

opto ■ surf

Optical surface measuring
technology in a harsh
production environment



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*"We can only optimize
what we can measure..."*

**OptoSurf brings
light to your
machining
processes**

Quality control – Process control – Cost reduction

opto - surf

Experts in scattered light technology



■ Out of the test room – into the production line

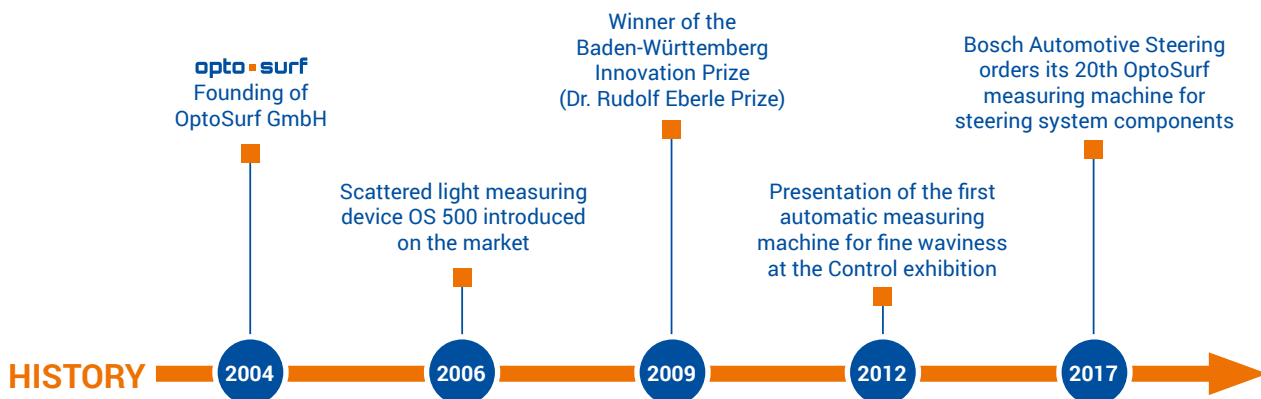
OptoSurf develops, produces and sells inline surface measurement systems for the quality assurance of precision parts during production. It is used in almost all areas of technology where surfaces play an important role, for instance the automotive industry, mechanical engineering and medical technology.

The 100 % testing of complex parts, the optimization of manufacturing processes

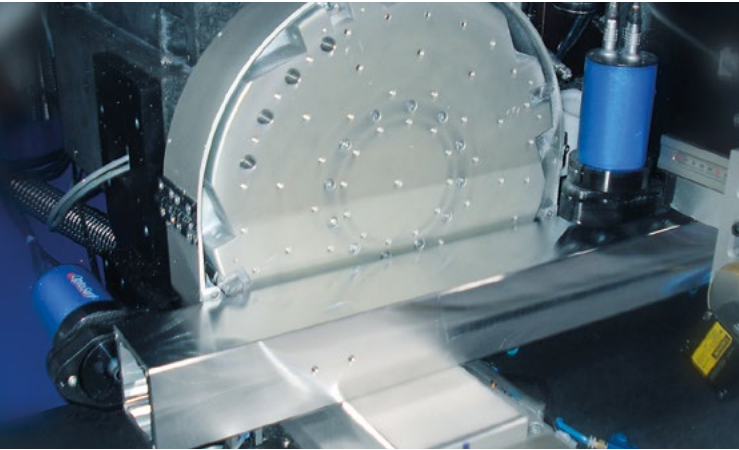
and the reduction of machine tool costs are challenges that face manufacturers of modern precision components. Using OptoSurf inline systems and measuring machines, solutions have been developed to meet the continually increasing requirements.

