



Fig.: The two fibre-based point light sources are located on the moving object. The image sensor detects the interference pattern whose orientation indicates the roll angle.

Advantages

- resolution better than 0.001°
- simple components
- insensitive to pitch and yaw movements

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Fibre-based roll angle measurement

PTB holds a patent for absolute roll angle measurement of high-precision linear adjusters used in optical metrology or industrial production, comprising an autocollimator and a roll angle measuring instrument. The roll angle can be measured with a low measurement uncertainty, making it possible to determine all three angular positions of an object in combination with the autocollimator.

In addition, this angle measurement system can be used to measure the topography of a surface in conjunction with a scanning topography sensor.

Two closely positioned single-mode optical fibres are located on a moving object, for example on an adjusting stage. The laser light emitted from the fibres creates an interference pattern that falls on an image sensor mounted on a stationary reference part. As the moving object rolls around the axis of the linear movement, the interference pattern rotates with it. The interference pattern is evaluated by means of a line-by-line Fast Fourier Transform (FFT) of the sensor data and its rotation is calculated from this. The measuring range of 360° degrees can be detected with a resolution better than 0.001° . In addition, the method is largely insensitive to small pitch and yaw movements. In principle, any wavelength can be used to generate the interference pattern.

Economic impact

The invention of this autocollimator with roll angle measurement replaces more complex roll angle measurement methods based on polarisation measurement. It is suitable for scanning systems in surface metrology and can be used by manufacturers of optical components for quality assurance purposes in the production of linear adjusters. Likewise, it can be used for monitoring and controlling the high-precision feeding of components in the production process.

Development status

A German patent has been granted (No. DE 10 2020 113 675 B4).

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