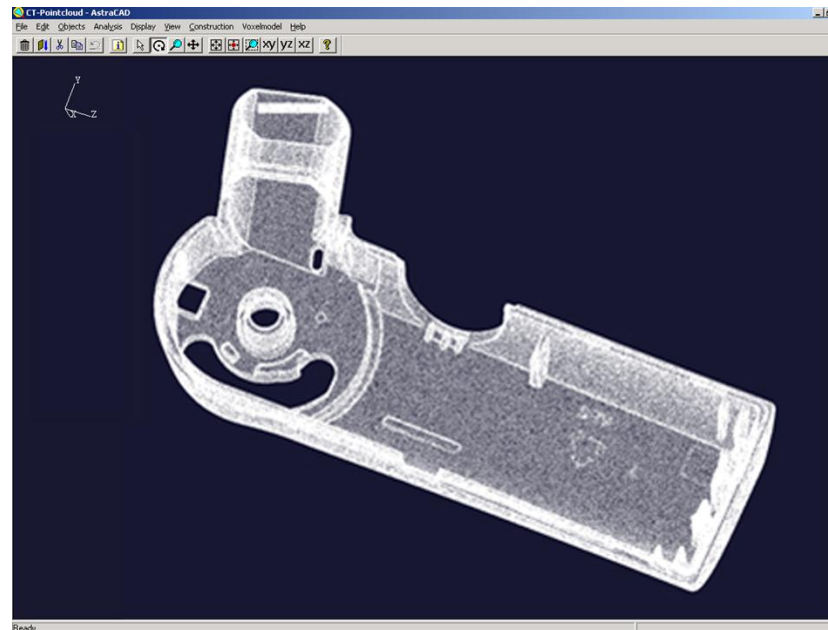


Measuring Microfeatures with Dense Point Clouds

Scanning with tomography, microprobes and confocal or contrast variation systems



Dr.-Ing. Ingomar Schmidt

- Geometries smaller than 300 μm , which cannot be reached by “standard” probes
- Part tolerances between 1 μm – 20 μm
- Independent of workpiece size



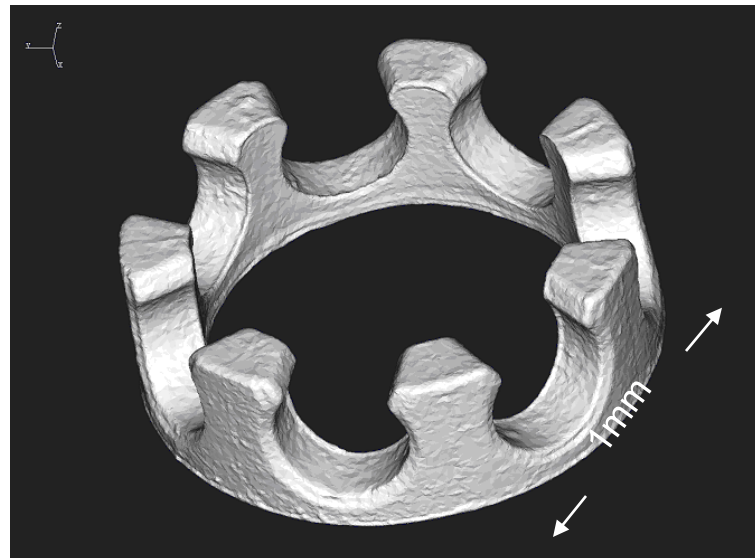
Measure Microfeatures

No difference in the possibilities compared to standard geometries
(with the right sensor)

- Dimensions
- Position
- Form / Shape
- Roughness

Measure Microfeatures

Standard sensors do not deliver enough point density, because feature form in relation to dimension is almost always worse.