The heart of the OptoSurf measuring solutions is scattered light technology, characterized by:

- **Robustness**
- **Precision**
- **Non-sensitivity to vibration**
- **Fast measuring speed**



Sets a new standard for measuring technology in production

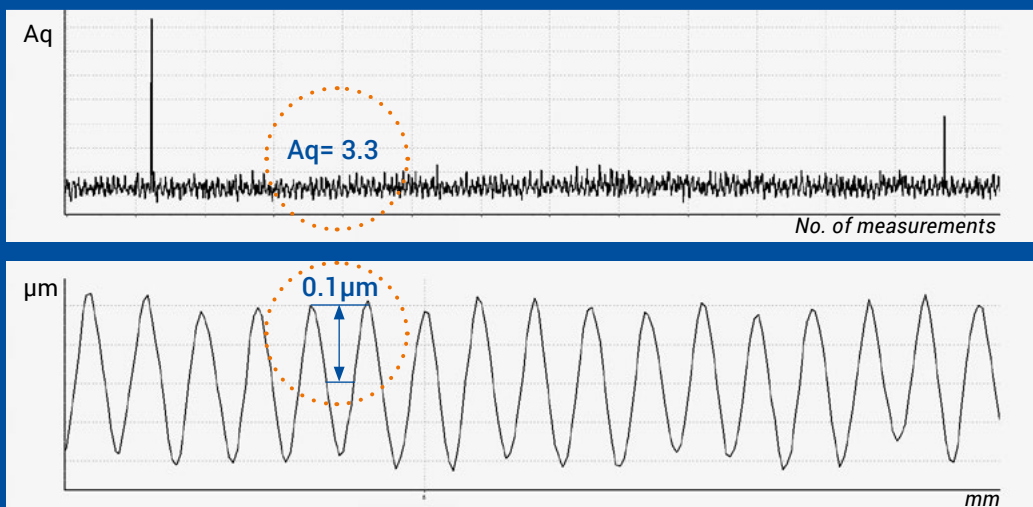


Process optimization

Measuring in the production machine, or directly next to it, enables optimum use of the machine tool and fast intervention in case of unexpected production problems. Until now, the measuring of extremely fine surfaces in the submicrometer range was

confined to the separate inspection rooms. Interference from the production environment made accurate, repeatable measurement during production a big challenge for quality assurance. OptoSurf now offers the ideal solution to this problem!

Measuring result, wave measurement standard WS 300_01



Even differences in roughness in the nanometer range are reliably measurable.

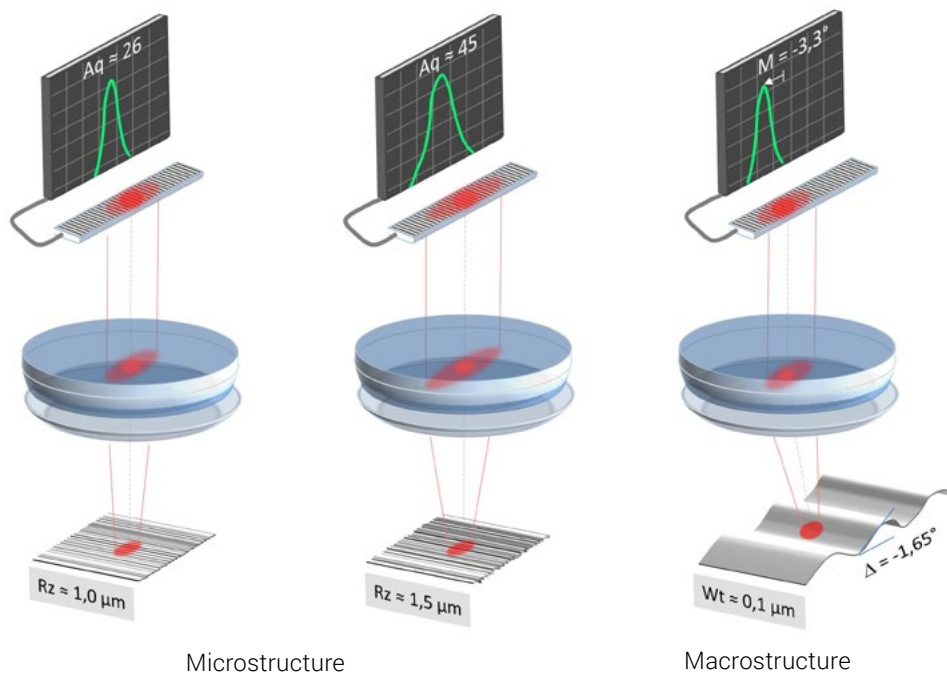
As well as roughness, waviness with an amplitude of less than 0.1 μm can be measured.

