Laser-triangulation: Non-contact displacement and position sensors

The non-contact displacement optoNCDT product group utilizes optical triangulation as a measuring principle. A laser diode projects a visible spot of light onto the target surface (laser class 2). The light reflected from this spot is directed through an optical receiving system onto a position-sensitive element. Optical displacement sensors measure with a large reference distance and a very small measuring spot diameter. A digital CMOS and CCD array is used as the position-sensitive measuring element (series 1300, 1401, 1700 and 2200). The 1607 series is equipped with analog signal processing.

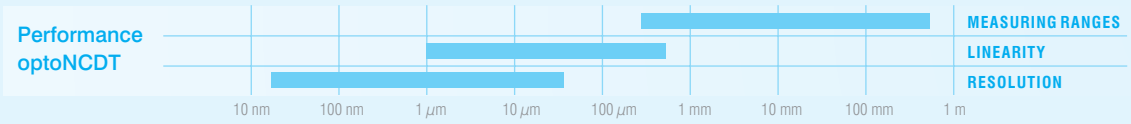
Advantages

- Small targets through tiny spot size
- Long measuring ranges
- Large stand off
- Extreme resolution
- Excellent linearity
- High measuring rates

Parts measurement
On machined surfaces of metal products, the optoNCDT is employed for quality assurance. Quantities such as roundness, concentricity, eccentricity and bending deflection are determined.

Surface profiling
Due to the small measuring spot and RTSC (Real-Time Surface Compensation), optoNCDT is excellent for the high precision mapping of any target regardless of its reflectivity, angle, shape and color.

Contour measurement on aluminum wheels
After casting, aluminum wheels are measured for a range of features, e.g. hub depth, roundness, bulging, etc., before being processed further.



optoNCDT 1300
Compact Low-Cost CMOS sensors with integral controller

Measuring ranges	20 - 200 mm
Linearity	±0.2 %
Resolution	0.02 %
Measuring rate	500 Hz

optoNCDT 1401
Compact CMOS sensors with integral controller

Measuring ranges	5 - 250 mm
Linearity	≤0.18 %
Resolution	0.01 %
Measuring rate	1 kHz

optoNCDT 1607
Analog PSD sensors for high speed measurements

Measuring ranges	0.5 - 200 mm
Linearity	≤0.2 %
Resolution	0.02 %
Measuring rate	37 kHz

optoNCDT 1700
Compact CMOS sensors with integral controller

Measuring ranges	2 - 750 mm
Linearity	≤0.08 %
Resolution	0.005 %
Measuring rate	2.5 kHz

optoNCDT 1700.001
Compact CMOS sensors for direct reflecting targets

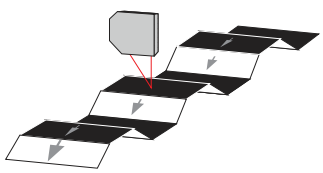
Measuring ranges	2 - 20 mm
Linearity	±0.1 %
Resolution	0.005 %
Measuring rate	2.5 kHz

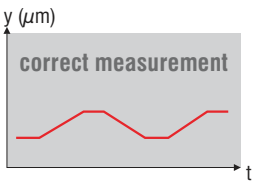
optoNCDT 2200
Intelligent CCD sensors for extreme precise measurements

Measuring ranges	2 - 200 mm
Linearity	≤0.03 %
Resolution	0.0015 %
Measuring rate	10 kHz

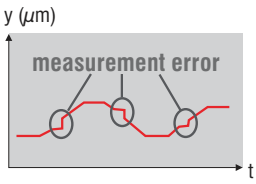
RTSC: Real-Time Surface Compensation

With RTSC, a world-wide unique innovation, the degree of reflection from the target is compensated during the on-going exposure in real-time. The exposure time or the amount of light produced by the laser is optimally matched to the currently running exposure cycle. Only sensors from Micro-Epsilon are equipped with this innovative real-time control and consequently they always achieve optimum results even with changing surfaces.

