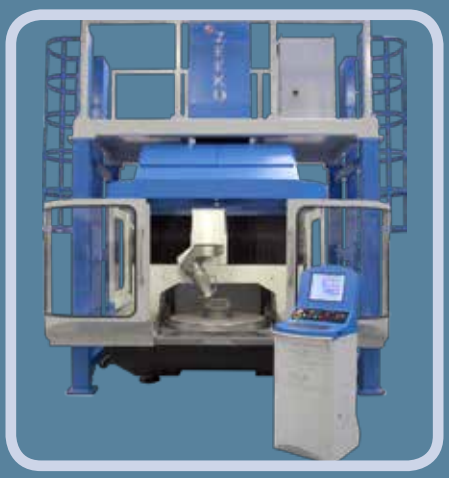
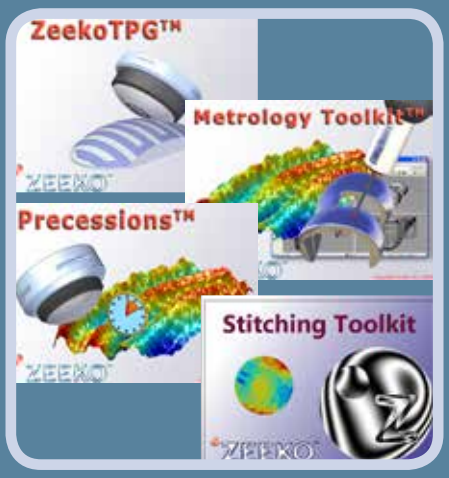
Complete Fabrication Solutions for Complex Ultra-Precision Surfaces





ZEEKO Ltd

Precision Grinding

Ultra-Precision Polishing

Integrated Metrology

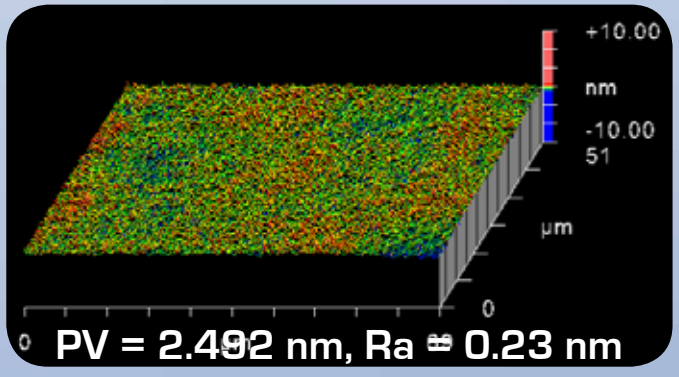
Software

THE QUEEN'S AWARDS
FOR ENTERPRISE:
INNOVATION
2011

Since its formation, Zeeko has progressed from being an innovative start-up company with solutions for the polishing of ultra precision surfaces for telescope mirrors and other optics, to occupy a market leading position with a product portfolio that covers the grinding, polishing and metrology of complex surfaces. Zeeko remains an innovative and dynamic technology based business with globally protected Intellectual Property that currently extending to over 50 worldwide patents.

Zeeko specialises in the manufacturing and commercialisation of Ultra-Precision Polishing Machines famously known as the Intelligent Robotic Polishers (IRP). These Robots are manufactured for fabricating high precision optics, orthopaedic joints, semiconductor components and precision moulds in a number of different materials.

The machines are supplied with state of the art software and processes suitable for the production of the most complex freeform artefacts. Covering a range of part sizes from 1.5mm to 6m they utilise patented processes including the mechanical "ZeekoClassic" technology and the "ZeekoJet" solution. These cost effective solutions are deterministic and scalable from the smallest cell-phone requirements to the largest astronomy applications and are suitable for polishing most materials from traditional optics materials, stainless steel etc. to both tungsten carbide and silicone carbide.



THE QUEEN'S AWARDS
FOR ENTERPRISE:
INNOVATION
2011

ZEEKO Ltd

Solutions Through the Process Chain

Contents

Precision Grinding

The hardware for Zeeko grinders is built by Cranfield Precision, Division of Cinetic Landis, its hardware partner for this product range. This collaboration combines Zeeko's optics fabrication knowledge and software expertise with the experience of Cinetic Landis, in the design and build of ultra-precision grinders and single point diamond turning machines

All grinders are fitted with:

- Linear motors
- Hydrostatic or air bearing rotary spindles
- Hydrostatic or air bearing linear slideways
- High precision linear and rotary encoders
- Temperature controlled hydrostatic power systems and environmental enclosures (different temperature control packages can beselected)
- Passive vibration isolation
- Optional part probing and part measurement (different solutions may be specified)
- Capability to operate in Raster or Spiral mode as well as rotationally symmetric or freeform mode (subject to the software selected)

For information on any one of the machines in this range please see the individual product specification sheets

