Wavefront sensor for advanced surface metrology

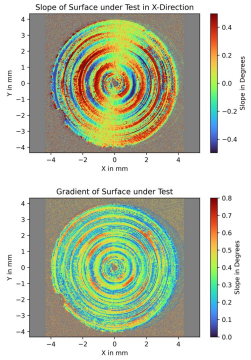
This invention simplifies the measurement of shape deviations on lenses, aspheres, mirrors, prisms or freeform optics. It overcomes the limited resolution of Shack-Hartmann sensors, offers higher slope acceptance angles than interferometers and delivers results in a very short timeframe compared to tactile measurement systems. The measurement principle is robust, simple and contact-free. Implementation does not depend on specialized components.

IP RIGHTS
European Application filed
2022

Simple measurement principle for complex surfaces

High-resolution wavefront sensing for surface metrology is accomplished with a simple optical setup. The surface under test is imaged with a multitude of aperture positions on a camera sensor. Surface slope can then be determined from the recorded intensity values. The principle was proven in practice with a prototype.

01 Improvement over Shack-Hartmann surface sensing: Absence of microlens array increases resolution
02 Advantageous compared to tactile measurement systems: Contact-free, fast, cost-efficient
03 Construction from readily available components
04 Large slope acceptance angle



Slope of a highly aberrated surface as determined with a first, low-cost prototype. Tests performed with the prototype have proven the principle and demonstrate its utility and potential.

REFERENCES:

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CHALLENGE

The production of optical surfaces demands precise and reliable metrology systems to detect minute fabrication errors and to ensure ever tighter tolerances on form and slope errors. Advanced optical elements with aspheric or freeform surfaces may be difficult to analyze with standard equipment because of their deviation from the spherical form and high slope angles. Interferometers or Shack-Hartmann sensors (SHS) may be utilized to measure aspheres and freeform optics.

INNOVATION

To overcome the limitations of the SHS while retaining its high flexibility, a next-generation wavefront sensor with an increased performance in surface metrology is needed. This new wavefront sensor does not depend on a microlens array. In contrast to the SHS, each photosite of the image sensor is employed to detect the surface slope of an optical element. This increases the spatial resolution. Accordingly, it enables the measurement of surface errors with higher spatial frequencies. The system can be built from readily available components and utilizes a robust evaluation algorithm.

01 Basic principles observed · **02** Technology concept formulated · **03** Experimental proof of concept · **04** Technology validated in lab · **05** Technology validated in relevant environment · **06** Technology demonstrated in relevant environment · **07** System prototype demonstration in operational environment · **08** System complete and qualified

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