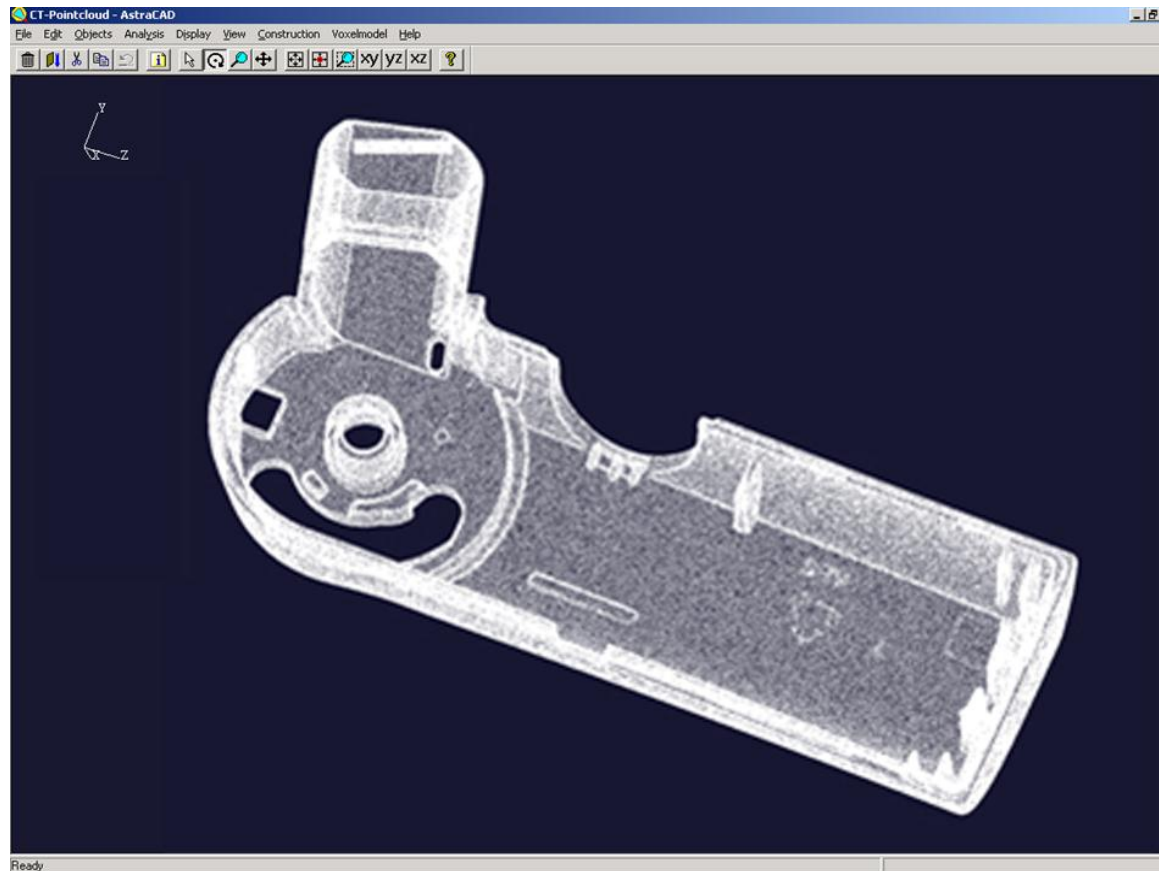




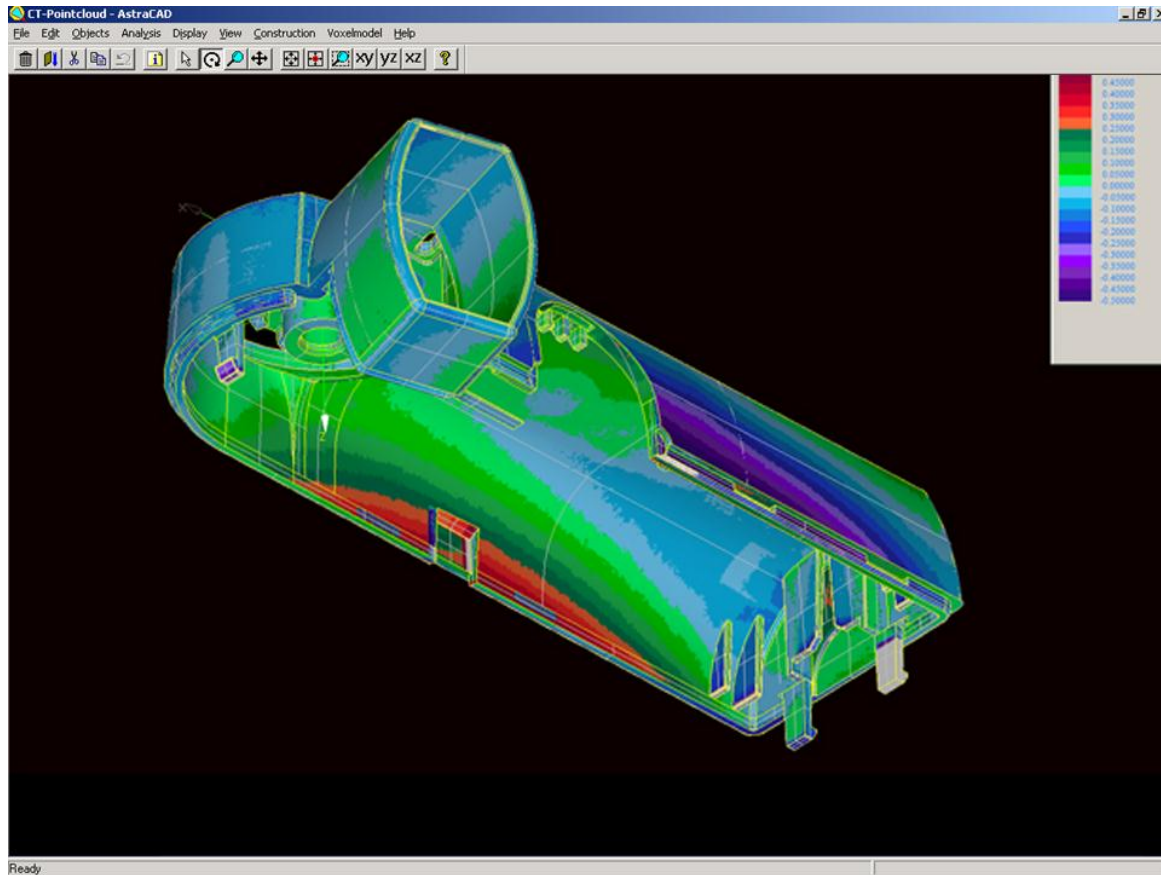
Measure Microfeatures

- Solution: Create dense point clouds by using the right sensor technology

Measuring Point Clouds



Color coded Presentation



The “Microfeature CMM“



Werth VideoCheck® UA 400x400

-Highest precision and accuracy for measurements on MICROPARTS due to one nanometer resolution and accuracy optimized design