Functional principle of scattered light method

■ Accurate, fast and non-sensitive to vibration

Surface measurement with scattered light (VDA 2009) has already been established for several years now. It is based on measuring the distribution of light backscattered from a surface, making it possible to measure surfaces up to 10,000 times faster than with traditional measuring devices.

Two particular strengths of the method are its lack of sensitivity to vibration and its high repeatability.



High-precision, traceable measuring method

In principle the scattered light sensor is a highly accurate angle measurement device that records micro angles from scattered light in the form of the roughness parameter Aq , and the macro angles from the center of gravity of the distribution curve. This enables form and waviness to be calculated with great precision. The measuring method is traceable by means of standards.

Fast measuring of whole surfaces

■ What is measured – and where?

Scattered light sensors are used wherever high demands are made on surfaces.

Roughness is determined with the characteristic value A_q , which gives a particularly good description of functional behavior (e.g. friction, adhesive properties). When a known machining process is used, A_q reacts to changes in other known characteristic values such as R_a , R_z and R_k , for instance. If the part travels past the sensor along a precisely defined path its form and waviness can be measured using ISO Gaussian filters.

■ OptoSurf brings light to your processes

Scattered light sensors are ideal not only for quality assurance, but also for process control. The measured data can be used to shorten machine set-up times and optimize tool life.

Advantages of scattered light technology:

- *Simultaneous measurement of roughness and form*
- *Not sensitive to interference from mechanical vibrations in the environment*
- *100% measurement is possible, even with large quantities*
- *Measurement of complete surfaces*
- *Ready for Industry 4.0*
- *In many cases, the characteristic value A_q correlates with the functional behavior of surfaces*

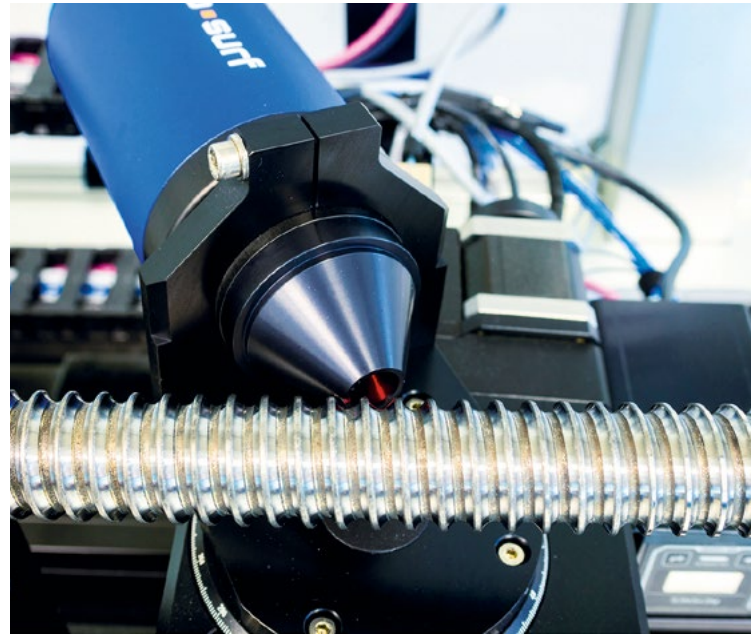


Automated measuring machines for quality assurance ...

Quality can be measured

OptoSurf offers measuring machines as turnkey solutions.

Surface measuring close to the process enables optimal tool utilization, and fast intervention in case of unexpected production problems. Long distances to the test room are saved and the measuring process is integrated into the production process. Networking of the data streams enables ongoing, long-term optimization of the process as a whole.