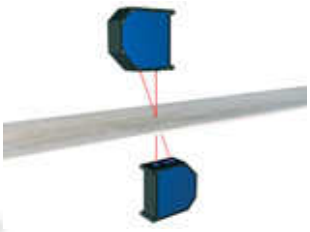




optoNCDT with RTSC real-time surface compensation

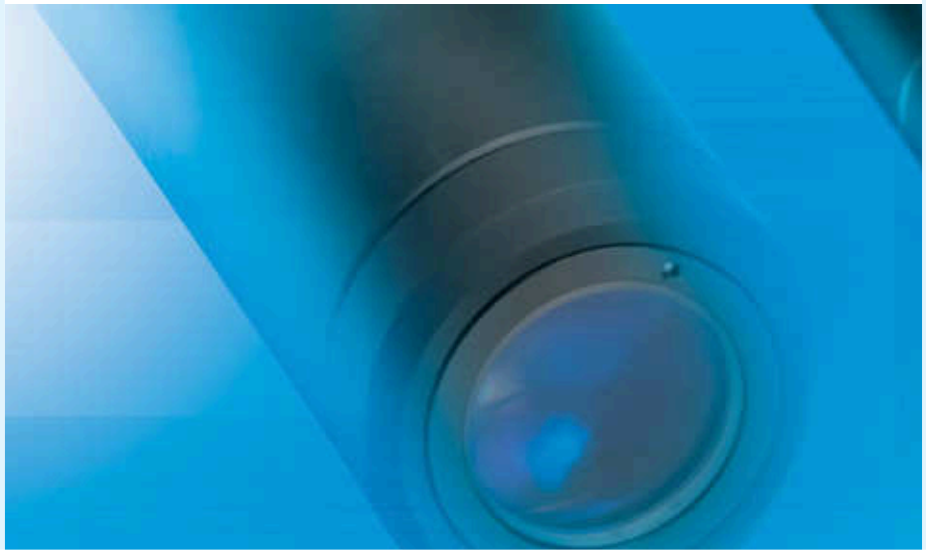


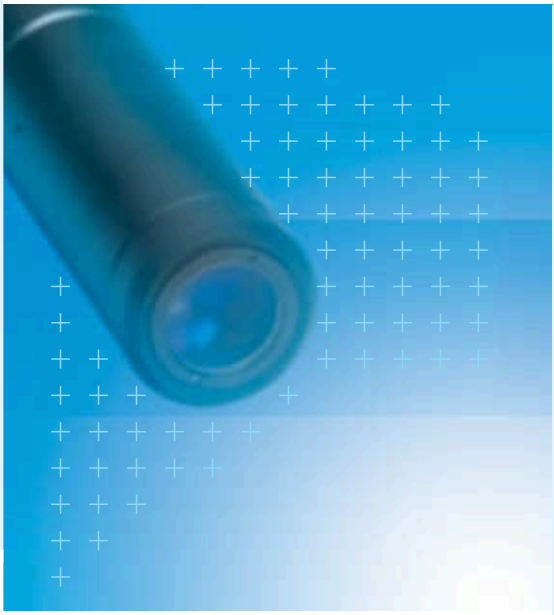
Standard laser sensors with time-shift control give distinctly incorrect signals with a change of surface



Synchronization of two sensors

Simultaneous measurement using two sensors is necessary in order to obtain precise results, with thickness or differential measurements, when the target is moving or oscillating. With the IF2004 PCI interface card the data from up to four sensors can be synchronously read.