- MPE E1 _(unid./20x): $(0.15 + L / 900) \mu\text{m}$

- MPE E _(3D WFP): $(0.25 + L / 600) \mu\text{m}$



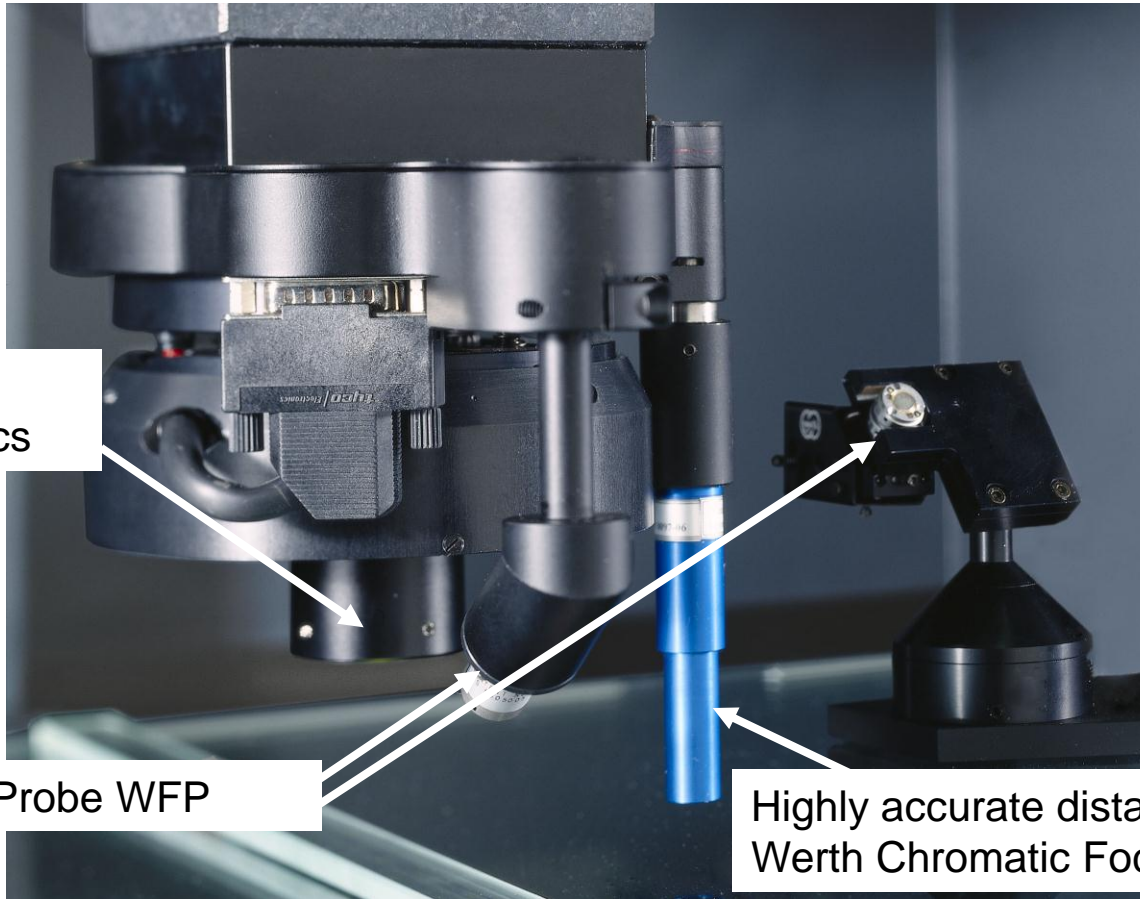
Werth VideoCheck® UA 400x400

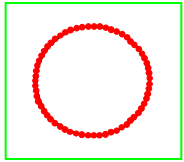
Multisensor Head

High precision,
telecentric optics

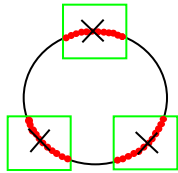
Werth Fiber Probe WFP

Highly accurate distance sensor
Werth Chromatic Focus Probe (CFP)

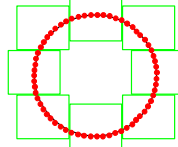




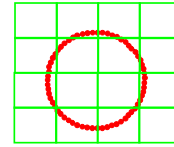
IP in Picture



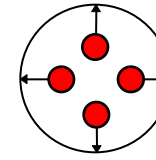
IP at Picture



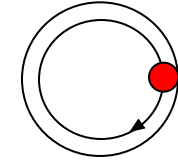
IP Scanning



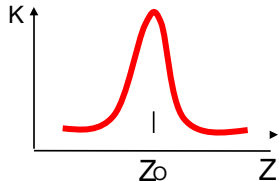
Grid Scanning



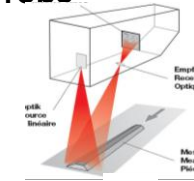
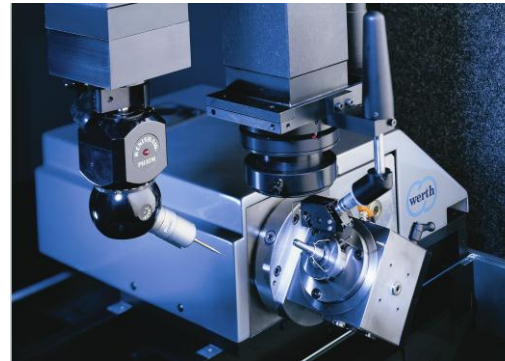
Trigger Probe



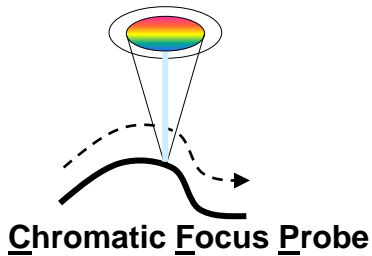
Scanning Probe



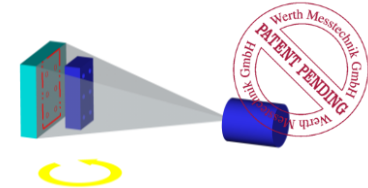
Focus Variation



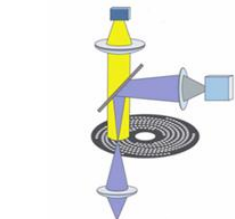
Laser Line Probe



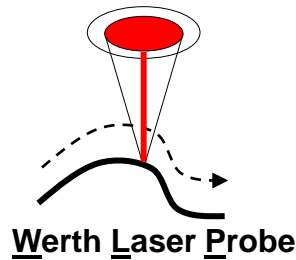
Chromatic Focus Probe



Computer Tomography



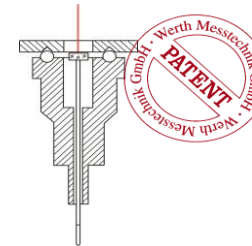
Nano Focus Probe



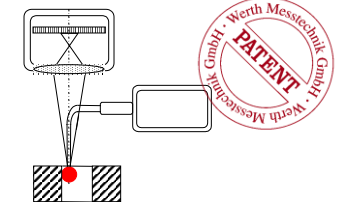
Werth Laser Probe



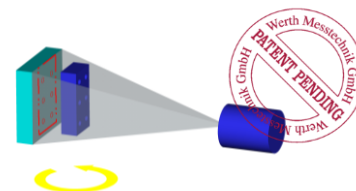
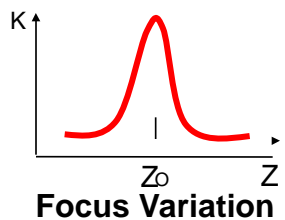
Werth Interferometer Probe