OptoShaft 015

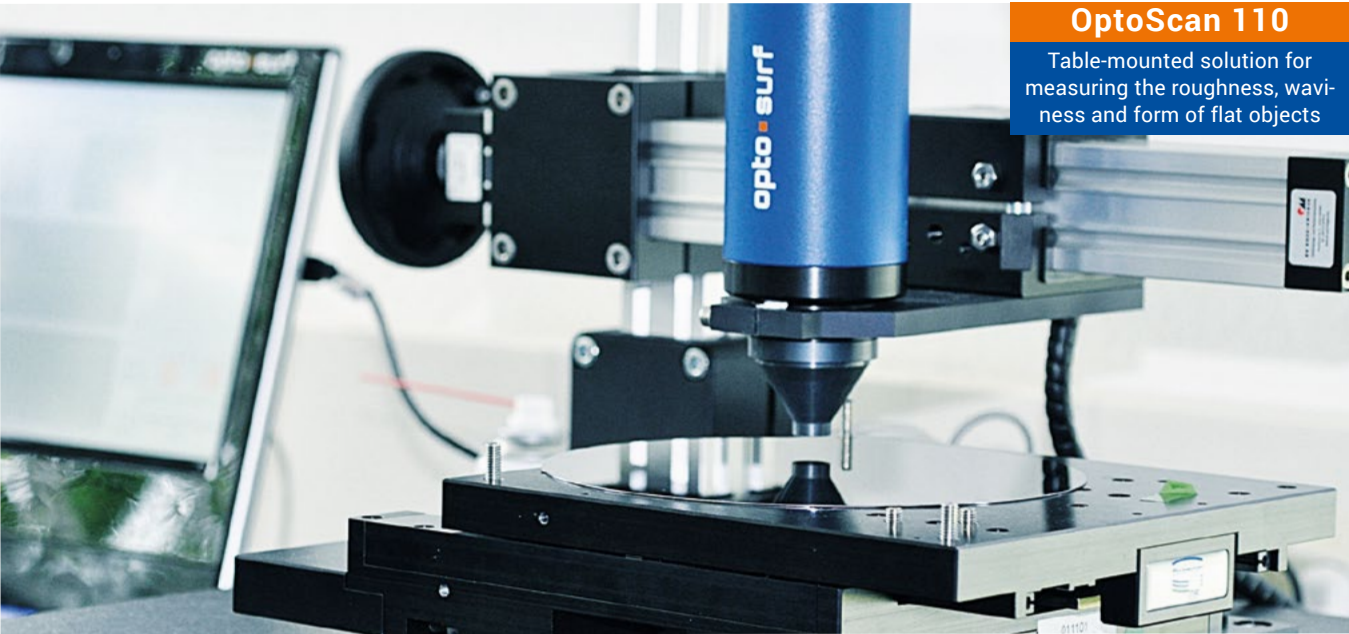
Measures roundness, waviness and roughness on gear shafts



OptoRack 017

Measures the machining quality of ball screw drive racks

... and process monitoring



OptoScan 110

Table-mounted solution for measuring the roughness, waviness and form of flat objects



Wafermaster

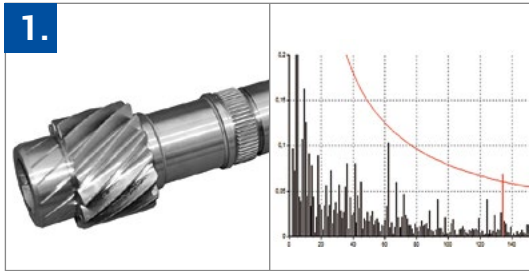
Measuring machine for the measurement of roughness and waviness on wafers in the nanometer range

Other measuring machines:

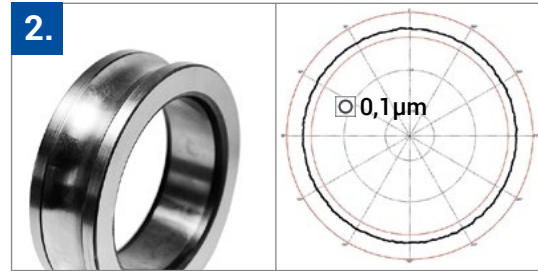
- **OptoBot**
robot measuring application
- **OptoRack**
for the back of steering gear racks
- **OptoSphere**
for artificial hip joints
- **OptoWorm**
for EPS worms
- **OptoShaft TT**
for laboratory applications

Versatile application options

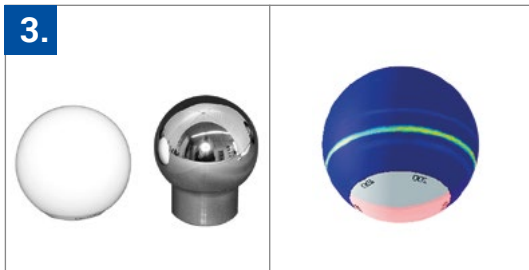
EXAMPLES:



