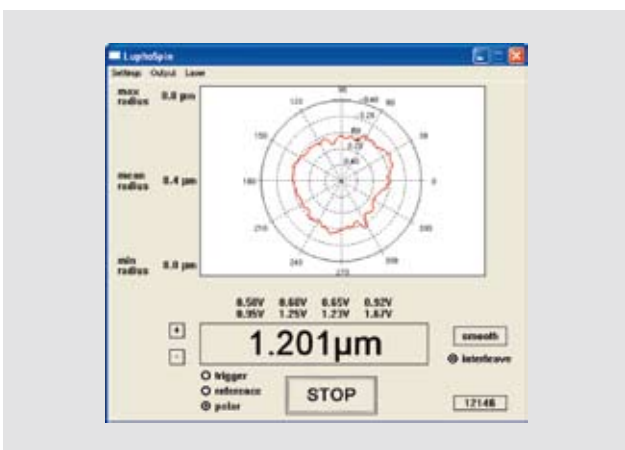
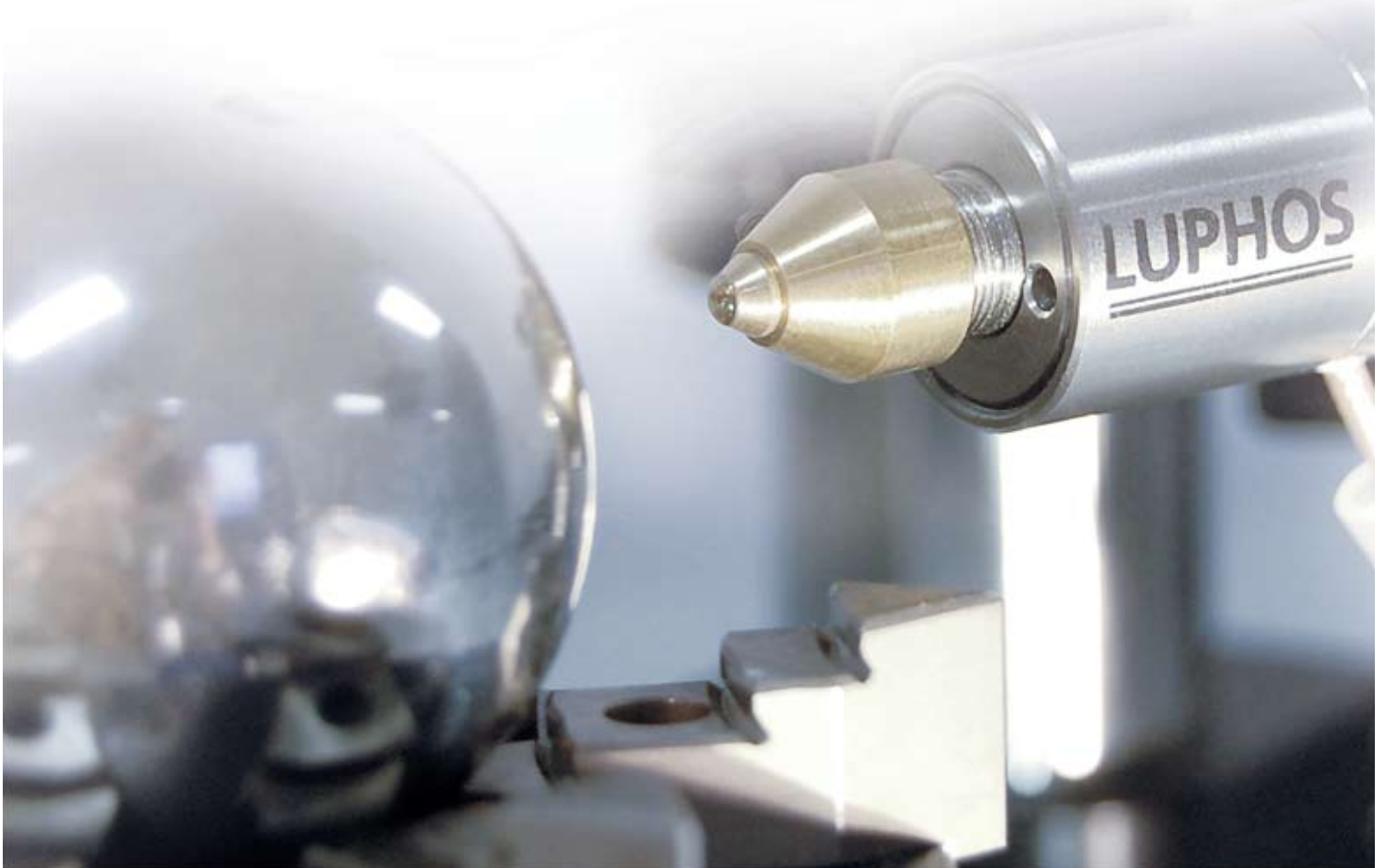
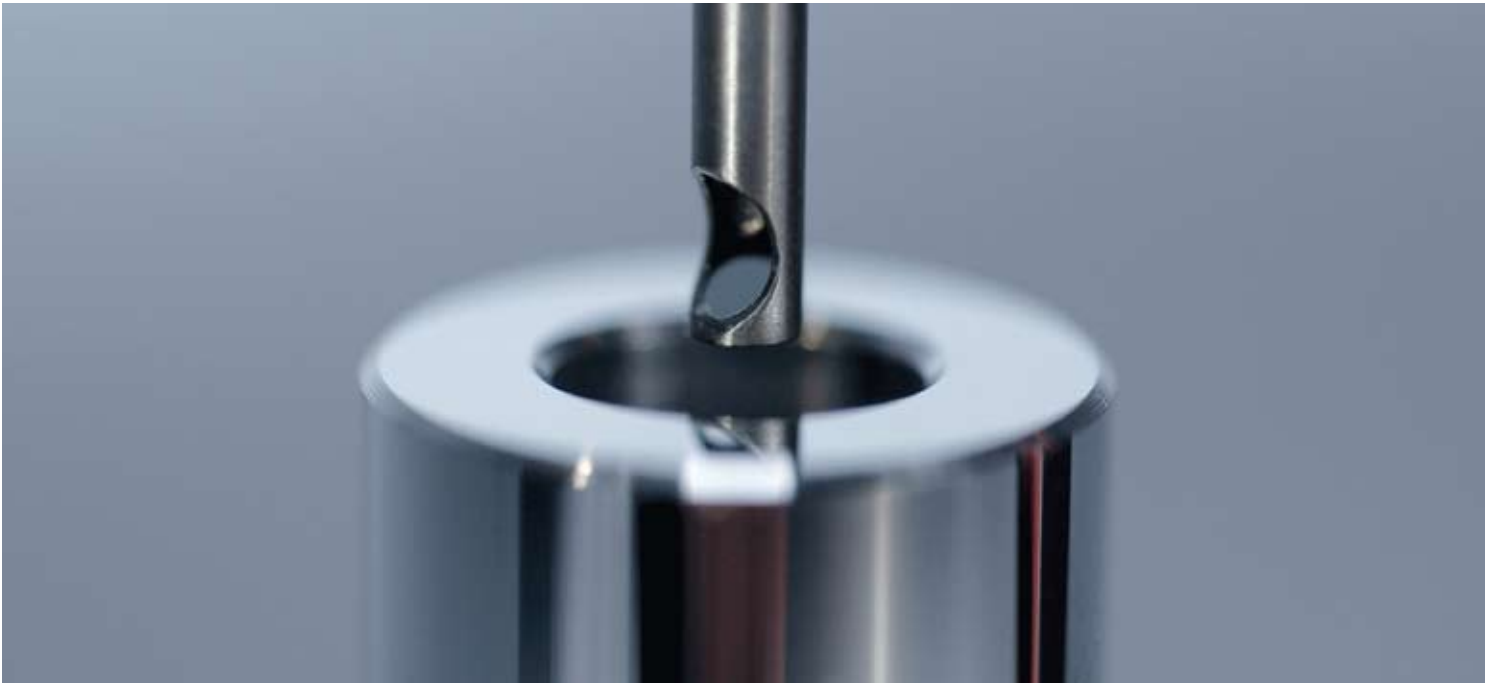