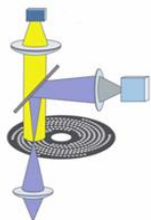
Werth Contour Probe



Werth Fiber Probe



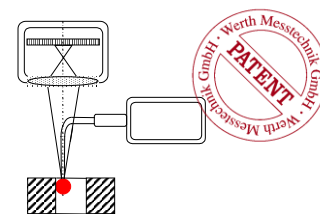
Computer Tomography



Nano Focus Probe



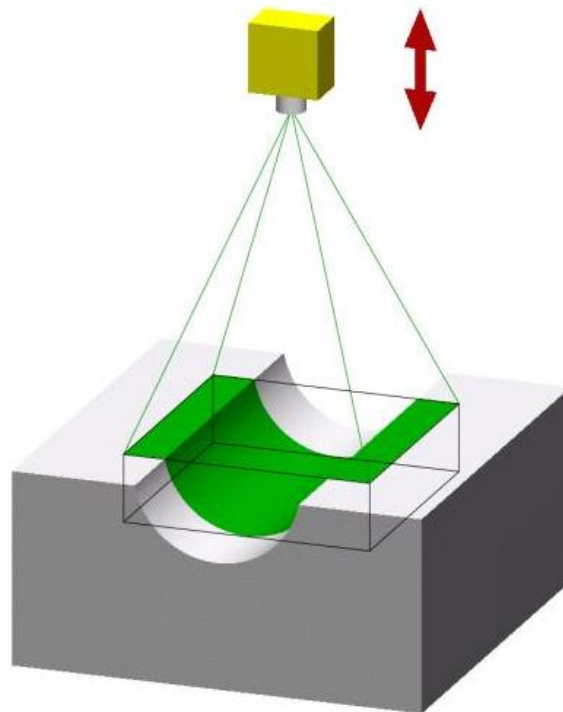
Werth Interferometer Probe



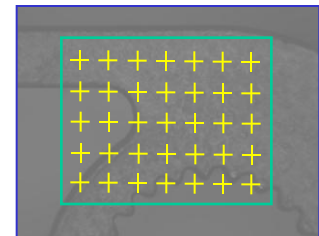
Werth Fiber Probe

VT-A-10-02-0065_E

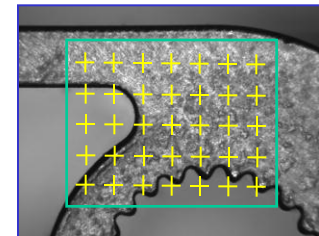
3D-Patch – “Focus Variation”



