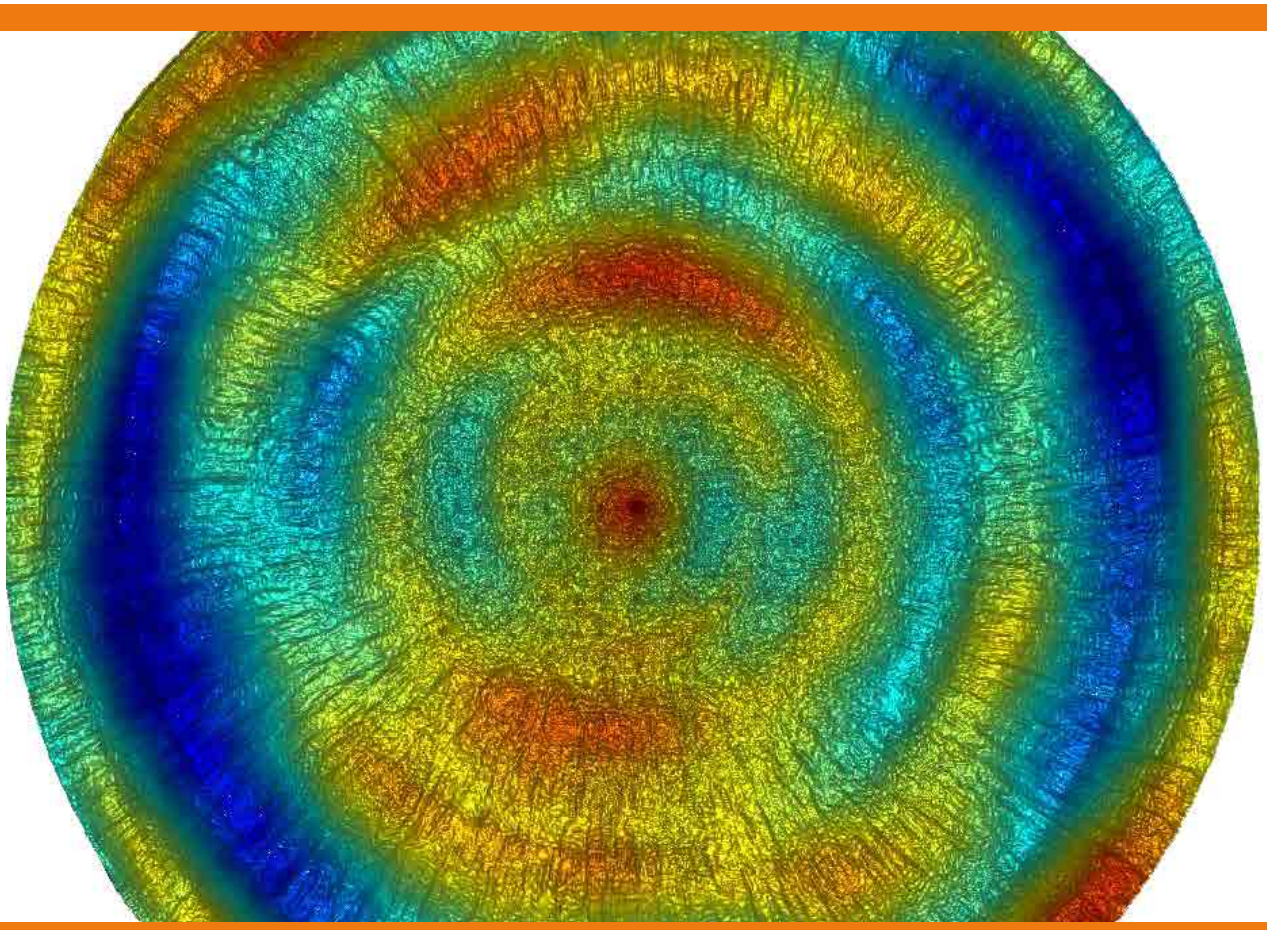
European Metrology Research Programme

Delivering Impact

EURAMET



Supporting high-quality consumer optics

Photonics – the science of light – is one of the key enabling technologies for Europe and is used in applications as diverse as smartphones and astronomy. In 2012, the European photonics industry employed around 377,000 workers in a market worth over €65 bn. State-of-the-art measurement techniques which enable the development and manufacture of sophisticated optical components are needed to ensure Europe sustains its strong position in this rapidly growing market.