LUPHOSpin *system concept*

Ultra-precise concentricity and roundness measurement based on *MWLI*[®] technology



**Non-contact measurement
in the most flexible way**



The LuphoSpin system concept offers unique solutions for ultra precision non-contact roundness and concentricity measurements.

- **Characterization of bearings, axles, balls, bore holes**

Determination of radial errors, axial errors, tilt, and roundness

- **Ultra-high, reproducible accuracy**

Better than ± 5 nm

- **Large measurement range and working distance**

Up to several cm, while still providing maximum accuracy and precision

- **Continuous measurement of uneven objects**

Measure samples that exhibit notches, grooves, steps

- **Highly flexible**

Small probe dimensions and adaptable system concept enable straightforward implementation

- **Almost every material**

Polished, rough, specular, transparent, opaque

Concentricity and roundness measurements

The LuphoSpin system concept provides unique solutions for ultra-precise concentricity and roundness measurements. It is based on the *MWLI*[®] sensor technology (multi-wavelength interferometry) that facilitates high flexibility due to non-contact measurement, large working distances, and straightforward implementation also in existing machines.

Applications

Major applications of the LuphoSpin concept include concentricity measurements of precision rotary stages and roundness measurements of precision axles, balls, and bore holes. Depending on the designated application the utilized LuphoSmart sensor device can operate up to 5 probes simultaneously. Special probe holders, reference objects and probe extensions enable straightforward adaption to a desired application. The systems come with software that can be used to control the measurements and that provides analysis tools for basic error characterization.