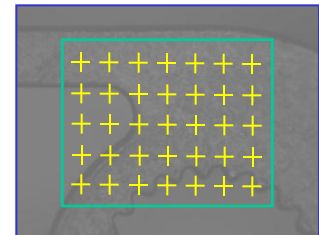
Z2



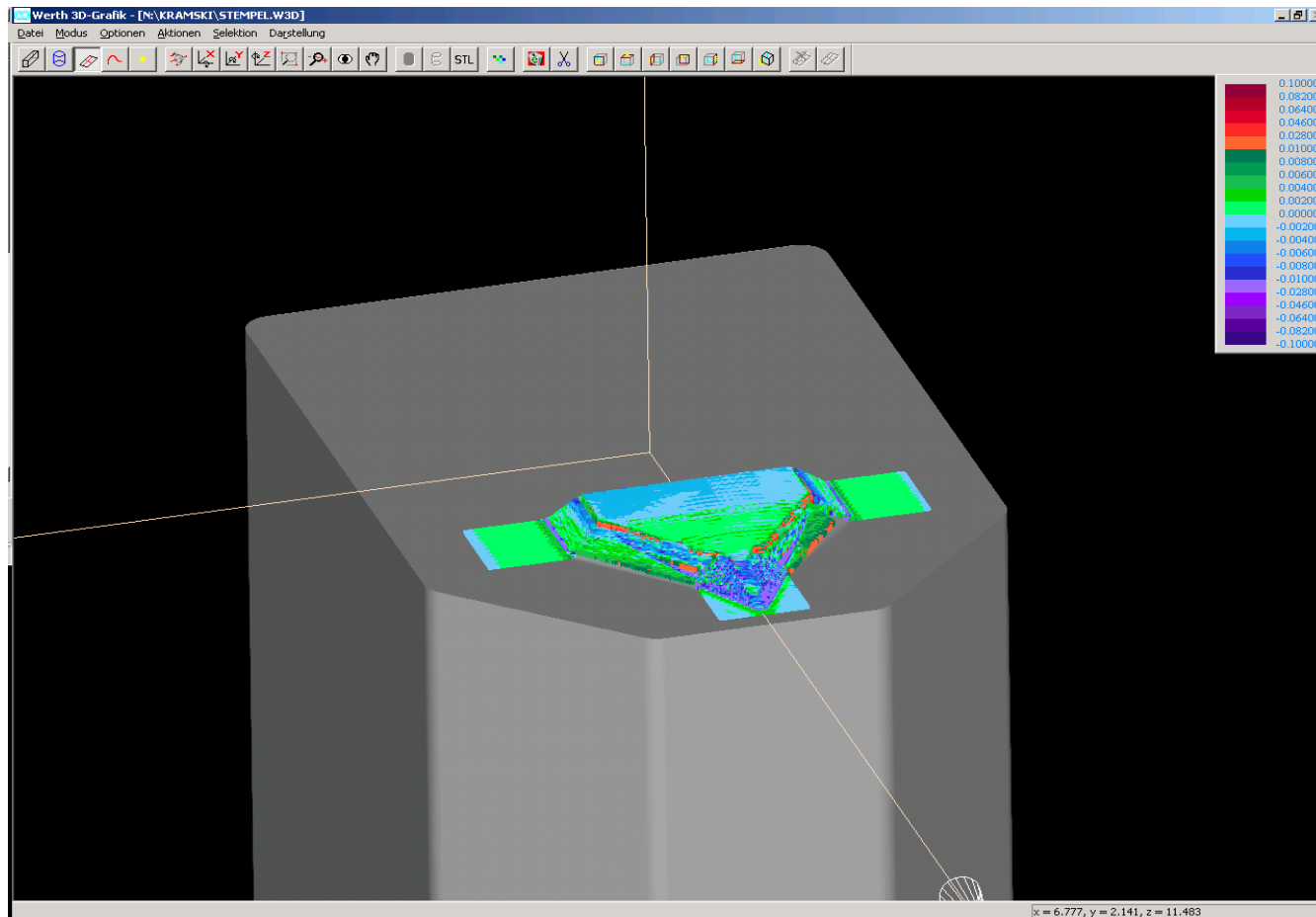
Z0



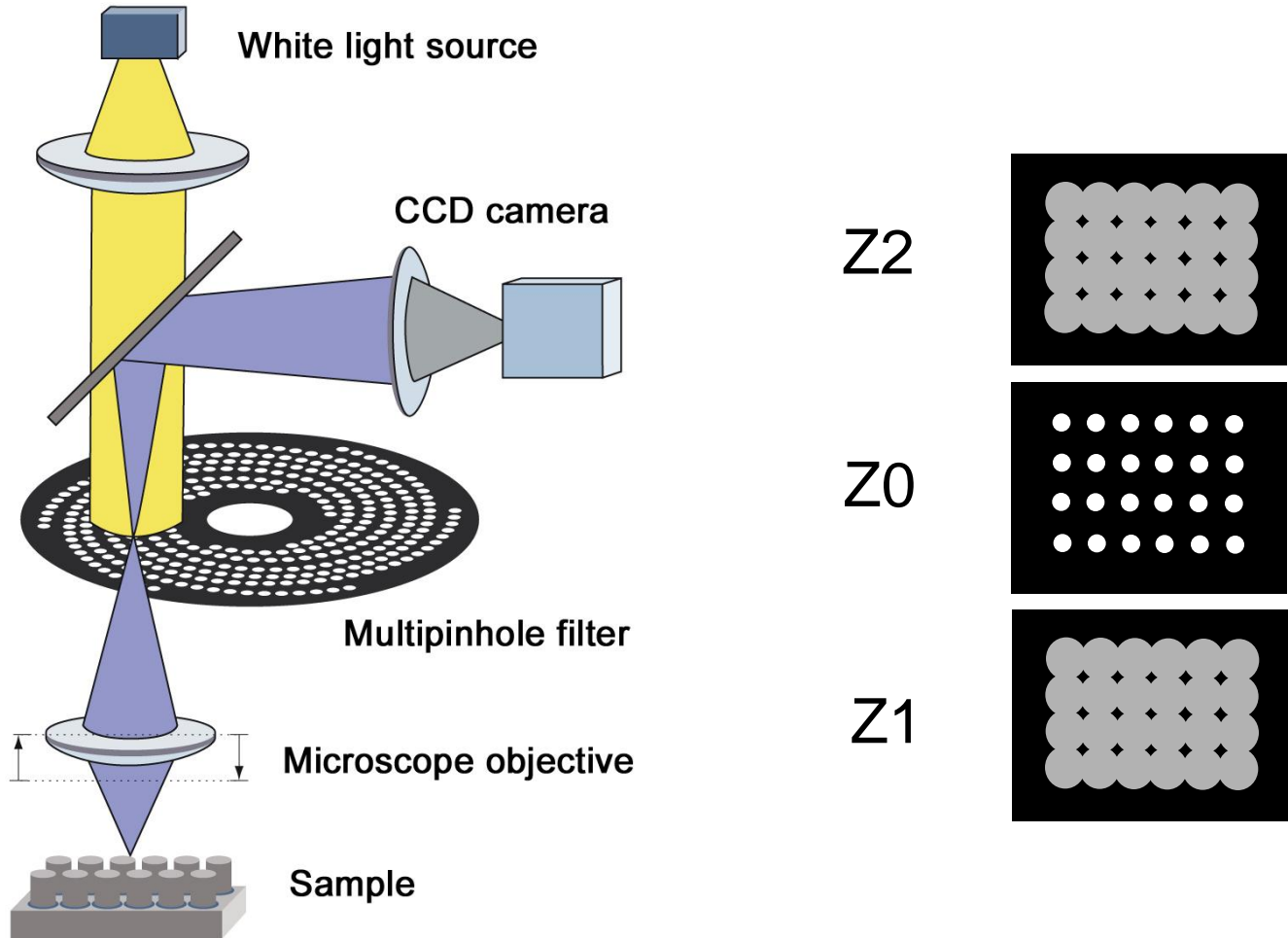
Z1



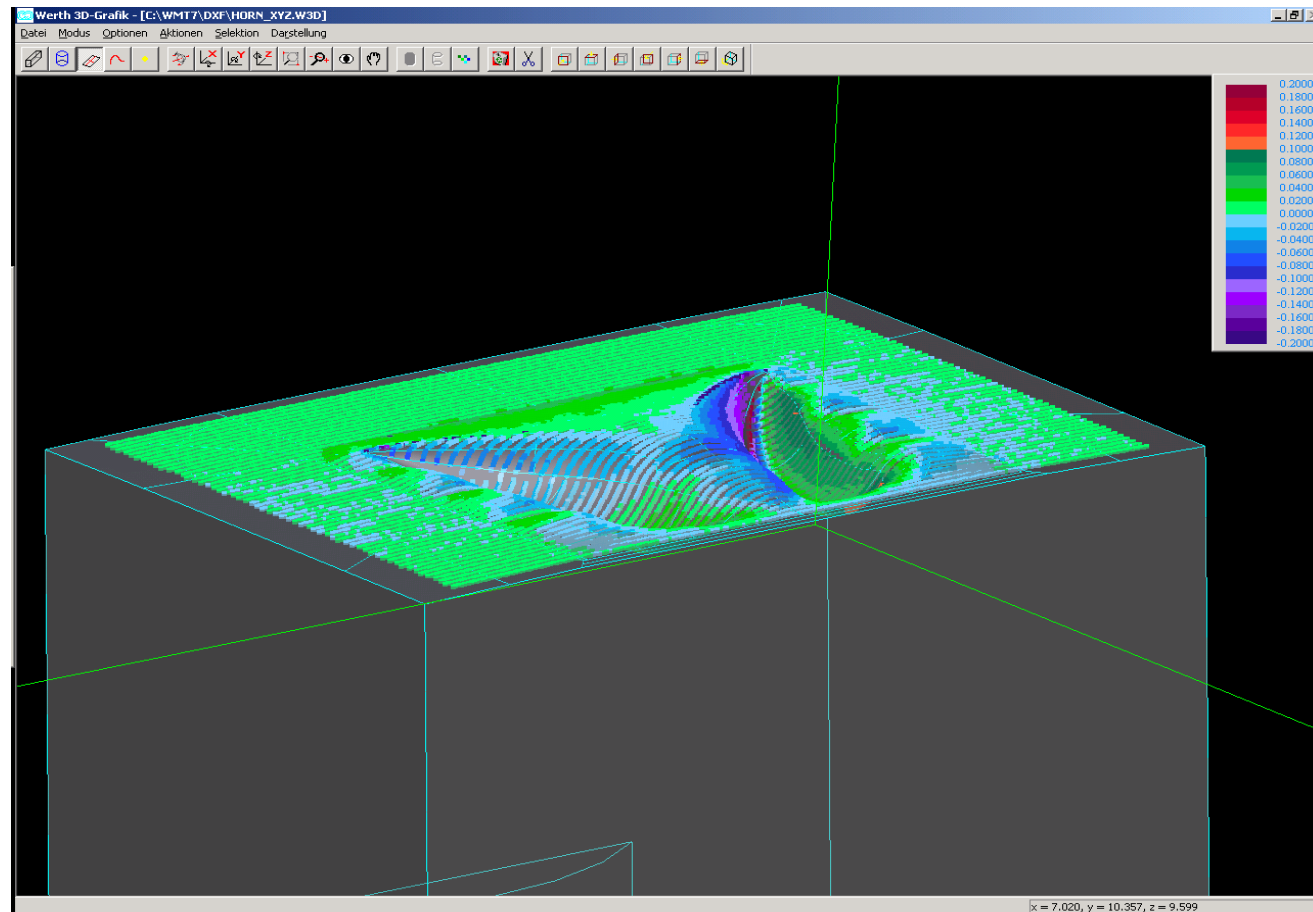
3D-Patch – Micro Form Punch



Nano Focus Probe - Principle

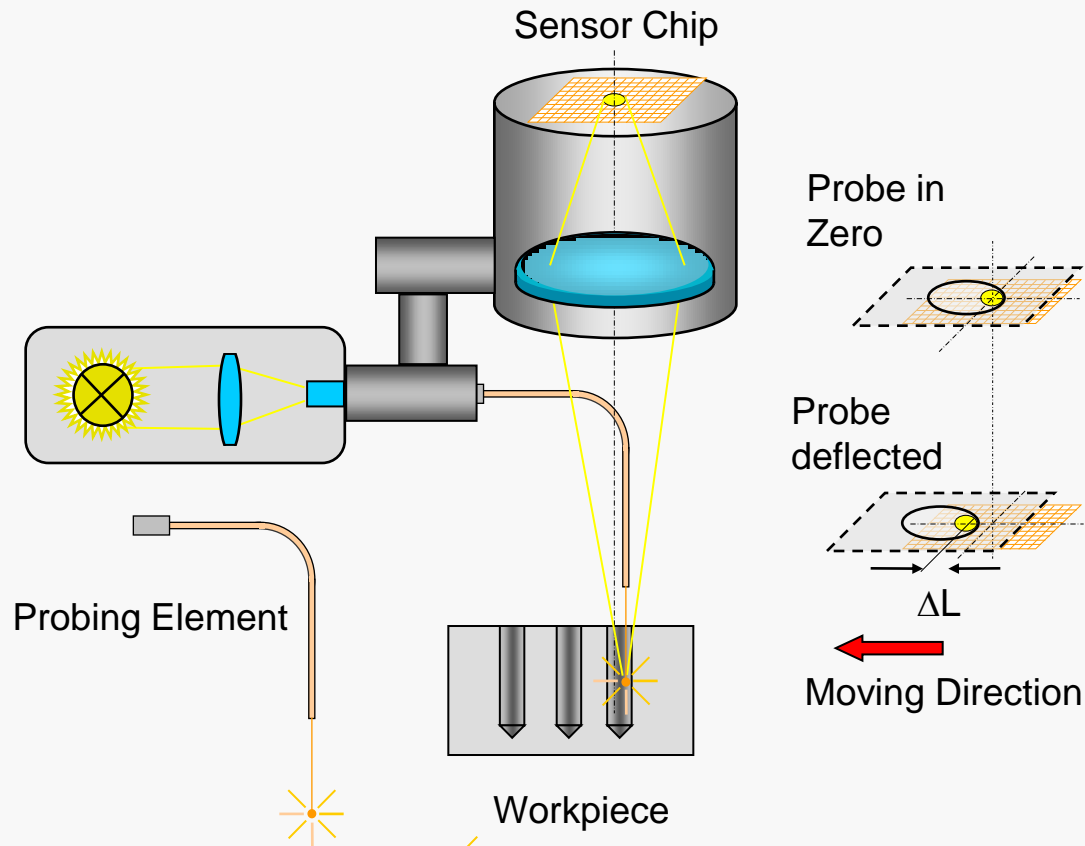


