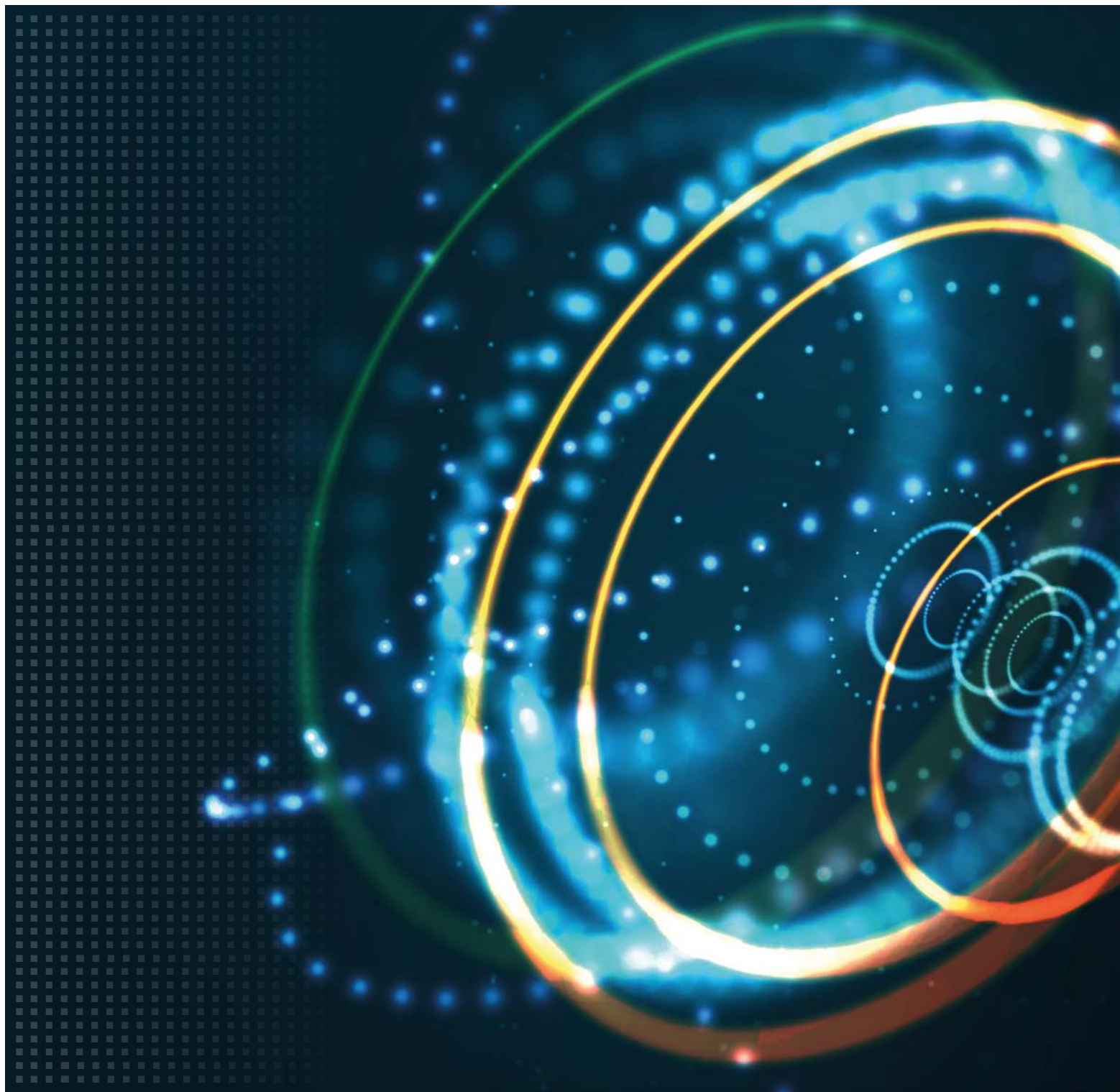


Sensors & Applications  
**Optics**



More Precision





**MICRO-EPSILON**

Micro-Epsilon is a globally active company and leader in industrial measurement technology. For more than 50 years, Micro-Epsilon has developed innovations providing unsurpassed solutions for precise measurement and inspection tasks. The product portfolio ranges from sensors for displacement and distance measurements over infrared temperature measurement and color recognition to systems for dimensional measurements and defect inspection. For the semiconductor and optics industries, Micro-Epsilon offers sensor solutions of highest precision.

