the geometry and texture of surfaces of specimens before and after reciprocating friction tests and it has proved easy to use and gives excellent results.

David Nowell,
Dept. Engineering Science, University of Oxford

We now measure roughness on a level we haven´t known before!

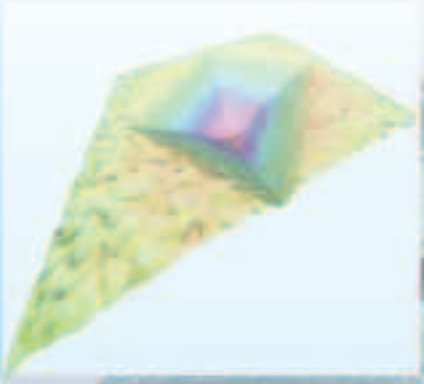
Harald Lehhofer,
Product Engineering, Montan-Universität Leoben

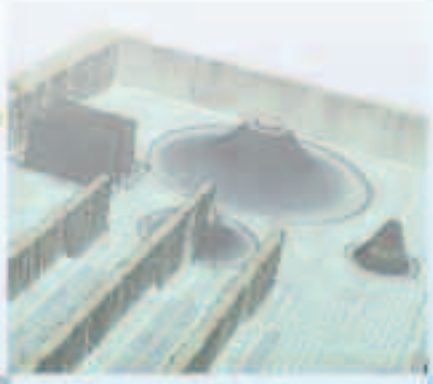
We are now able to measure geometries that have not been accessable before!

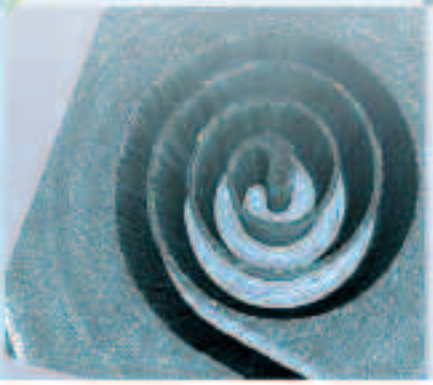
Heinz Dirrhammer,
Ceratizit Austria GmbH

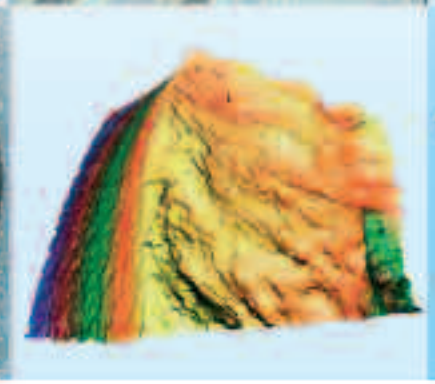
I can now measure the real form of surfaces!

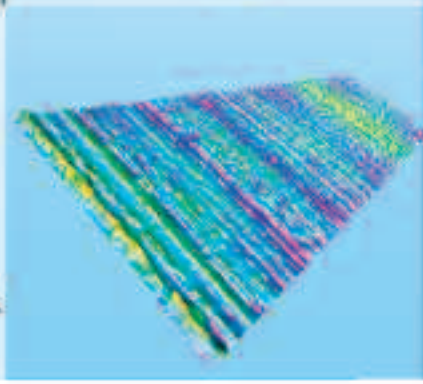
Ronny Brinkmann,
Mechanical Engineering, at University of Magdeburg











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