Confocal Scanning of a Micro Form Punch with NFP

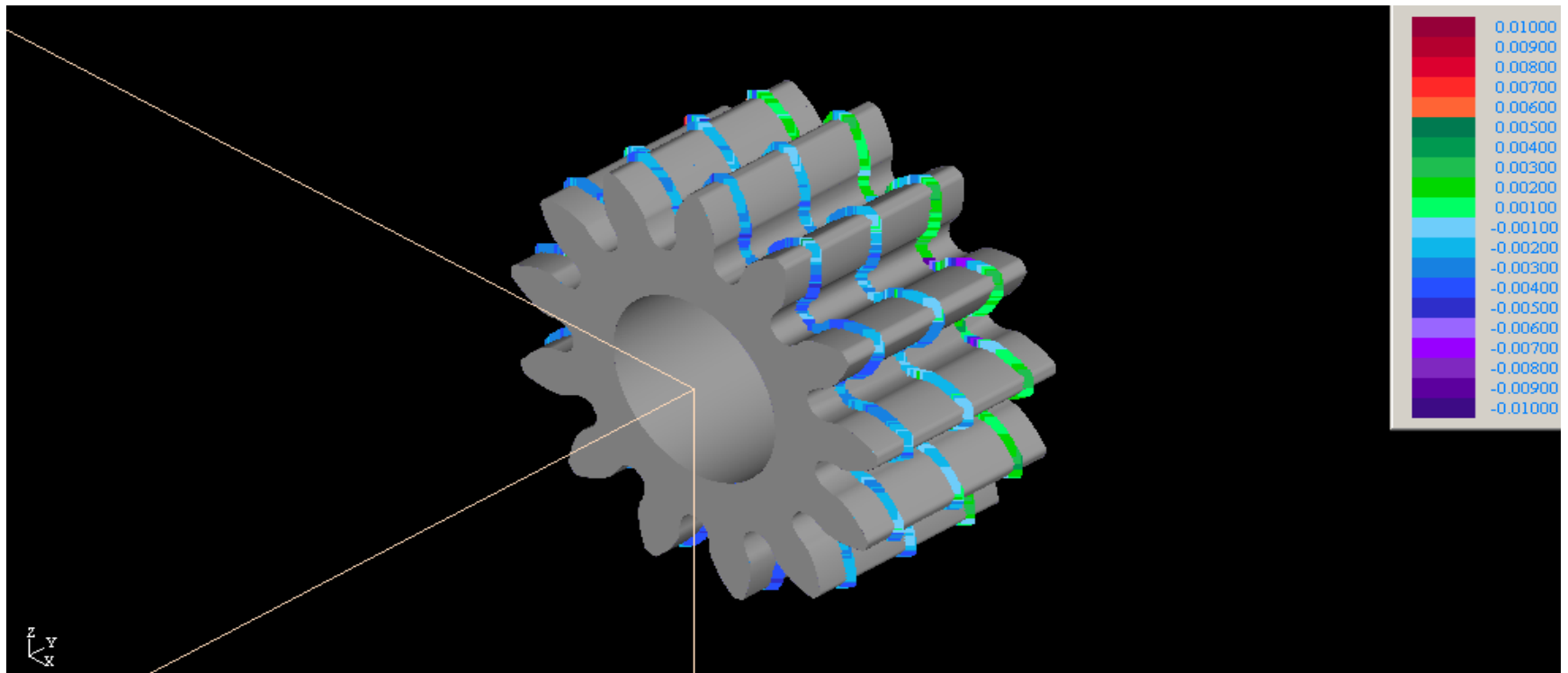


Werth Fiber Probe WFP (Pat.) – Principle

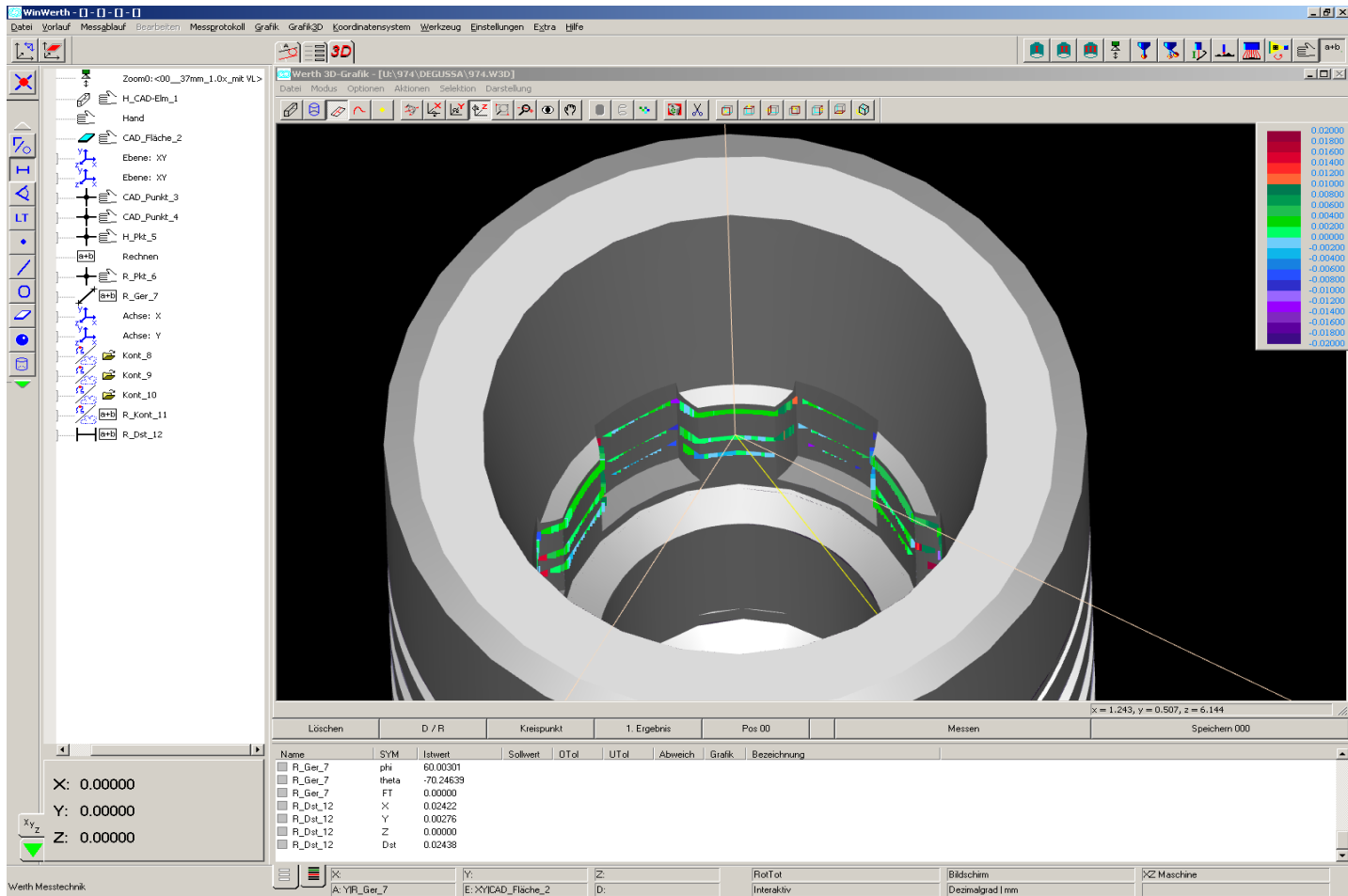
Ball Size down to 10 μ m Radius



Developed in cooperation with PTB Braunschweig, Germany