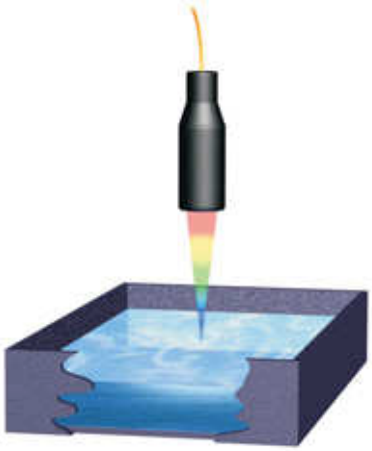
Confocal-chromatic principle: Non-contact displacement sensors

The confocal-chromatic measurement system, optoNCDT 2400, consists of a controller and a sensor. Polychromatic white light is focused onto the target surface by a multi-lens optical system. The lenses are arranged such that the white light is dispersed into a monochromatic light by controlled chromatic deviation. A certain distance is assigned to each wavelength by a factory calibration. Only the wavelength which is exactly focussed on the target is used for the measurement. This light reflected from the target surface is passed via a confocal aperature to the receiver which detects and processes the spectral changes. This unique measuring principle enables displacements and distances to be measured with high precision. Both diffuse and specular surfaces can be measured. With transparent materials a one sided thickness measurement can be accomplished along with the distance measurement. Since the emitter and receiver are arranged in one axis, shadowing is avoided.

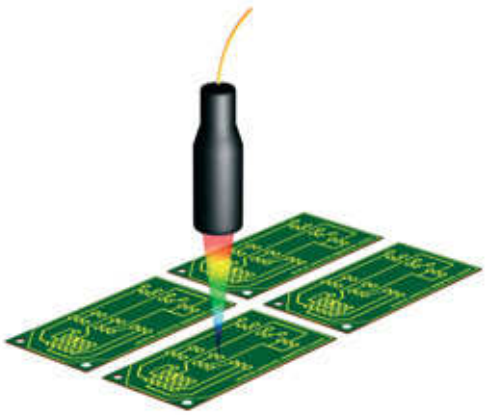
Advantages

- Extreme high resolution
- Target independent measurement
- Tiny, constant measuring spot
- Compact course of beam
- One-sided thickness measurement of transparent materials

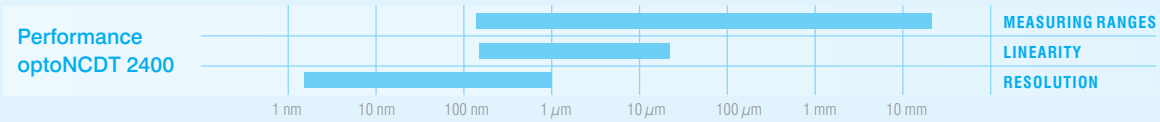
Thickness measurement of sleeves
Two synchronized sensors acquire the bottom thickness of sleeves in a double-sided layout.



Liquid level
The confocal measurement principle facilitates measurements against reflecting surfaces (glass, mirror), as well as liquids.



Surface scan
The extreme spatial resolution in x-axis and the submicron accuracy in the z-axis make it a perfect sensor for surface scans



optoNCDT 2400
Intelligent CCD sensors

Measuring ranges	120 µm - 25 mm
Linearity	±0.05 %
Resolution	0.004 %
Measuring rate	1 kHz

optoNCDT 2430
High-Speed design with additional light source

Measuring rate 30 kHz

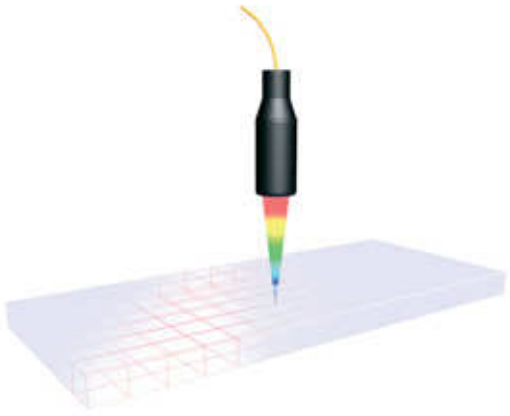
optoNCDT 2402
Confocal miniature sensors

Measuring ranges 400 µm, 1.5 mm, 4 mm and 10 mm

Sensors with axial measuring direction and sensors with 90° beam exit

One-sided thickness measurement transparent materials

The unique measurement principle enables a single-side thickness measurement on transparent materials such as glass. Here, just one sensor measures the thickness with nanometer accuracy.