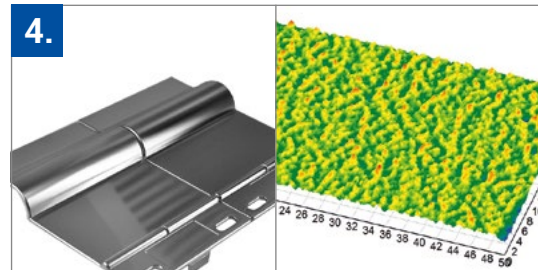
1. Gear shaft bearings:
Waviness measurement (chatter marks)



2. Roller bearings, inner and outer rings:
Roughness and roundness measurement



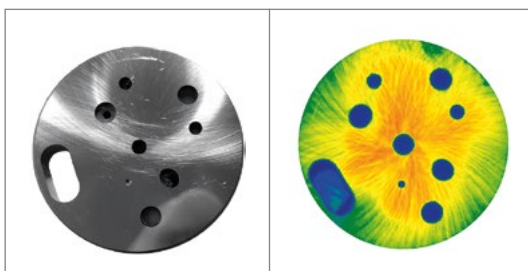
3. Artificial hip joint:
Form and roughness measurement with defect detection



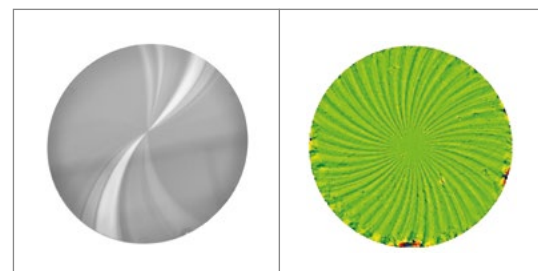
4. Galvanized surfaces:
Gloss measurement



From the semiconductor industry to mechanical engineering, from the automotive industry to medical technology – scattered light technology offers a wide range of applications.



Complete surface measurement of roughness on sealing seat surfaces



Roughness and waviness measurement in the nanometer range on Si wafers

Our measuring and analysis software

Quality under control

Innovative measuring technology needs a modern software connection so that the processed data volumes can be used in production.

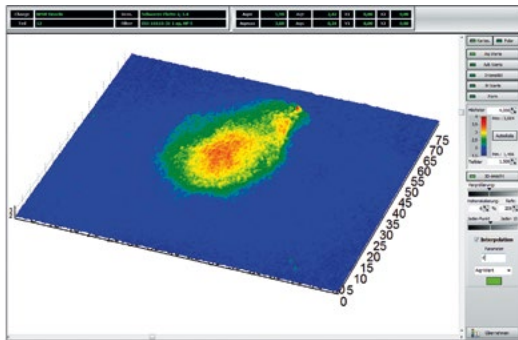
The OS 500 software controls the recording of measurement data and the subsequent analysis and presentation of the measurements. By defining tolerance values, NOK parts can be recognized and automatically removed. OptoSurf develops automatic measuring programs for measuring machines in production, with the possibility of identifying parts using a matrix scanner.

Advantages of the software:

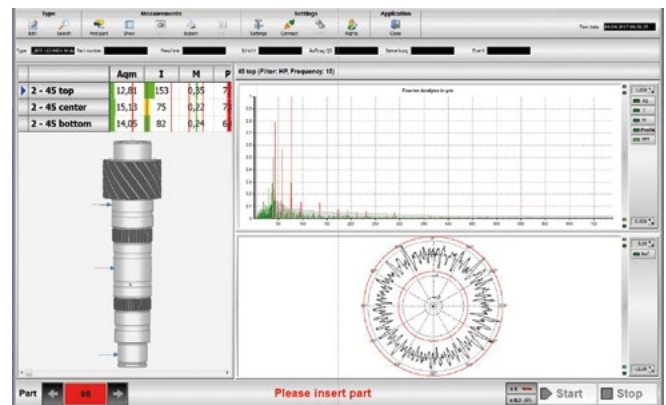
- Database-based software
- Parts identification via matrix scanner possible
- Fully automatic measuring process
- qs-STAT data export