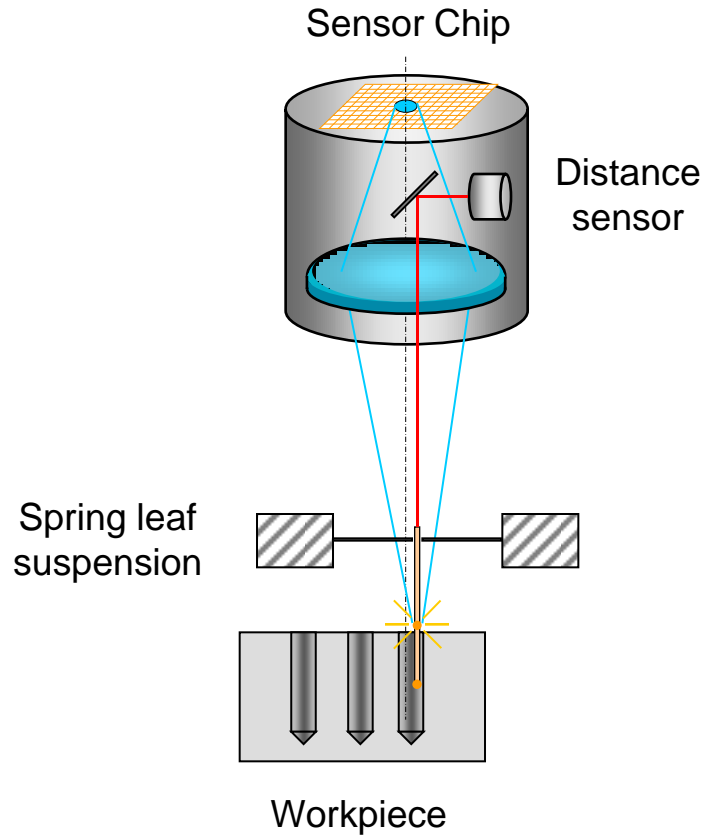
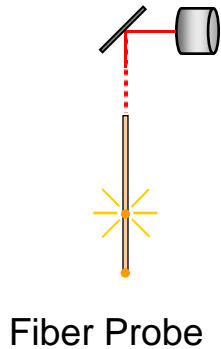
Tooth Implant Measured by WFP Scanning



Werth 3D Fiberprobe WFP

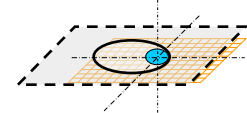
Principle

z- deflection, measured with distance sensor