Ultra-high accuracy

LuphoSpin systems are designed for high accuracy measurements. The utilized LuphoSmart sensor technology enables accuracies down to a few nanometers at extremely low noise levels.

Non-contact measurement

Based on a multi-wavelength interferometer approach LuphoSpin systems accomplish non-contact measurements. This prevents from damage of the object surface and any influence on the measurement itself.

OEM solution

Due to their small dimensions, probes can easily be implemented in existing measurement setups and production machines. The fiber connection cable can be extended up to 25 m and can be installed in cable carriers. In addition, the complete software can be controlled through a custom application.

Sample setup for quality control of rotary stages.



Large working distance and range

Due to the interferometric principle, working distance and measurement range can be in the range of centimeters while still providing maximum accuracy. The large distance between a specimen or reference object and the utilized probes (typ. several mm) offers very flexible and easy adjustment of a test setup.

Different surface textures

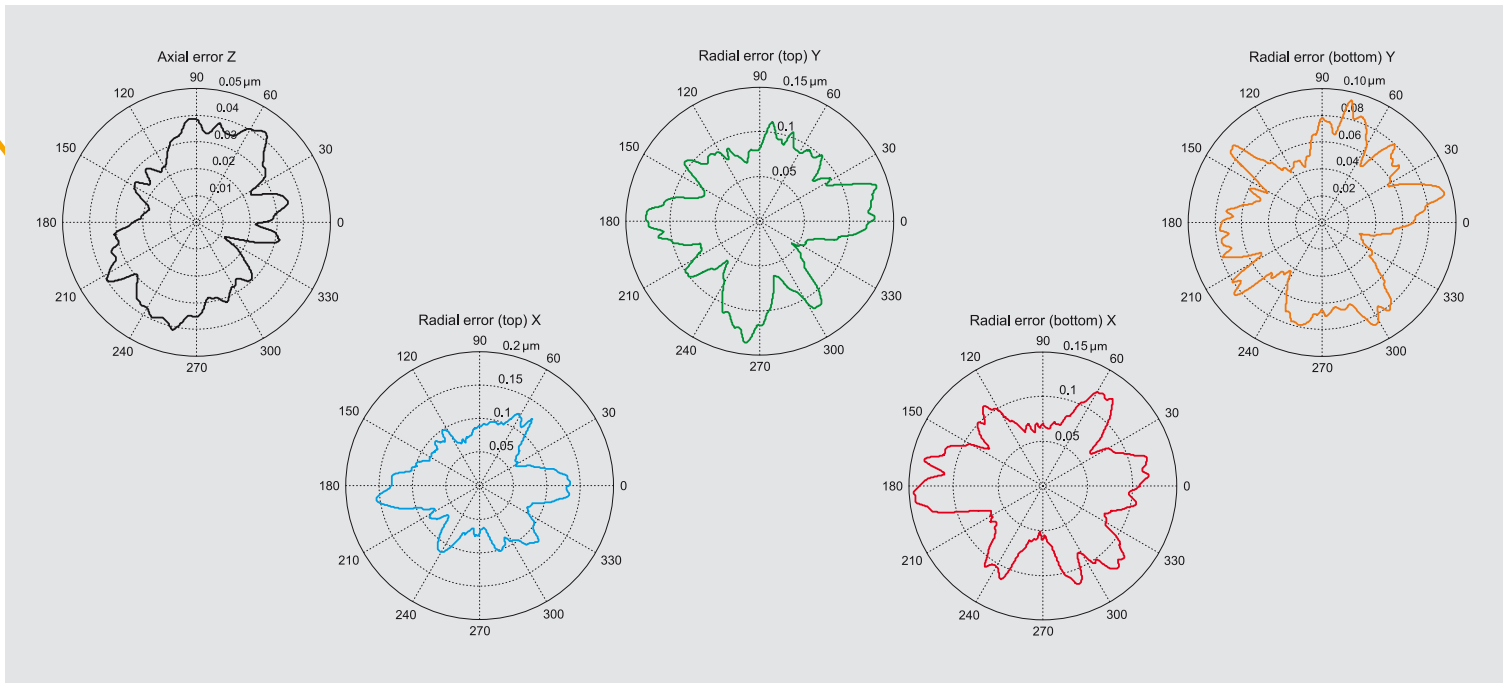
A special feature of the *MWLI*[®] technology is the capability to measure on almost every surface. While on polished surfaces the achievable accuracy is in the nanometer range, the same system can be used to measure ground or rough surfaces at a reduced accuracy.

Grooves and notches

Another unique feature of the technology is its absolute measurement capability. LuphoSpin systems facilitate continuous measurements of complex objects that exhibit grooves, notches, or any structure that gives rise to signal interruptions.