Europe's National Measurement Institutes working together

The European Metrology Research Programme (EMRP) brings together National Measurement Institutes in 23 countries to address key measurement challenges at a European level. It supports collaborative research to ensure that measurement science meets the future needs of industry and wider society.

Challenge

Many photonic technologies require optical components, such as lenses or mirrors, with more complex geometries than traditional spherical systems. High-quality consumer optics such as eyeglasses, cameras and DVD players all use free-form lenses. These lenses offer superior imaging quality over spherical lenses, and a single lens can be used where previously a much larger, multiple lens system would have been necessary. This allows manufacturers to produce smaller, lighter, higher-quality devices.

The shape of the surface of free-form lenses strongly determines their performance, and they must be accurately fabricated to meet demanding specifications. Advanced manufacturing techniques are capable of shaping optical surfaces with nanometre resolution, but accurate surface measurements are essential if components are to meet design specifications. The accuracy needed for this surface topography measurement still is highly challenging.

Thus, more accurate and efficient measurement techniques were needed to support the production of improved optical components and enable development of the innovative technologies which exploit them.

Solution

The EMRP project *Optical and tactile metrology for absolute form characterisation* significantly improved the absolute form measurement of components. One example of project delivery is improvements to the design of a free form optics interferometer, based on the Tilted-Wave Interferometry principle. The Tilted-Wave Interferometry approach illuminates a surface from several directions at once, enabling quick, high-precision measurements of small and strongly curved samples.

The project also developed new and improved measurement methods for determining the spatial resolution and sources of errors during measurement of both flat and curved surfaces. To efficiently handle the large data sets produced during form measurements new topography combination software was validated and a new procedure developed for the quantitative comparison of surface topography measurements made by instruments based on different techniques.

Impact

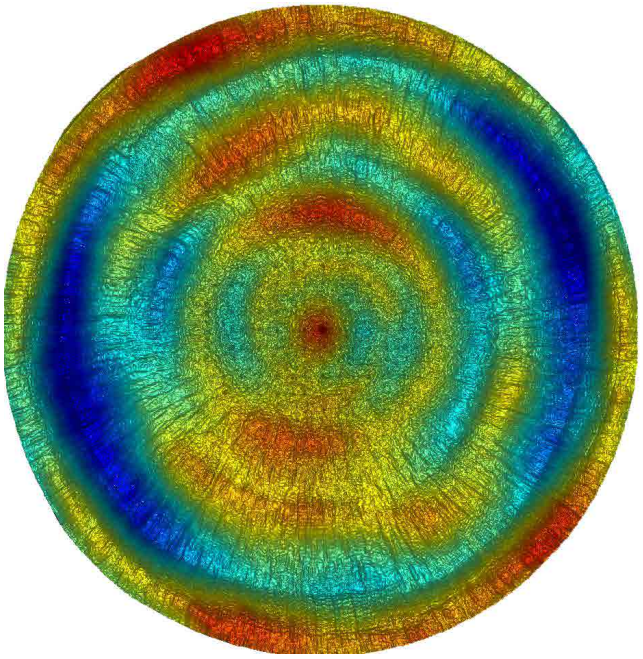
Mahr GmbH, a leading metrology instrument manufacturer has developed an improved prototype Tilted-Wave Interferometer (TWI) for precisely measuring aspheric and free-form lenses and mirrors. This innovative instrument can make measurements fast and with great accuracy.

Mahr has been able to confirm the accuracy of their prototype TWI and has improved the instruments environmental control system. A commercial instrument is now available, offering Mahr's customers a new faster, cheaper and more accurate way of characterising aspheric and free-form lenses. This gives Mahr a commercial edge in an increasingly demanding and rapidly-expanding market.

Manufacturers of a wide range of optical products from eyeglasses to DVD players purchasing this instrument will benefit from increased production efficiency and decreased design costs.

Metrology for optical surfaces

The EMRP project *Optical and tactile metrology for absolute form characterisation* significantly improved the absolute form measurement of optical components – ranging from flat surfaces to aspherical and free-form surfaces. Different physical probing principles were combined and compared to develop improved measurement techniques, tools and standards which support the accurate measurement of optical surfaces. These capabilities will lead to the design of better optical components and systems, which can be manufactured with less energy and waste, and help strengthen Europe's position in the global photonics market.



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Michael Schulz
PTB, Germany
+49 531 592 4210 | michael.schulz@ptb.de

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