Presentation options:

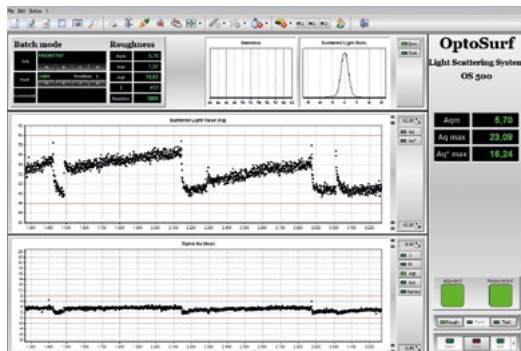
- 3D graphics (Aq, I, M, form, waviness)
- Presentation of raw data
- Presentation of filtered data
- High, low, bandpass ISO filter settings



3D option for presentation of roughness and waviness



Measuring machine software for the measurement of roughness, form and waviness on gear shaft bearings



Software for the inline measurement of roughness with trend recognition for process control

Scattered light sensor for versatile measuring tasks

Standard sensor OS 500 with 32° lens



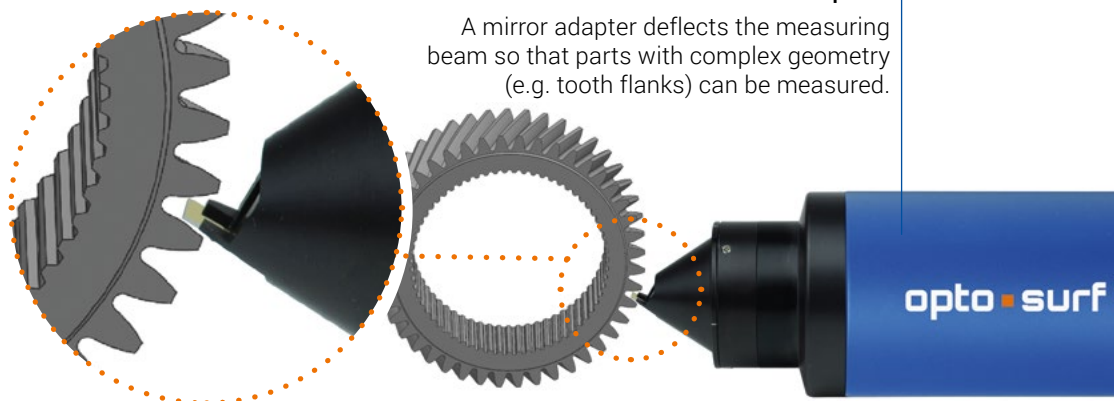
Sensor with periscopic lens:

The periscopic lens enables inner surfaces (e.g. the inner bearing races of gear shafts) to be measured.



Sensor with mirror adapter:

A mirror adapter deflects the measuring beam so that parts with complex geometry (e.g. tooth flanks) can be measured.



Sensor specifications

■ Reliable - accurate - repeatable

For every measuring device, its resolution limits and the repeatability of a measurement at predefined tolerance values are important. This is one of the greatest strengths of scattered light sensors – the finest detectable roughness is around $Ra \sim 1 \text{ nm}$ and the minimum detectable straightness deviation is approximately $< 0.03 \text{ }\mu\text{m}$ over a length of 50 mm. Repeated measurements yield a Cg value > 1.33



Reference standard set CS3:
For sensor testing

Technical data:

- **Roughness measurement principle:** scattered light method by angle resolution
- **Form measurement principle:** deflectometry
- **Available measuring spot sizes:** 7mm / 0.9 mm / 0.3 mm / 0.03 mm
- **Working distance:** 43 mm (without protective cap), standard 5 mm (with protective cap)
- **Measuring range angle:** 32°
- **Measuring range roughness (Aq):** $1.6 < Aq < 100$
- **Low measuring range roughness (Ra):** approx. $0.001 \text{ }\mu\text{m} < Ra$ for grinding, finishing, polishing
- **Measuring speed:** 2000 measurements/sec
- **Resolution:** 16 bit
- **Interface type:** USB
- **Protection rating:** IP 65

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Roughness measurement
Roundness measurement
Waviness measurement



fast – robust – high-precision



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