Precision Grinding

The TTOG (Twin Turret Optics Grinder) Range for freeform optics grinding

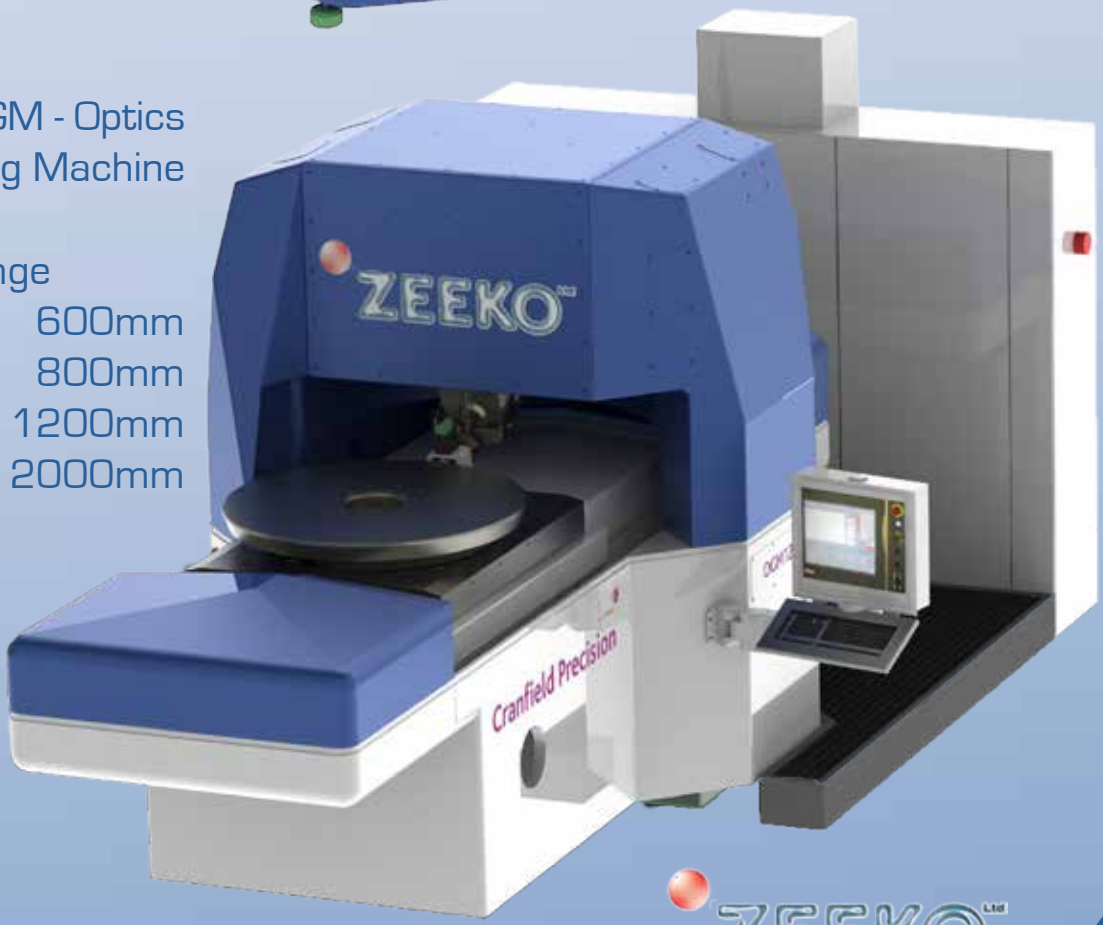
Range

- 50mm
- 100mm
- 200mm
- 400mm

The OGM - Optics Grinding Machine

Range

- 600mm
- 800mm
- 1200mm
- 2000mm



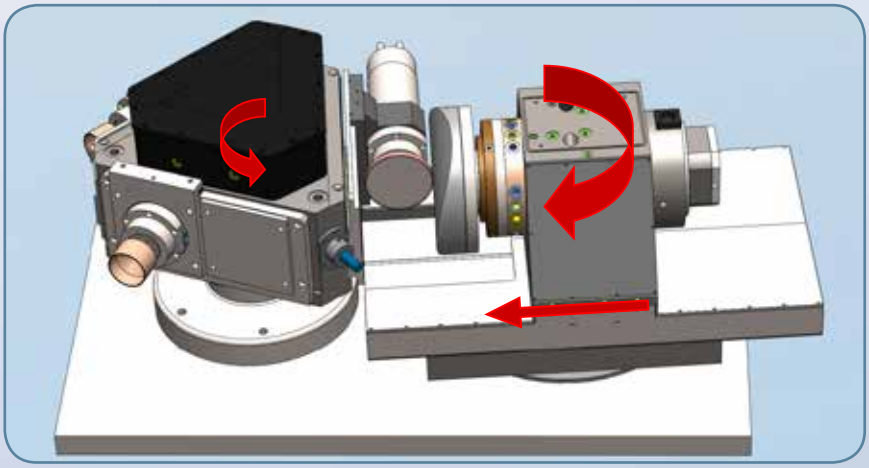
Precision Grinding

The TTOG
(Twin Turret Optics Grinder)
Range for freeform surface generation

Range 50mm to 400mm

Compatible with Zeeko Grolishing process

Patents Granted in UK and Europe



Optional Heads Include:

Rough and Fine grinding

Part Probing

Light-Weighting

Edging

Chamfering

Precision Grinding

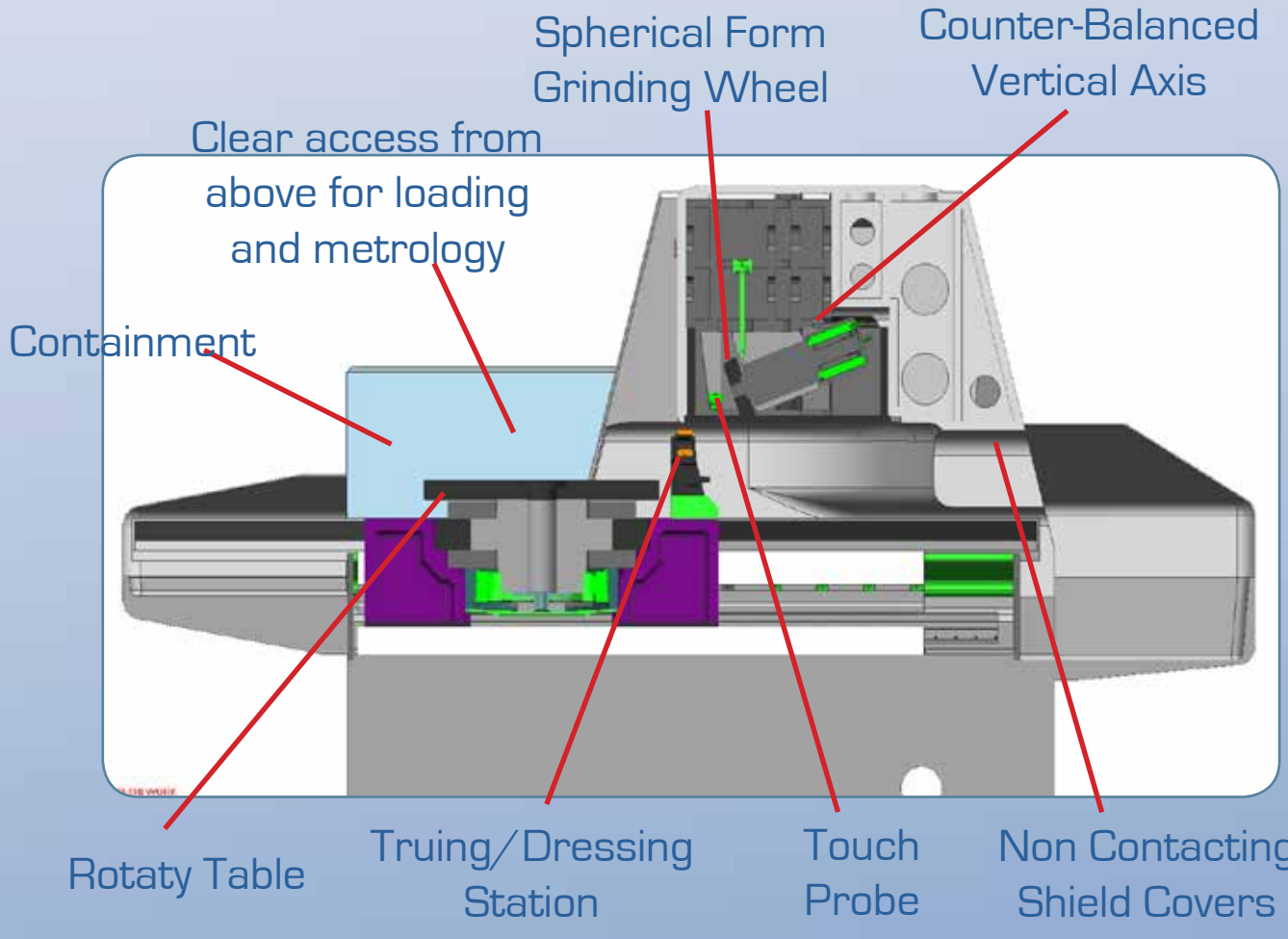
The OGM - Optics Grinding Machine

Range 600mm to 2000mm

Vertical axis with patented ultra low hysteresis counterbalance system
Patents Granted in UK

Optional Heads Include:

Rough and Fine grinding
Part Probing
Light-Weighting
Edging
Chamfering



Ultra-Precision Polishing

IRP50 / IRP100
For Parts up to 50mm/100mm Diameter and
Free-Form Parts up to 50mm x 50mm / 100mm x 100mm

IRP200
For Parts up to
200mm Diameter or
Free-Form Parts up to
200mm x 200mm

Slurry Management Unit (SMU)

IRP400
For Parts up to
400mm Diameter or
Free-Form Parts up to
400mm x 400mm

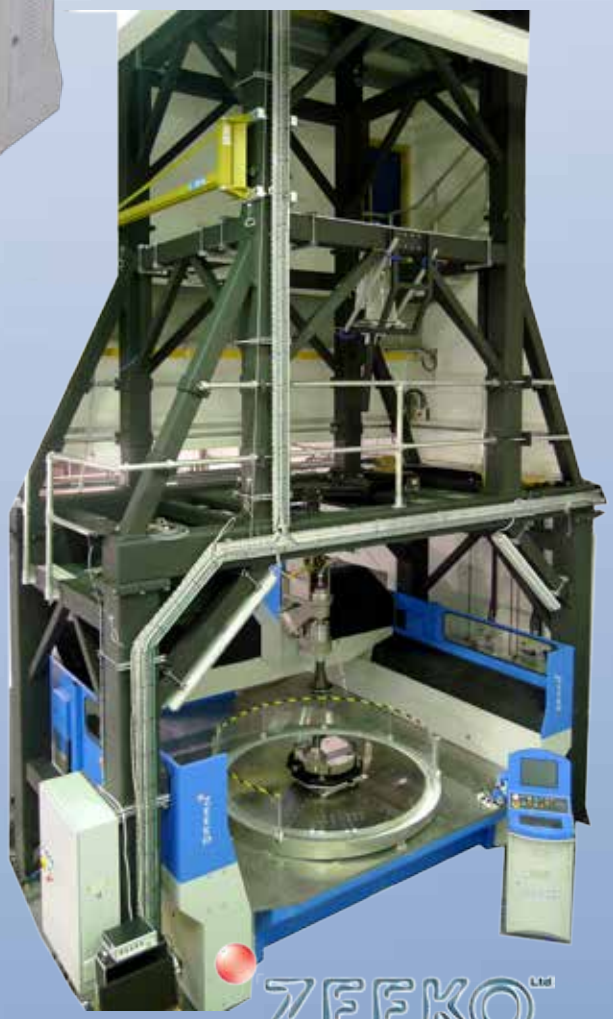
IRP600
For Parts up to
600mm Diameter or
Free-Form Parts up to
600mm x 600mm

IRP800
For Parts up to
800mm Diameter or
Free-Form Parts up to
800mm x 800mm

Ultra-Precision Polishing

Zeeko Optics Fabrication Centre 1200mm

For Parts up to 1200mm Diameter or Free-Form Parts up to 1200mm x 1200mm



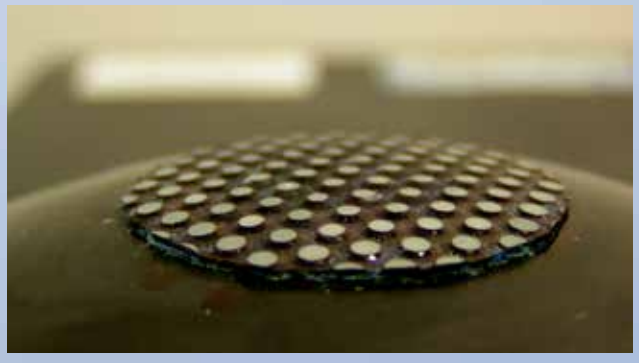
Zeeko Optics Fabrication Centre 1600mm

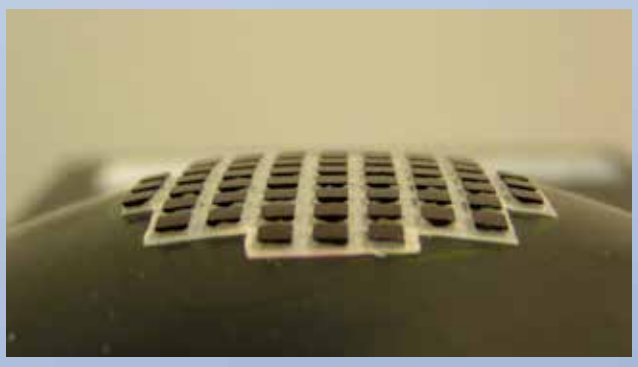
For Parts up to 1600mm Diameter or Free-Form Parts up to 1600mm x 1600mm

Ultra-Precision Polishing

Zeeko polishers have been developed over a period of more than 10 years and follow a philosophy of continuous improvement. All machines are built on a universal platform that enables convex, concave, freeform and other complex geometries to be polished.

All machines can (subject to the correct selection of the software) polish any of these geometries and use raster, spiral or more complex tool-paths to achieve finishes that can be as good as 2-3 Angstrom, and form accuracies that can be as good as lambda/20 P-V dependent on the material, metrology and prior condition.