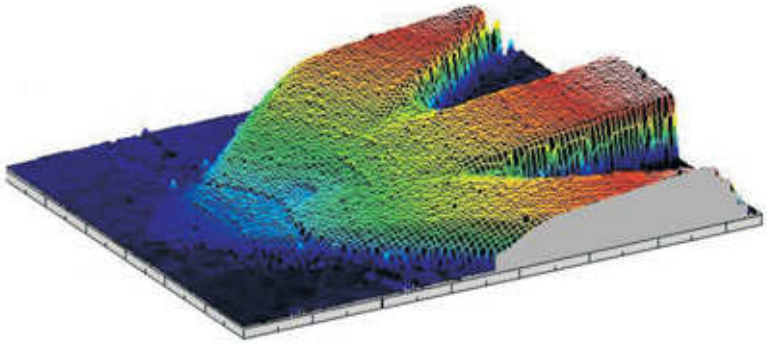


Confocal miniature sensors

Special miniature sensors with a diameter of 4 mm measure in confined installation spaces, e.g. in drilled holes and recesses. Furthermore, the 90° version of these sensors enables the inspection of the smallest internal walls.

Extreme resolution

The confocal sensors facilitate optical measurements in the submicrometer resolution in x and y-axis. In this way, the smallest structural changes or displacements can be resolved extremely accurately.



Time of flight principle: Non-contact Gauging sensors and distance sensors

The time of flight series optoNCDT ILR are optoelectronic sensors for accurate non-contact gap and distance measurements. The sensor operates according to the principle of light propagation time measurement. A laser diode in the sensor produces a short laser pulse which is projected onto the measurement object. The light reflected from the measurement object is detected by the sensor element. The propagation time of the light pulses to the measurement object and back determines the measurement distance. The integrated electronic inside the sensor calculates the distance from the propagation time and conditions the signal for analog or digital output.

Propagation time sensors in the series ILR are designed in two types which are suitable for different applications: The laser gauging sensors are designed for direct measurements against an object at distances of up to 10 m. If very high accuracy at large distances (up to 250 m) are required, then the distance sensors are used by measuring against a special reflector mounted onto the measurement object.

Advantages

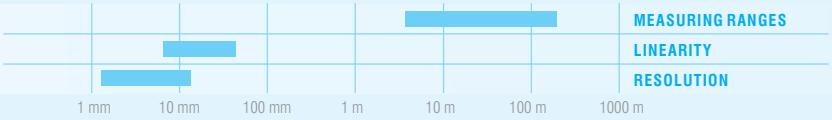
- Outstanding repeatability
- Fast response time
- Excellent price-performance ratio
- Various interfaces, analog and digital
- Sighting laser
- Easy to use with class 1 laser

Position acquisition storage and retrieval units
Fast response time in combination with high measurement accuracy facilitate the exact positioning of storage and retrieval units.

Distance measurement on monorail conveyors
To control the flow of production and to prevent damage to the parts, the spacing between the conveyors is monitored.

Acquisition of coil diameters
The quantities of steel, paper and fabric wound on and off are monitored via the acquisition of coil diameters using laser probes.

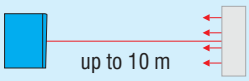
Performance
optoNCDT ILR



optoNCDT ILR
Gauging sensors

Measuring ranges	6 - 10 m
Linearity	≤8 mm
Repeatability	≤4 mm
Response time	12 ms

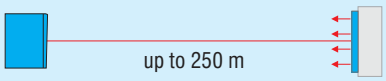
Gauging sensors
Measurement against target



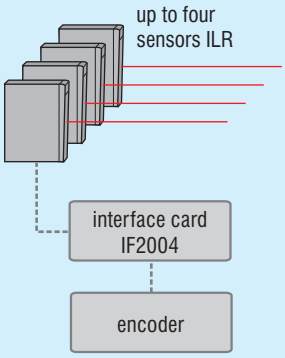
optoNCDT ILR
Distance sensors

Measuring ranges	30 - 250 m
Linearity	≤10 mm
Repeatability	≤2 mm
Response time	12 ms

