

# Asphärenmesstechnik im Rahmen des Europäischen Metrologie - Forschungsprogramms EMRP



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The European Metrology Research Programme (EMRP) is a metrology-focused European programme of coordinated R&D that facilitates closer integration of national research programmes.



Flatness measurement:  
Curved surfaces (aspheres, freeforms):  
Methods:

## State of the art

Uncertainty  $\geq 1$  nm (deflectometry), but lateral resolution  $\approx 1$  mm  
Uncertainty reliably achieved  $> 100$  nm  
Optical and tactile single point and interferometric imaging methods



## Objectives

### General

- Improve competitiveness of European optical industry
- Enable 'smarter' manufacturing of optical components
- Create metrological innovations by combining different technologies

### Specific

- Improve form measurement for optical surfaces
- Analyse error influences in interferometry
- Create calibration standards
- Investigate errors in tactile scanning methods
- Compare imaging and scanning methods
- Establish guidelines for measuring
- Adapted software / comprehensive characterisation

Secure Europe's strong position in the global photonics market

# Optical & tactile metrology for optical surfaces

## Excellence

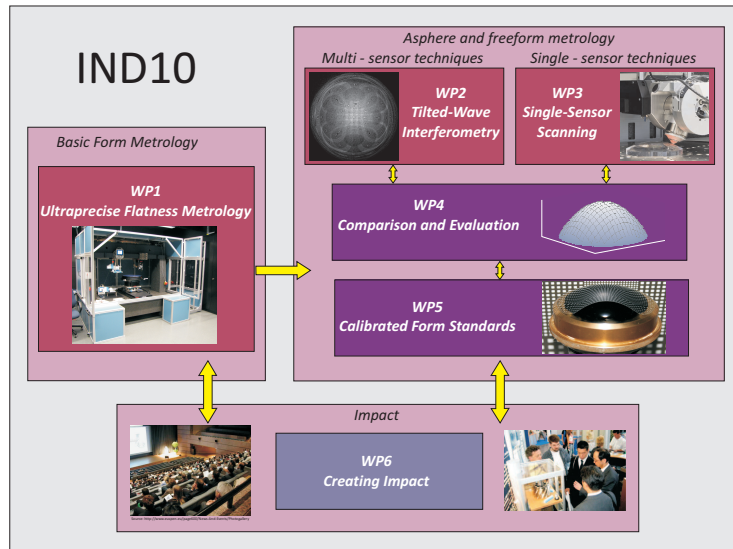
### Scientific

- The consortium brings together the internationally acknowledged experts from NMIs, institutes, industry
- Innovative principles and inventions by the partners
- Interdisciplinary concept: cooperation of precision engineering, optics and data analysis experts

### Technical

- Ultraprecise tactile scanning, including Zeiss F25
- Ultraprecise optical point sensors, incl. NANOMEFOS
- Tilted Wave Interferometry for aspheres
- Traceable Multi Sensor technique for interferometry
- Innovative concepts for measurement data analysis

Project concept furnishes a new quality in form metrology of optical surfaces



## WP7

### JRP Management and Coordination

- Implementation of management board (Coordinator & WP leaders)
- Internal status report system
- Project meetings / reports

### Output

- Interim / progress / final reports
- Full control of progress
- Detection of possible problems at an early stage
- Securing high scientific / economic output of the JRP

Partners: PTB, all

## WP6

### Creating Impact

- Optical industry / manufacturing
- New measuring instruments
- Knowledge transfer

### Output

- Publications, presentations (EUSPEN, FRINGE, SPIE,...)
- Implementation of ISO working group „Freeform Optics“
- Technology offers, leaflets to fairs, internet marketplace, patents
- Guestworker training

Partners: PTB, all

## WP1

### Ultraprecise flatness metrology

- Mirrors, reference surfaces
- Size up to 1 m
- Different sensor types

### Output

- Improved autocollimator calibration
- Capacitive / optical sensor comp.
- $U < 1$  nm (pv) / 0.25 nm (rms)
- Lateral resolution  $< 0.1$  mm
- EADS: Exact Autocollimation Deflectometric Scanning

Partners: CMI, PTB

## WP2

### Tilted-Wave Interferometry for Asphere/Freeform Metrology

- Strongly curved surfaces
- Size up to 200 mm
- Traceable stitching technique

### Output

- Uncertainty model of TWI
- 1D/2D Scanning TWI setup
- $U \leq 20$  nm
- Lateral resolution some 10  $\mu$ m

Partners: ITO, PTB

## WP3

### Single sensor scanning (optical/tactile)

- Optical surface artefacts
- Optical and tactile probes
- Probe surface interaction

### Output

- Artefact characterisation
- Task dependent uncertainty
- $U \leq 30$  nm

Partners: VSL, CMI, METAS, LNE, MKEH, SMD, IBSPE, IPMS, TNO, Xpress

## WP4

### Comparison of optical / tactile methods and development of evaluation software

- Topography details / coordinate systems / data grids
- Parameterisation of surface

### Output

- Comparison optical / tactile & single point / scanning instruments
- Software algorithms
- Guidance for comparison of topography data

Partners: LNE, PTB, METAS, MKEH, SMD, VSL, IPMS, IPT, TNO, Xpress, ITO

## WP5

### Development and provision of calibrated form standards

- Develop standards and calibration procedures in cooperation with industry
- Lateral positioning of specimen

### Output

- Set of calibration standards for different applications
- Calibration service by at least one NMI

Partners: PTB, METAS, MKEH, SMD, VSL, IBSPE, IPT

## Coordinator Funded partners



## Unfunded Partners



## REGs