Ultra-Precision Polishing

All machines can perform:

- Grolishing
- Pre-polishing
- Corrective polishing and finishing processes using:
- “Classic” (or bonnet polishing)
- Jet polishing
- Pitch laced polishing (for finishing)
- Smoothing
- Spiral Tool Path
- Raster Tool Path
- Random Tool Path
- Adaptive Spiral Tool Path

Integrated Metrology

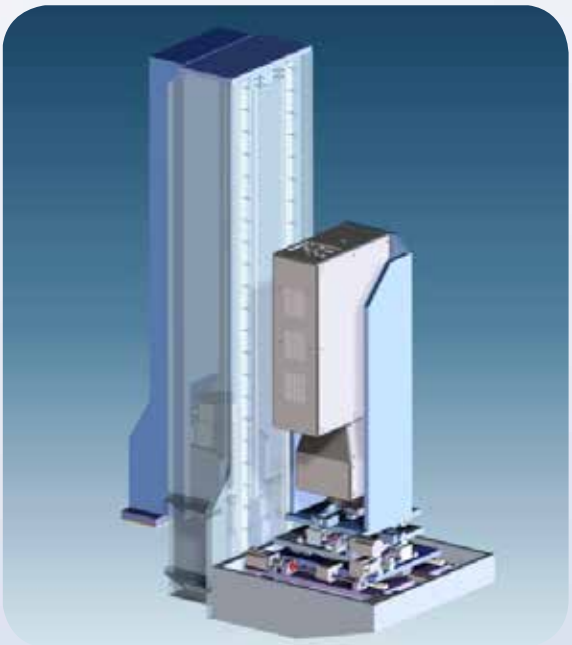
All Vertical machines can be used in “Optics Fabrication Centre” mode where a choice of metrology options can be built into the machine: see list on opposite page.

Integrated Metrology

- Full aperture interferometry (often with the part kinematically mounted on a Zeeko optics support system)
- Sub-aperture stitching interferometry combined with a Zeeko rotary tilt stage with centering and levelling
- Integrated swing arm profilometer
- Surface Texture Analysis white light interferometer (STA1)
- Integrated scanning penta-prism – long trace profilometer

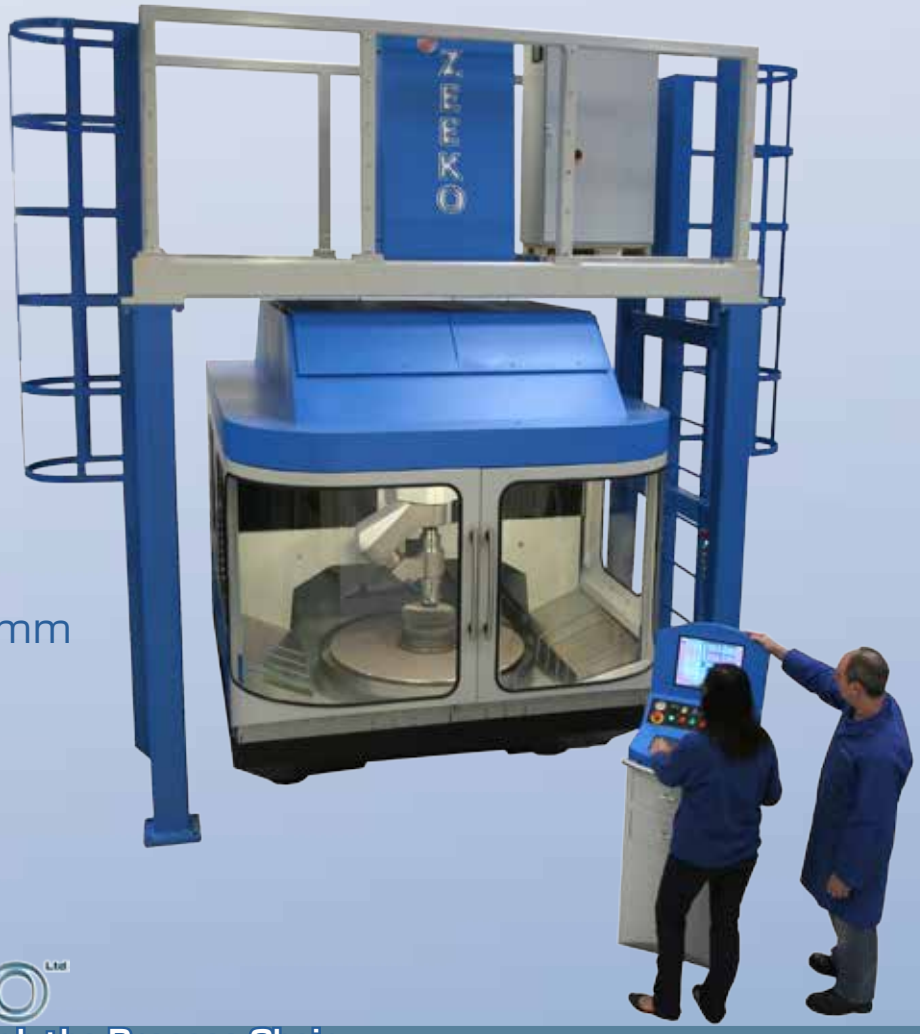
Integrated Metrology

Zeeko Bespoke Designed Test Tower with integrated 5-Axis Stage



The remotely operated CNC 5 axis stage with mounted vibration insensitive interferometer for full aperture measurement.

The system can carry a CGH as required and is mounted to a metrology tower above the machine and operated from the machine console.