Distance sensors
Measurement against reflector



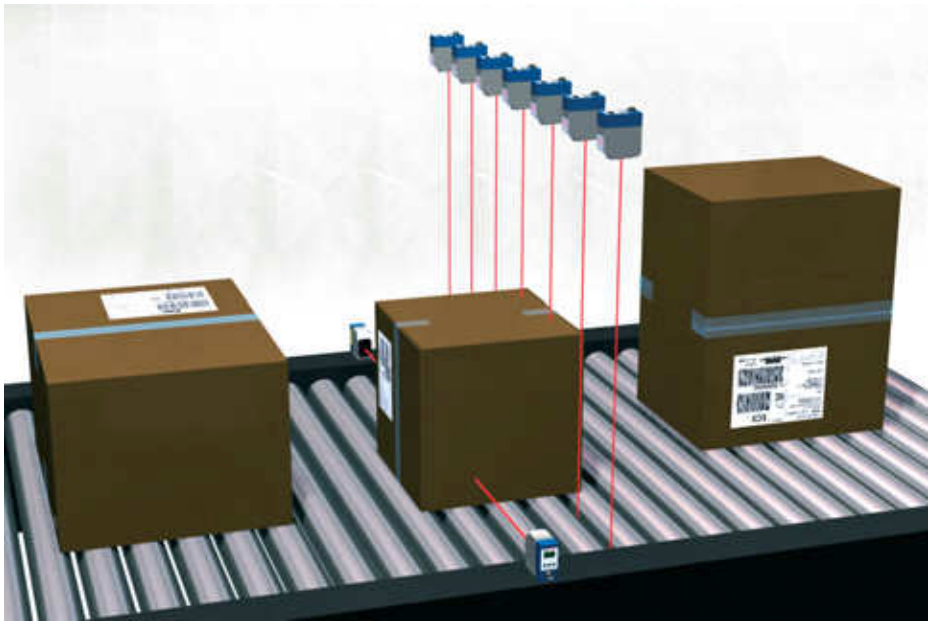
Synchronous data aquisition with PCI-card IF2004



Synchronous data acquisition

Synchronization facilitates applications in geometrical measurement, for example for the three-dimensional acquisition on conveyors. If a number of sensors are arranged such that both the height and the width of the measurement objects are determined in only one measurement pass, the signals can be synchronized at the point of measurement via the IF2004 interface card.

With the PCI interface card IF2004 the data from up to four sensors are read in synchronously via a FIFO memory in order to facilitate real-time processing. The fourth channel can alternatively be assigned to map an encoder or a linear measurement system with the sensors.