**[www.micro-epsilon.com](http://www.micro-epsilon.com)**

**OPTOCRAFT**  
OPTICAL METROLOGY

Since its foundation in 2001, Optocraft is developing high-quality optical measurement devices. Numerous customers working in R&D and production in different territories and markets rely on well-tried Optocraft workmanship. The goal is to prove the quality of your products like for example lenses, microscope objectives or laser systems. The product portfolio ranges from the SHSLab wavefront sensors, to the SHSInspect optical test systems and fully customized solutions in the field of laser and optics testing. Since 2018, Optocraft has been a member of the Micro-Epsilon Group. With this substantial know-how, innovative solutions for advances in metrology and for individual customer requests are opened up. In this way, it is possible to provide efficient standardized systems as well as perfectly customized solutions.

**[www.optocraft.com](http://www.optocraft.com)**

# Displacement & Position measurement



## SHS Lab

- Shack-Hartmann wavefront sensor for measurement of the alignment of optical systems (transmitted wavefront)
- High Tilt measurement range:  $\pm 10^\circ$
- Measurement of strongly curved wavefronts (defocus and aberrations)
- Measurement at different wavelengths
- Excellent accuracy
- Excellent wavefront resolution and stability



## capa NCDT

- Capacitive multi-channel measuring system for machine position monitoring
- Non-contact displacement and distance measurement with measuring ranges from 0.05 mm to 10 mm
- Nanometer resolution
- High bandwidth for dynamic measurements
- Ideal for long-term stable measurements



## eddy NCDT

- High-performance inductive displacement measuring system with nanometer resolution
- Non-contact displacement and distance measurements with measuring ranges from 0.4 mm to 80 mm
- High frequency response for dynamic measurement tasks



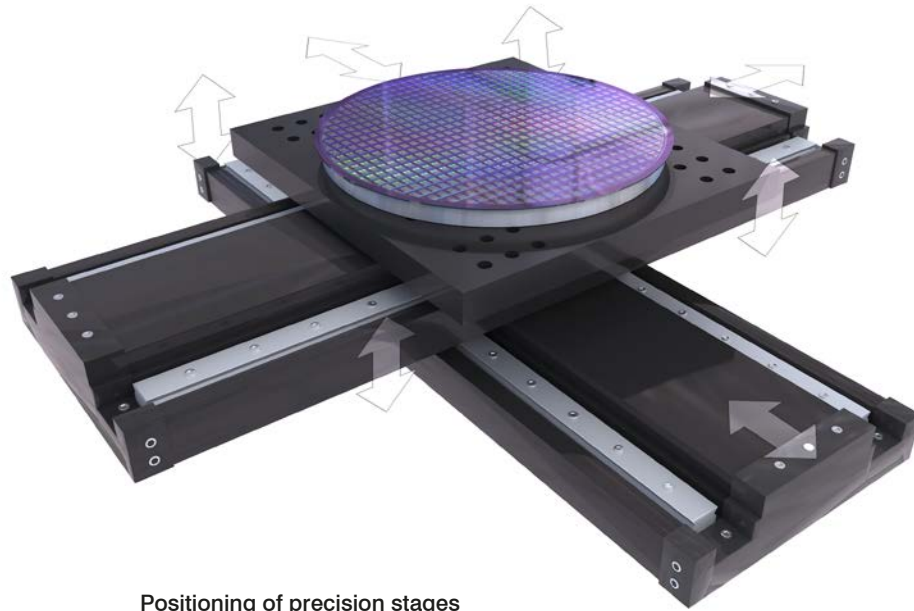
### Positioning of lens systems

Highly dynamic, inductive displacement sensors (eddy current) measure the position of lens elements in order to achieve the highest possible imaging accuracy.

*Sensor: eddyNCDT*

The transmitted wavefront allows precise alignment of single sub-groups of a lens assembly. Additionally, the optical performance of the lens assembly can be measured.