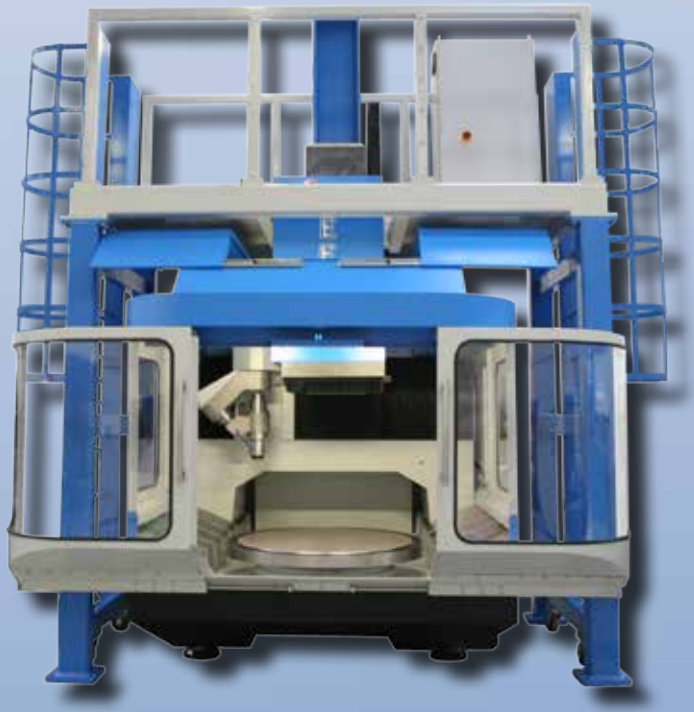
Zeeko
Optics
Fabrication
Centre 1200mm

Integrated Metrology

Zeeko
Optics Fabrication Centre
1200mm

In polishing mode with roof doors closed and interferometer in parked position

Full aperture interferometry mode with roof doors open

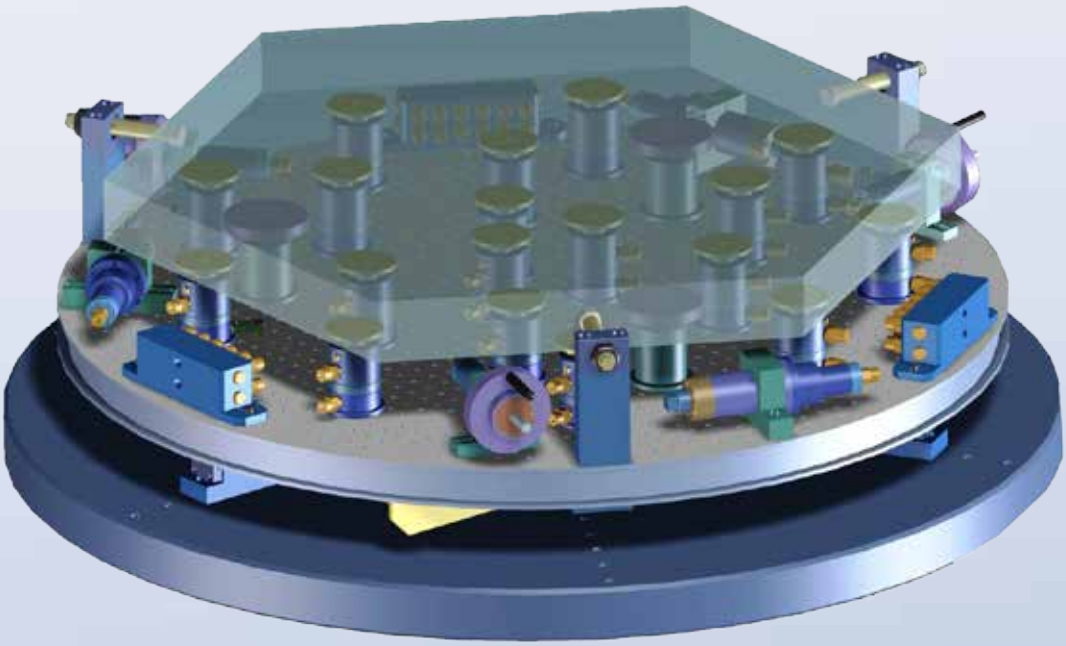


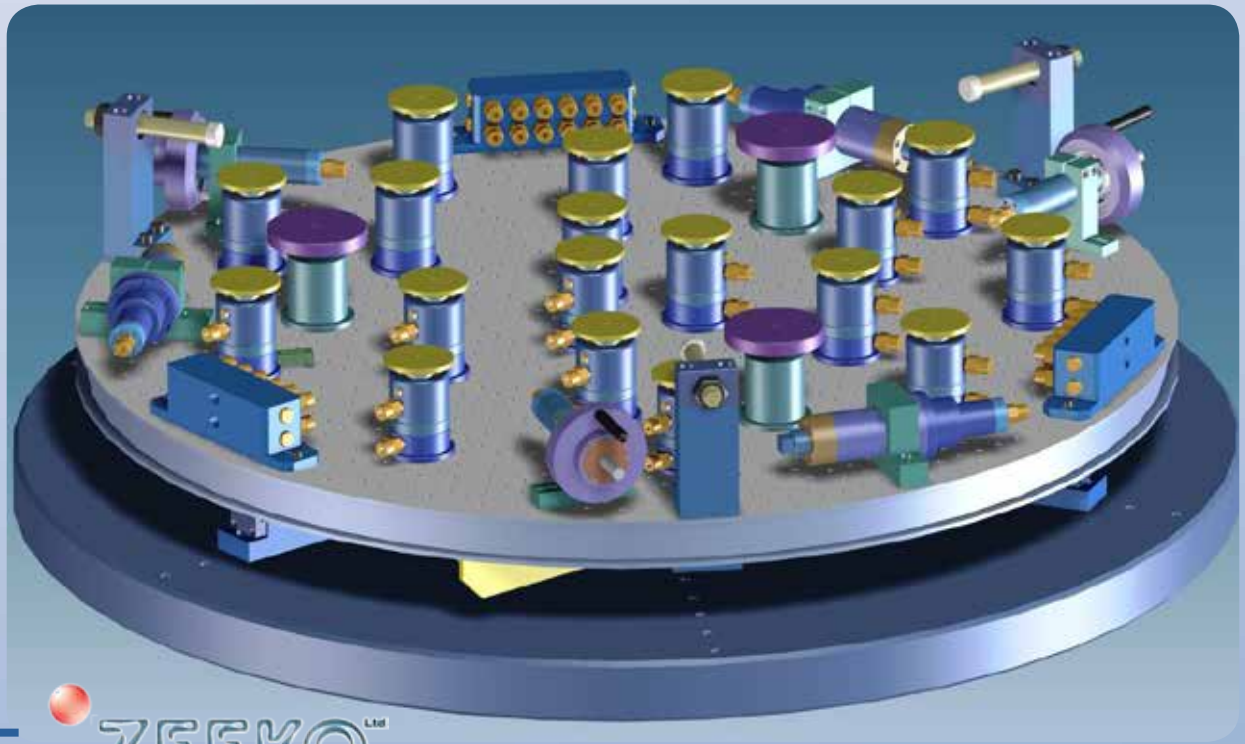
Inteferometer lowered to focus on subject part

Mirror Support System

Applicable to, the polishing and metrology stations, Zeeko's Modular Mirror Support System is a selectable, versatile, fully self contained, hydraulically operated solution for the support, adjustment, and tilt compensation of the subject optic.

Flexible placement of the optical support units allows for repeatable part support during measurement. When lowered, the mirror is supported during the polishing process.