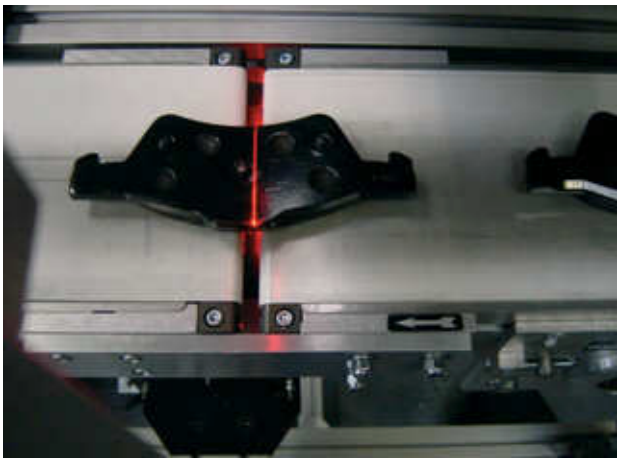


Laser-Line Triangulation: Non-contact 2D/3D profile sensor

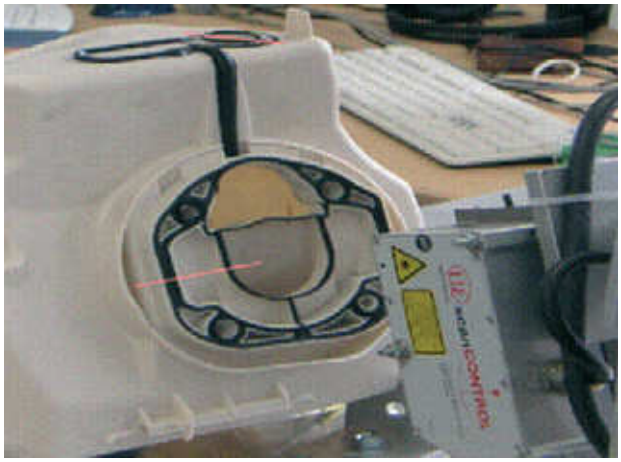
The laser-line profile sensor scanCONTROL makes use of the triangulation principle for two dimensional acquisition of profiles on the most varied target surfaces. In contrast to familiar point laser sensors, a line optical system projects a laser line onto the surface of the object to be measured. The back scattered light from the laser line is registered on a CMOS array by a high quality optical system. Along with distance information (z-axis), the controller also computes the true position along the laser line (x-axis) from the camera image and outputs both values in the sensor two dimensional coordinate system. A moving object or a scanning sensor will generate three dimensional representation of the object.

Advantages

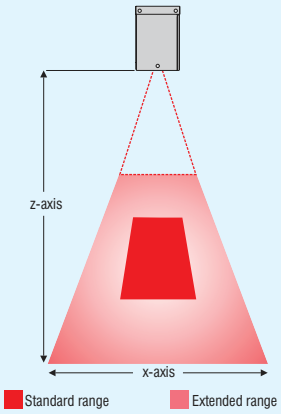
- High accuracy
- Very high measuring rate
- Flexible field of view
- High-performance signal processing unit
- Trigger and synchronization options



On line inspection



Off line inspection



scanCONTROL

Measuring ranges	z-axis	25 - 245 mm
	x-axis	13 - 140 mm
Linearity	z-axis	±0.2 %
Resolution	z-axis	0.04 %
	x-axis	1024 points/profile
Profile frequency		up to 4000 Hz
Measuring rate		up to 256 kHz

Applications scanCONTROL 2800

scanCONTROL 2800 is a basic unit for applications programmed by the customer. The Series 2800 supplies highly accurate x and z values in fast profile sequences for individual data processing, e.g. for applications in coordinate measuring machines.

Applications scanCONTROL 2810

scanCONTROL 2810 is equipped with a preprogrammed signal processor which is designed for the computation of profile data (grooves and beading). The Series 2810 is employed in automated applications.

High speed and variable measuring field

Due to the high measuring rate of up to 256,000 measuring points/s, a significant improvement in the cycle times during quality inspection is achieved. Here, the resolution and profile frequency can be set to suit the requirements of the application. If the point resolution of the x-axis is reduced, a correspondingly higher profile frequency can be achieved. With higher point resolution the profile frequency is lower.