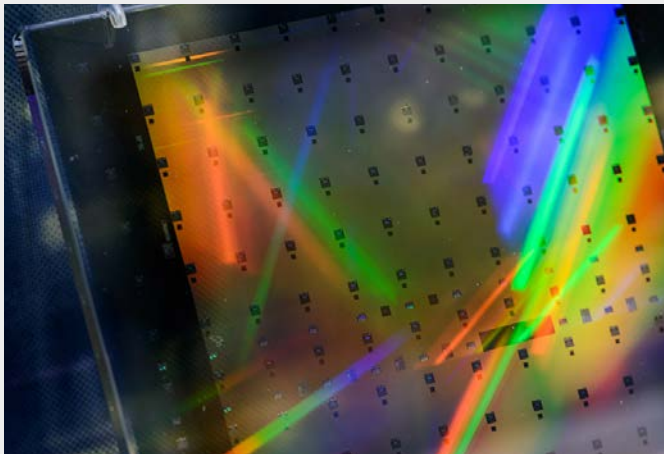
*Sensor: SHSLab*



### Positioning of precision stages

Non-contact displacement sensors from Micro-Epsilon are used for position monitoring in the wafer stage where they measure highly dynamic XYZ movements. Capacitive and inductive (eddy current) sensors achieve nanometer resolution.

*Sensor: capaNCDT / eddyNCDT*



## Lithography applications

### Mask positioning in lithography applications

Lithography processes require high resolution and long-term stable measurement of machine movements in order to achieve maximum precision. Capacitive displacement sensors monitor this highly accurate mask positioning process.