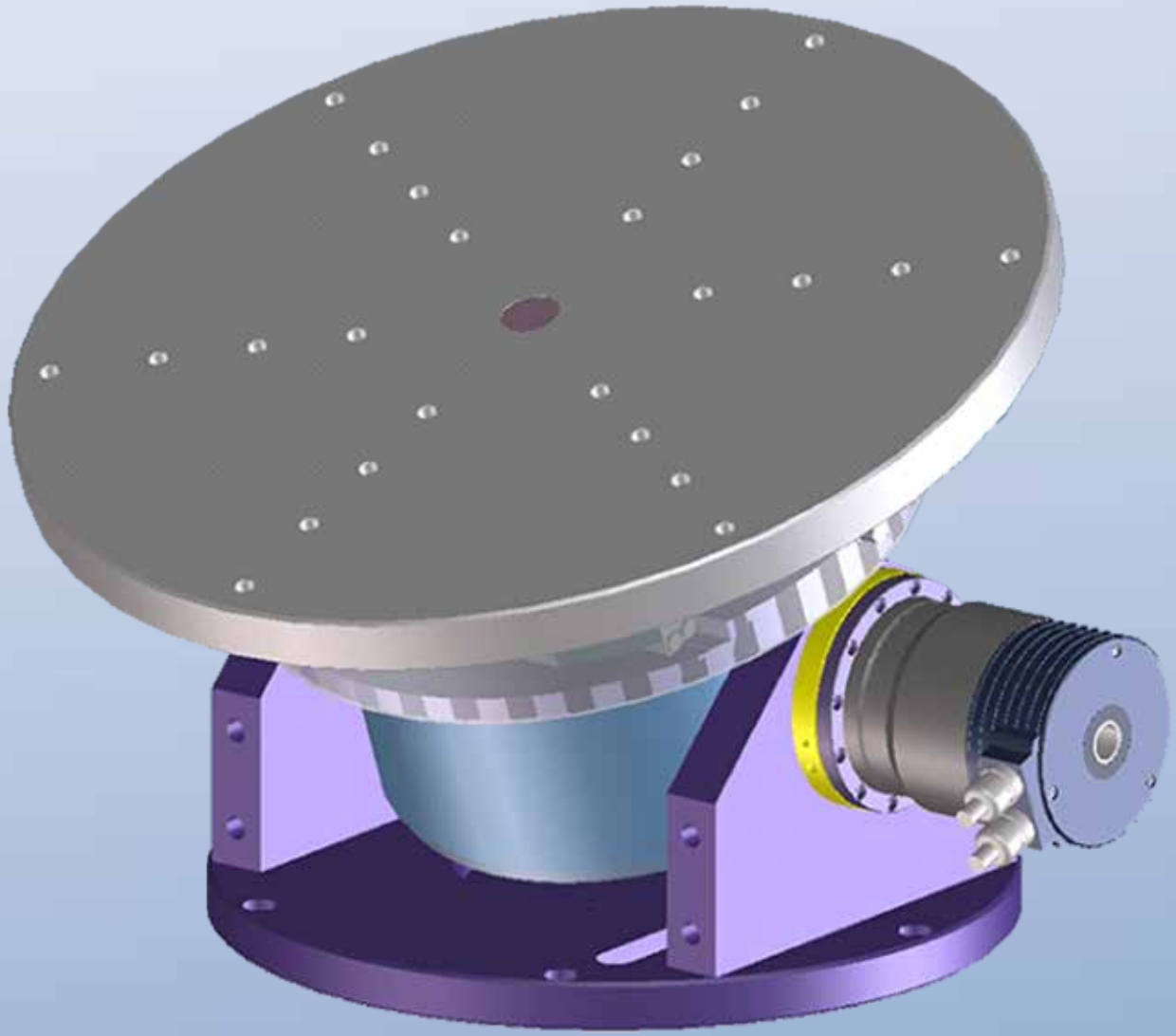




Rotary Tilt Stage

The tilting rotary stage with integrated centering and levelling mechanism is a precision table designed for the measurement of convex optical components and is especially suitable for use in conjunction with Zeeko's vertical interferometer 5-Axis Stage Test Tower and Stitching Toolkit.

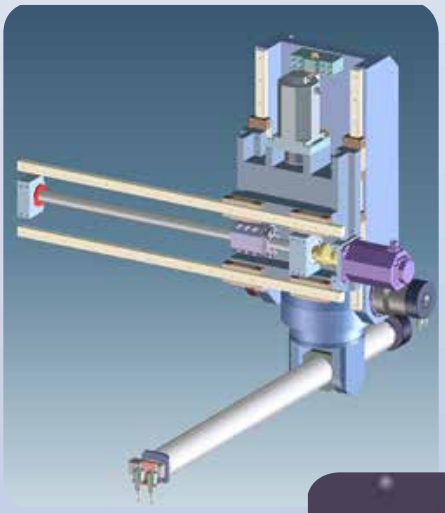
The system is produced in several different table diameters. Below is the 525mm rotary table version capable of handling steep parts up to 450mm diameter.

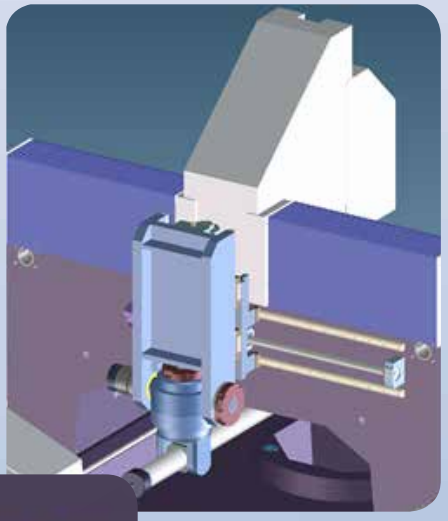


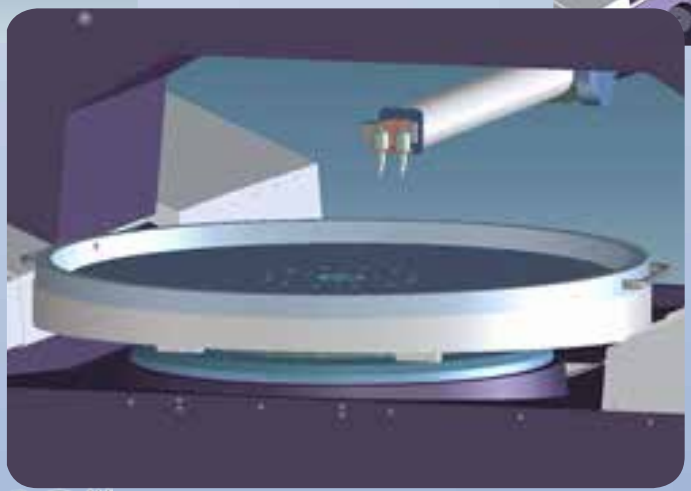
Swing Arm Profilometer

The Zeeko Integrated Swing-Arm Profilometer is a profiling instrument designed to provide measurement capability for larger optics. The part to be measured is mounted on the C-axis of the IRP machine on a suitable support system. In order to measure the part's departure from a sphere, a tilted swinging arm is used to move a probe (which can be contacting or non-contacting) across the surface under test.