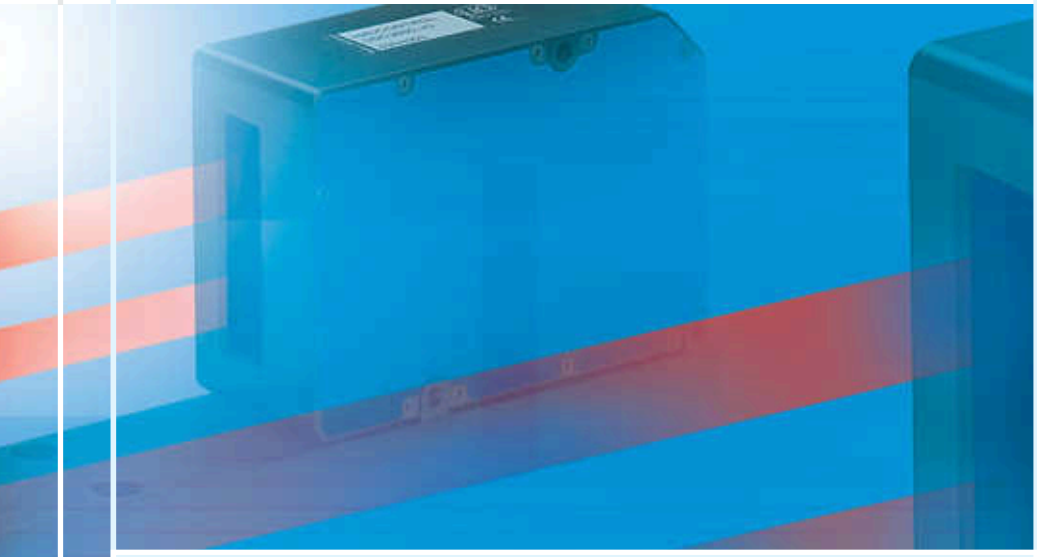
Apart from the processing rate and number of measuring points to be read out, the height and width of the measuring field can be set, e.g. 512 points over a narrow measuring strip (e.g. for edge detection) or 256 points over a wide strip for high speed applications (e.g. control of adhesive beading).

Laser Class 3B for difficult surfaces

For difficult surfaces such as rubber a special version with the Laser Class 3B is available which compensates for the weak level of reflection by a high light intensity. Consequently, high precision measurements, e.g. on tire rubber, are possible.

Process guidance and monitoring

Digitizing



ThruBeam principle: optical micrometer

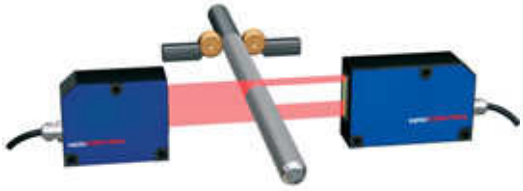
Optical micrometers in the product group optoCONTROL are based on various measuring principles. Apart from the CCD camera technique using laser or LED light, the principle of light quantity measurement is used. The micrometers consist of a light source and a receiver or a CCD camera. The light source produces a parallel continuous light curtain which is lined up with the receiver. If an object interrupts the light curtain, this shadow or darkening is detected at the receiver unit.

The Series optoCONTROL 1200 here acquires the incident quantity of light, whereas the Series 2500 and 2600 measure the exact shadow via a CCD array. In this way dimensional quantities such as diameter, gap, position and also segment can be acquired.

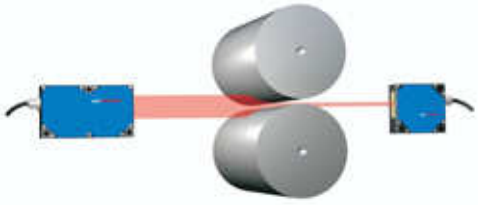
These units use state of the art high speed CCD cameras with solid state technology which eliminates the measurement errors caused by the traditional scanning laser micrometer.

Advantages

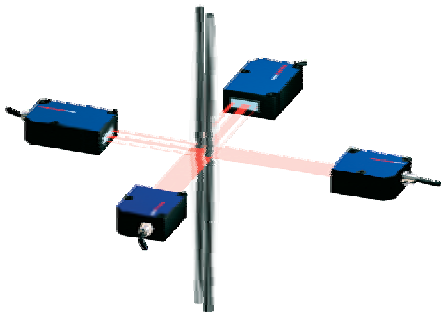
- Various models for different applications
- Laser- or LED light source
- Extreme compact construction
- Very accurate measurements
- High speed measurements



During the stamping of threaded rods, micrometers are used for quality assurance in order to determine the exact thread guidance.



Optical micrometers are used for acquiring roller gaps to ensure a constant gap height.