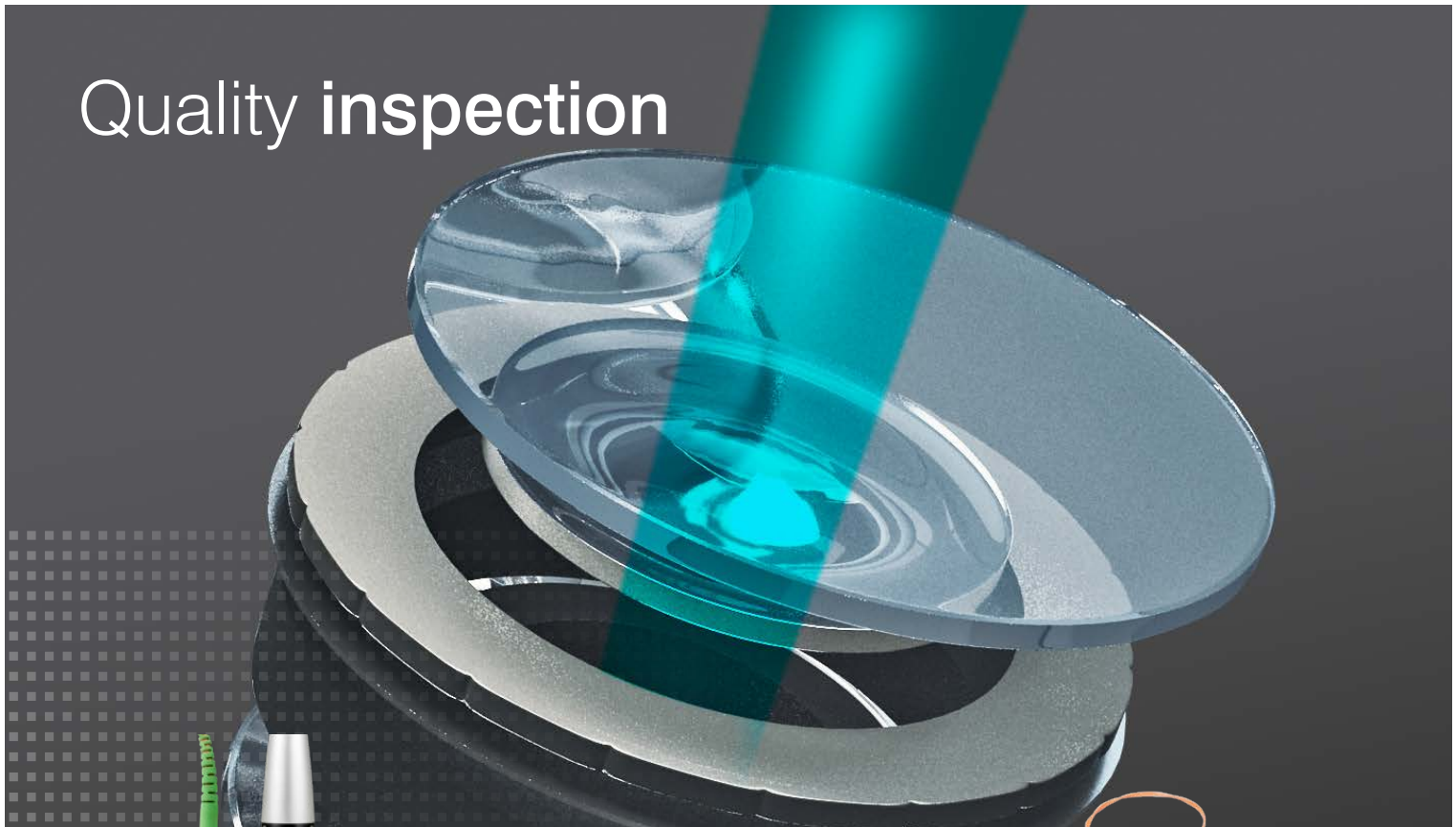
*Sensor: capaNCDT*

### Optical system monitoring

Lens systems used in lithography processes are tested and monitored using high-precision Shack-Hartmann wavefront sensors.

*Sensor: SHSLab*

# Quality inspection



## confocalDT

- World leading confocal-chromatic sensor system for distance, thickness and roughness
- Detection of finest structures with a lateral resolution from  $3\ \mu\text{m}$
- High numerical aperture (NA) ensures highest precision
- Compact sensors, designs with  $90^\circ$  beam path
- Vacuum suitability

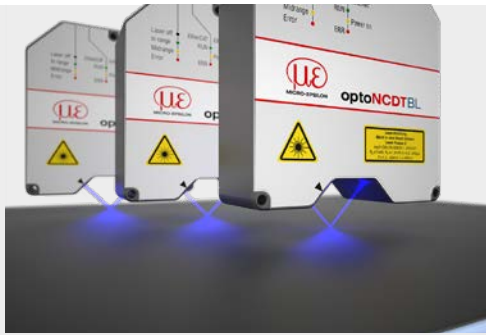


## Wavefront testing applications

- Measurement on-axis and at field points
- Measurement of
  - transmitted wavefront, PSF, MTF
  - focal length (EFL, BFL)
  - field curvature
  - chromatic aberrations
  - polarization effects

Sensor: SHS Lab, SHSInspect RL module, SHSInspect 2Xpass

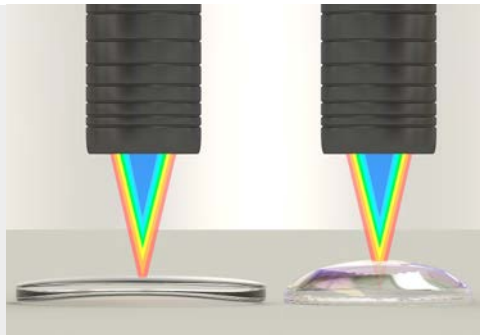
# Multi-functional optics testing



## Distance measurement on AR coated glass

After the coating process, glass with anti-reflective coatings is inspected using blue laser sensors in order to determine undulations and torsion. The planarity of the coated glass surface is measured in several tracks. Based on the patented Blue Laser Technology, optoNCDT 2300-2DR sensors provide high measurement accuracies on coated glass surfaces.

Sensor: *optoNCDT 2300-2DR*



## Curvature measurement of optical glass

In order to meet production tolerances, the contour of optical lenses such as eyeglass lenses or objectives is measured using confocal chromatic sensors. Based on the distance values, statements about the surface properties can also be made. Furthermore, the center thickness of the lens is determined. Due to the large tilt angle the sensors can also detect highly curved surfaces.