The unique geometry of the swing-arm results in the probe providing a direct measure of the part's departure from spherical. By combining the arm swinging motion with the rotary table motion, it is possible to build up 3D error maps of the surface under test.
The data produced by the swing-arm profilometer can be used to guide corrective coarse figuring and also fine polishing and can be used to make corrections on a part where an interferometric measurement is not possible.

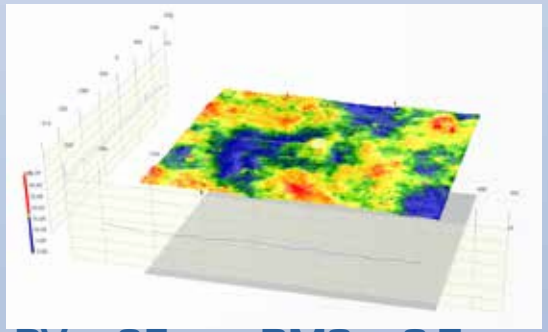






Surface Texture Analysis white light Interferometer - STA1

The Zeeko STA1 system is capable of making surface roughness measurements whilst mounted to the polishing head of a Zeeko IRP machine. Using the machine's software, the STA1 can be programmed to log surface texture information at a number of predetermined points across the subject optic.



PV = 35 nm, RMS = 0.7 nm

The STA1 is used for Surface Texture Analysis and comprises a vibration insesitive white light interferometer that is supplied by Zeeko's Optical Metrology Partner, 4D Technologies Inc.

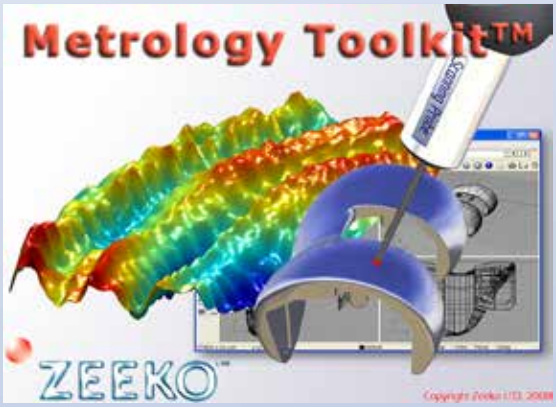
It is mounted to the Zeeko polishing head replacing the polishing bonnet and can measure the surface texture at any point on the subject surface.

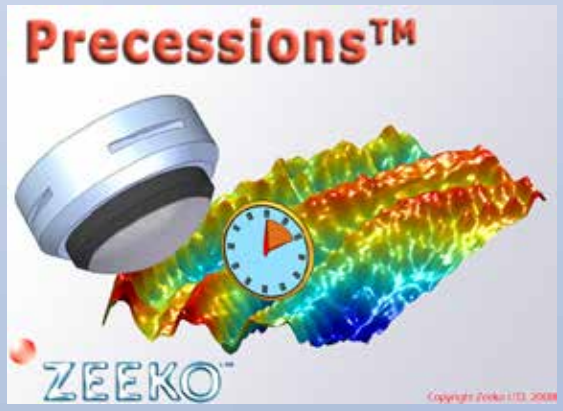
Software

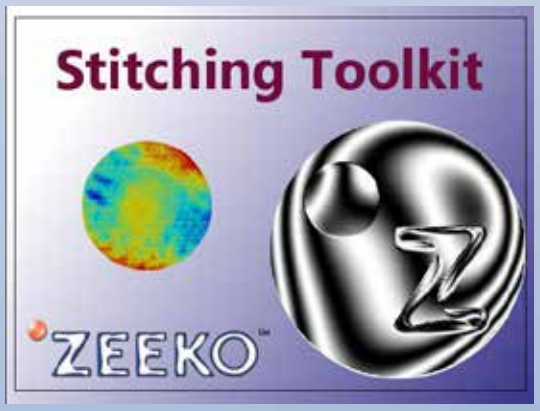
In every case, the Zeeko Optics Fabrication Support software has been developed in response to specific customer applications.

The software solutions described below are all available for individual purchase or to be supplied with machine packages.

- Precessions™
- TPG
- Metrology Toolkit
- Stitching Toolkit for sub-aperture Interferometry
- Profiler software
- Grinder software for corrective grinding
- Other specialist applications







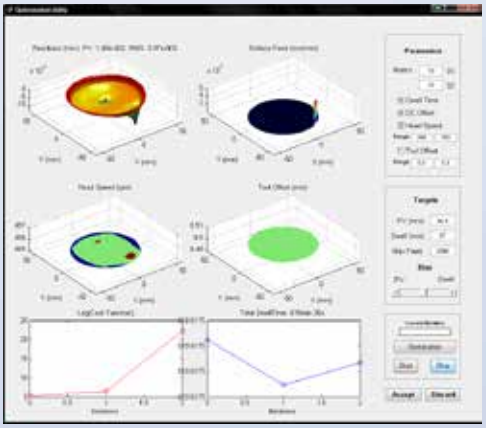
Zeeko Precessions

- Precessions is capable of optimising simple and complex tool paths in order to efficiently reduce surface form deviations within little iteration. It is used in connection with Zeeko TPG, which outputs CNC code to the Zeeko IRP Series of polishing machines

- 3 Software editions to choose from: 2D, 2.5D or 3D

Product Features:

- Integrated Surface Designer (In conjunction with Zeeko TPG ™)
- Tool Path Modules (In conjunction with Zeeko TPG ™)
- Metrology Interface
- Influence Function Database
- Advanced Optimisation Module
- 64 Bit Version and Parallel Processing Module



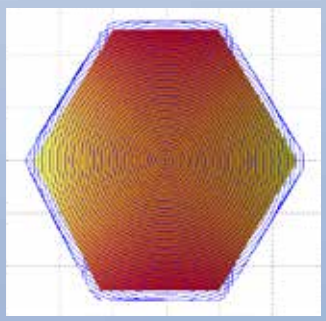
Zeeko Tool Path Generator (TPG)

- Zeeko TPG is capable of generating simple and complex tool paths for the Zeeko IRP Series of polishing machines. It can be used stand alone or in connection with Precessions.