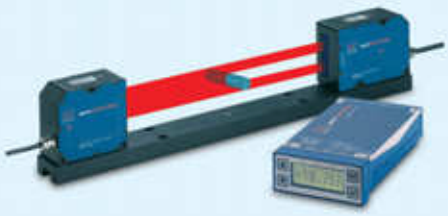
Synchronized micrometers acquire the vibration of tensioned steel lift cables in order to control the vibration behavior.

optoCONTROL 1200
Miniature high-speed micrometer (laser)

Measuring ranges	2 - 30 mm
Linearity	≤0.3 %
Resolution	0.05 %
Measuring rate	100 kHz
Integrated controller	

optoCONTROL 2500
High resolution micrometer (laser)

Measuring ranges	0.5 - 34 mm
Linearity	≤10 µm
Resolution	1 µm
Measuring rate	2.3 kHz
External controller	

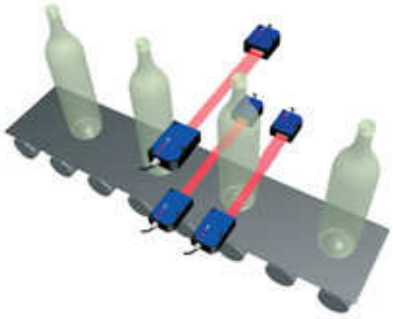


optoCONTROL 2600
High resolution micrometer (LED)

Measuring ranges	0.3 - 40 mm
Linearity	≤3 µm
Resolution	0.1 µm
Measuring rate	2.3 kHz
External controller	

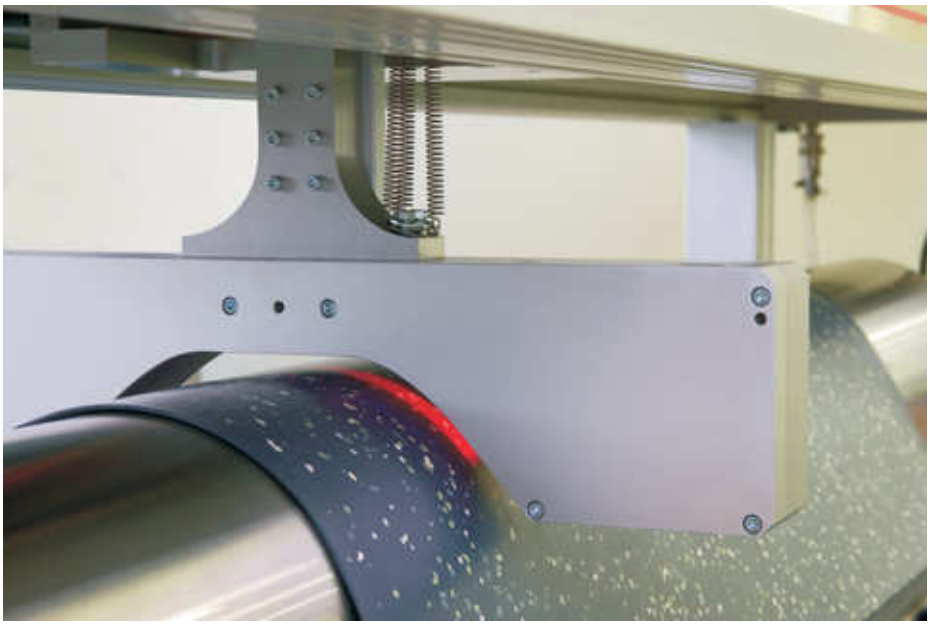
Checking for presence in fast processes

Apart form measurement tasks, the Series 1200 can be employed for ascertaining the presence of components. The versatile concept with enormously high cut-off frequency and compact design opens up numerous fields of application.



Measuring transparent materials

The Series 2600 uses LED light sources to achieve a high measurement accuracy. Along with the excellent performance data, the Series 2600 is suitable for measurement against transparent measurement objects such as glass bottles, bulbs or tubes. The acquisition of transparent and extremely thin materials is simplified due to the adjustable edge detection threshold.



Innovative dual sensor system

To determine material thicknesses a sensor system consisting of a micrometer and an eddy current sensor is fitted above a roller. The eddy current sensor measures the reference distance to the roller and the micrometer acquires the web surface. The material thickness is found from the combination of the two signals.