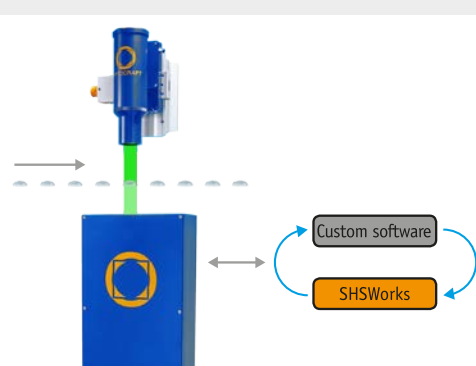
Sensor: *confocalDT*



## Camera auto focus measurement

Confocal sensors measure the distances between the auto focus lenses to provide the camera with the highest possible image quality.

Sensor: *confocalDT*



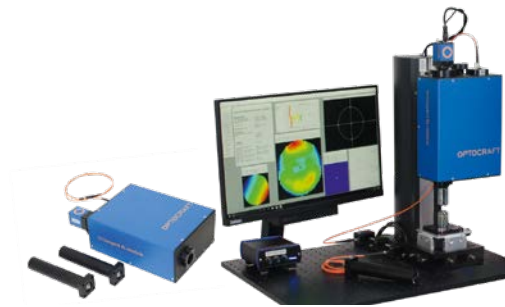
## Inline measurement of imaging quality and refractive data

Optocraft's wavefront measurement modules enable a fast and robust inline measurement of imaging quality. In addition to the wavefront sensor that measures transmitted wavefront and refractive data, these modules include a high resolution imaging camera that captures the lens position, diameter and defects.



## Testing the quality of objectives for microscopy and smartphones

Testing imaging quality of lenses is based on wavefront measurements on the optical axis and in the field. Furthermore, automated measurement procedures provide information about focal length, chromatic aberration, polarization effects, PSF and MTF.



## Testing and adjusting binoculars/spotting scopes and objectives

The precise measurement of the transmitted wavefront provides a quantitative assessment of the imaging quality of optical systems while enabling inline adjustment of these systems. The SHSInspect RL measuring module can be flexibly integrated into a test bench.

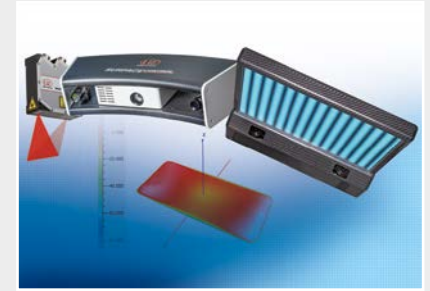
## Sensors and Systems from Micro-Epsilon | [www.micro-epsilon.com](http://www.micro-epsilon.com)



Sensors and systems for displacement, distance and position

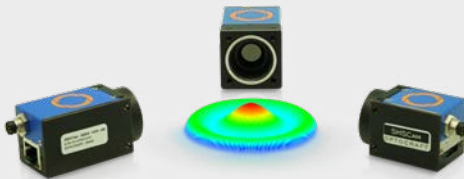


Sensors and measurement devices for non-contact temperature measurement



3D measurement technology for dimensional testing and surface inspection

## Sensors and Inspection Systems from Optocraft | [www.optocraft.com](http://www.optocraft.com)



### SHSLab

- High speed, single-shot measurements
- Excellent accuracy
- Extreme dynamics and broad spectral range
- Excellent wavefront resolution and stability
- Powerful, customizable evaluation software
- Versatile and flexible usage
- Optocraft's systems are in operation in many demanding customer applications



### SHSInspect RL module

- Optical measurement module for integration into customer set-ups, OEM, inline testing, etc.
- High accuracy
  - Versatile application
  - Wavefront, Zernike, PSF, MTF
  - Adjustment, quality test
  - Surface and radius of curvature



### SHSInspect 2Xpass

- All-in-one instrument for multifunctional measurements of lenses, objectives, etc.
- Wavefront, Zernike, PSF, MTF
  - On-and off-axis
  - Chromatic aberrations
  - Polarization effects
  - High accuracy, automated measurement process