Measuring the concentricity of a diamond turning machine.



Concentricity

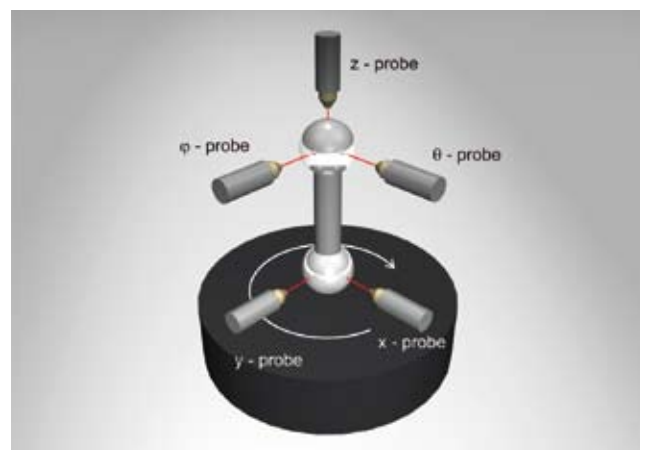
The characterization of precision air-bearing rotary stages is a major application of LuphoSpin systems. In the standard approach 5 probes are utilized as shown in the photo and the sketch on the right. During quality control a reference object that comprises two high-precision ball segments is placed on the stage to be tested. With a suitable holder the probes are easily adjusted, taking advantage of the large measuring distance. Finally, the incorporated software reveals all radial errors, axial errors, and tilt errors and enables basic analysis and filtering. It accomplishes sufficient separation of errors related to the reference object and the rotary stage. Typical results are shown in the above plots.

Adaptable systems

A LuphoSpin system designed for quality control of rotary stages comprises an adapted LuphoSmart system and corresponding software. Together with the optionally available 5 probe holder and a matching reference object, setup of a powerful custom application is straightforward.



LuphoSmart 4λ - 5 system that enables simultaneous operation of up to 5 probes.





Roundness

LuphoSpin systems enable straightforward inspection of the roundness of high precision balls, axles, and rotational symmetric components. Utilization of up to 5 probes facilitates characterization of profile shape errors of your specimen and simultaneous referencing of your system. The basic LuphoSpin system includes a 1-probe LuphoSmart system and software that provides analysis and basic filtering tools. It can easily be set up with a rotary stage in order to enable fast and ultra-precise quality control of your components. Also an adapted 3-probe system is available that enable better separation of roundness and concentricity errors.

Bore holes

By means of a probe add-on (see picture on the right) the LuphoSpin concept can easily be configured for measuring the roundness of precision bore holes. When implementing the adapted probe in a custom made system that comprises e.g. an object rotary stage and a vertical linear stage the LuphoSpin concept enables straightforward 3D topology measurements of the inside of holes. The available adapter supports measurement of bore holes with diameters ≥ 3 mm.

Due to the absolute measurement capability of the employed *MWLI*[®] technology, measuring holes that exhibit surface structures or different diameters is possible. In addition, the technology facilitates measuring holes whose surface exhibits a roughness of up to $R_a = 5 \mu\text{m}$. Best accuracies in the nanometer range are achieved on surfaces with $R_a < 0.1 \mu\text{m}$.



Probe adapter for bore hole measurements.

Probe technology	
Controller	LuphoSmart 4λ-1, ..., 4λ-5
Measurement technology	Fiber optics based multi-wavelength interferometry (MWLI®)
Wavelength range	1530 nm ... 1610 nm
Laser safety class	1
Measurement range ¹	(P050) 5...15 mm, (P100) 10...60 mm
Accuracy (3σ)	≤ ± 5 nm
Longitudinal resolution	0,1 nm
Lateral resolution (spotsizes)	(P050) 10 μm, (P100) 25 μm
Probe dimensions (length x diameter)	42 mm x 18 mm
Object surface types	polished, rough, transparent, specular, opaque
Object materials	metal, ceramic, glass, plastics
Absolute measurement interval ²	1,25 mm
Max. speed of distance variation	600 μm/s
Type	USB 2.0 device

Software	
Data recording	triggered / untriggered
Data rate (per probe)	2 kHz
Data resolution	0.01 nm
Live data display	2D profile plot, numeric values
Analysis	axial and radial errors, tilt
Filter	Gaussian, LS, Spline, FFT
Data formats	ASCII, binary
Custom implementation	Shared library for Microsoft Windows systems (.dll)

¹ The actual measurement ranges are valid for polished specular surfaces.
² By means of signal tracking the actual measurement range is significantly larger.

Please note: Data subject to change; enhanced performance requires optimal conditions.

The new way of non-contact
 ultra precision concentricity
 and roundness measurement

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 Light matters

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