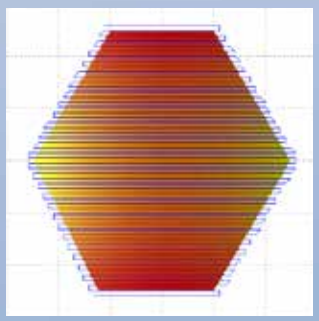
- 3 software editions to choose from: 2D, 2.5D and 3D.

Product Features:

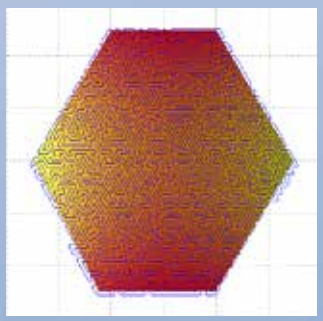
- Integrated Surface Designer
- Tool Path Modules
- On-Machine Geometry Compensation
- Form Correction Module (Moderation)
- 3rd Party Tool & Machine Support (SDK)



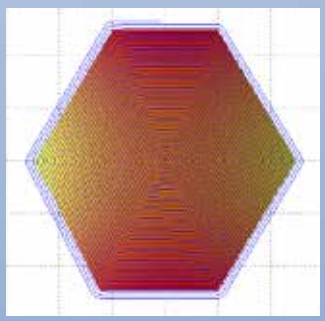
Spiral Tool Path



Raster Tool Path



Random Tool Path



Adaptive Spiral Tool Path

Metrology Toolkit

- The Metrology Toolkit software is capable of reading data from a wide variety of Metrology Instruments, to process and analyse it. The software can also export surface deviation maps:
  - To the native file format of the measuring instrument
  - As corrected tool paths for precision machine tools (Grinders, SPDT...)
  - To other software packages such as: ZeekoTPG, Precessions, Mountains, Talymap, Surfstand, MetroPro...
- 3 Software editions to choose from: 2D, 2.5D or 3D.

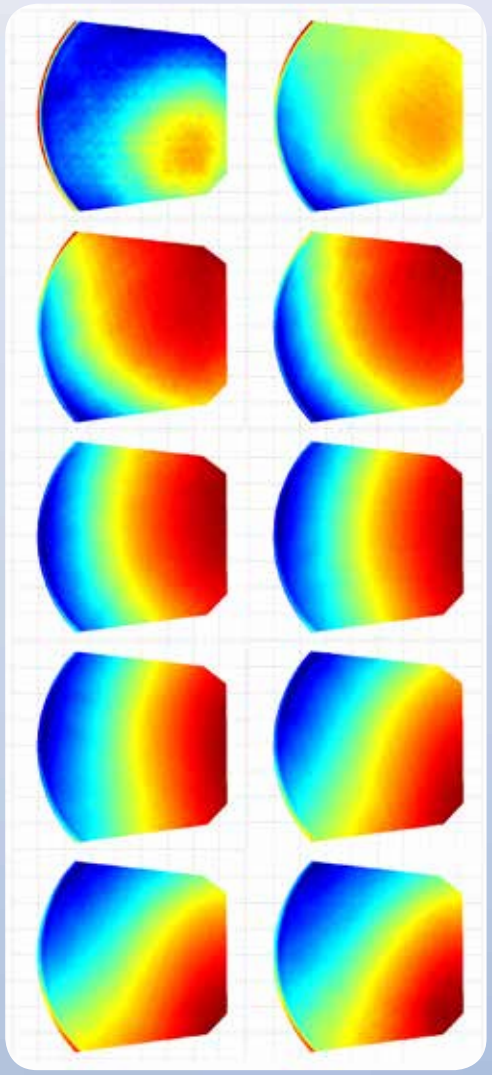
Product Features:

- Integrated Surface Designer
- Metrology Interface
- Basic Geometry Manipulations
- Advanced Data Processing
- Data Combining and Analysis
- Point Clouds and Data Stitching
- Integrated Custom Script Editor
- Machining Compensation
- Data Visualisation Modes

Stitching Toolkit

The Zeeko Stitching Toolkit is an extensible software application designed for sub-aperture interferometry data stitching. The number of sub-apertures that can be stitched is limited solely by computer memory. The stitching software can easily be configured to optimise standard fitting terms depending on the particular part in question. With the correct auxiliary equipment (hardware) and data processing, the software can stitch plano, spherical and aspherical parts.

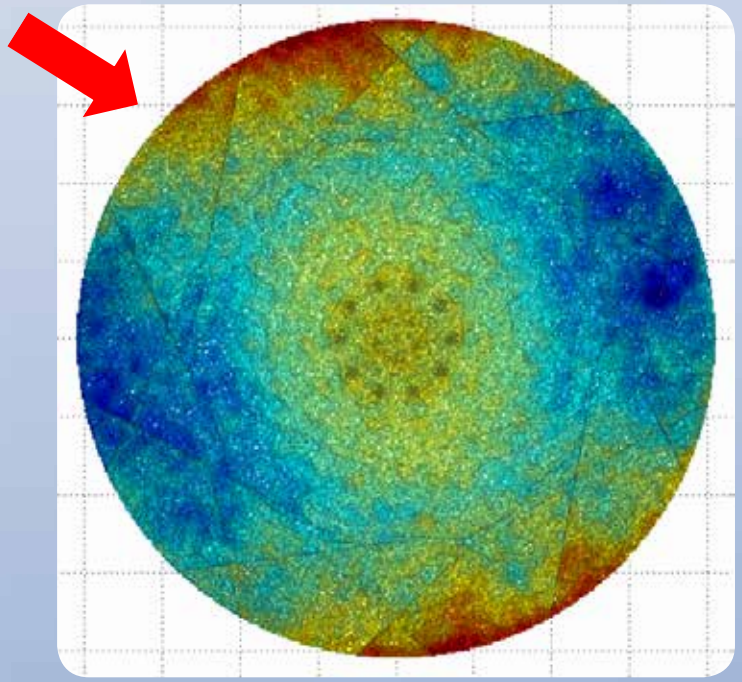
The software also performs stitching terms analysis and contains a very powerful Zernike fitting tool that can be used to construct arbitrary wavefronts.



Raw sub-aperture measurements

Principle of Stitching

Computes stitched measurements result: example testing an asphere.



Stitching software finds the correct terms to fit to each sub-aperture to stitch the data together

ZEEKO Ltd

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