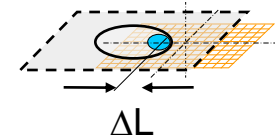


x-/y- deflection, measured with image processing sensor

Fiber Probe in zero position



Fiber Probe deflected



←
Direction of movement



Werth 3D Fiberprobe WFP

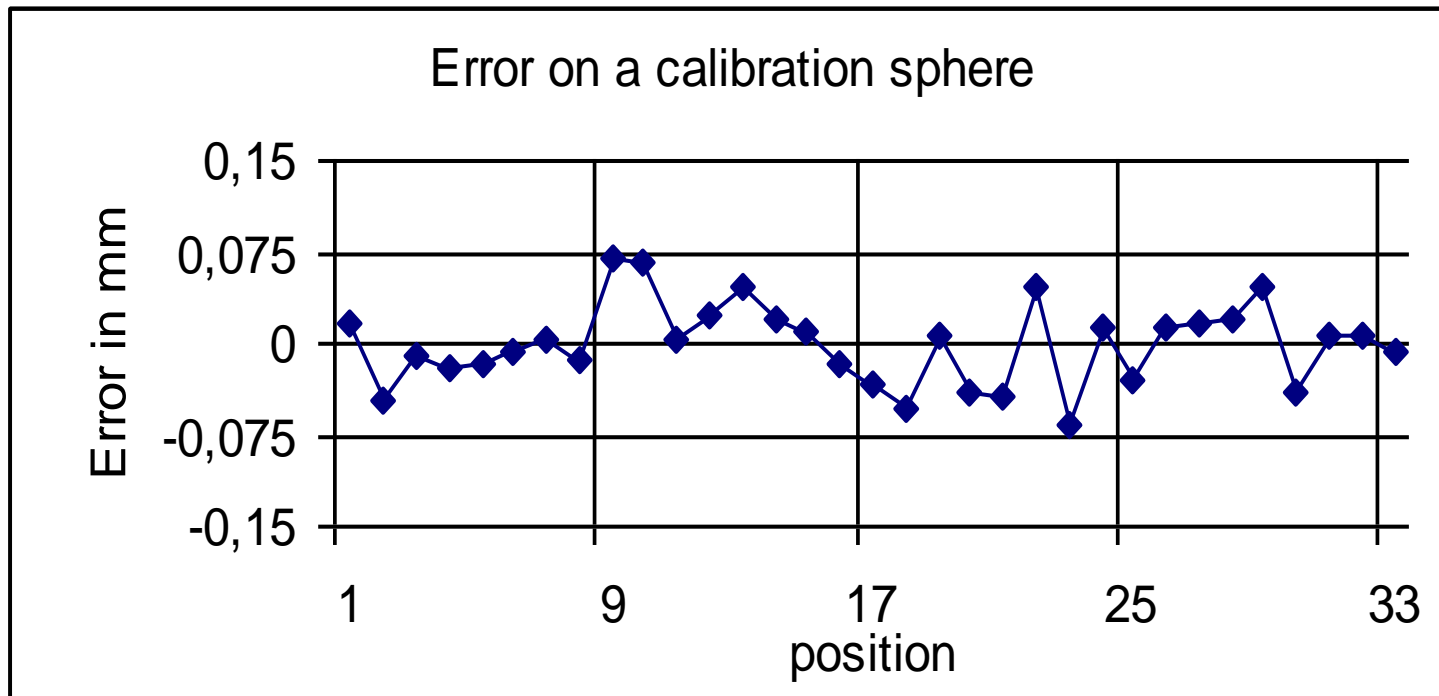
Design



Werth 3D Fiber Probe WFP

Results

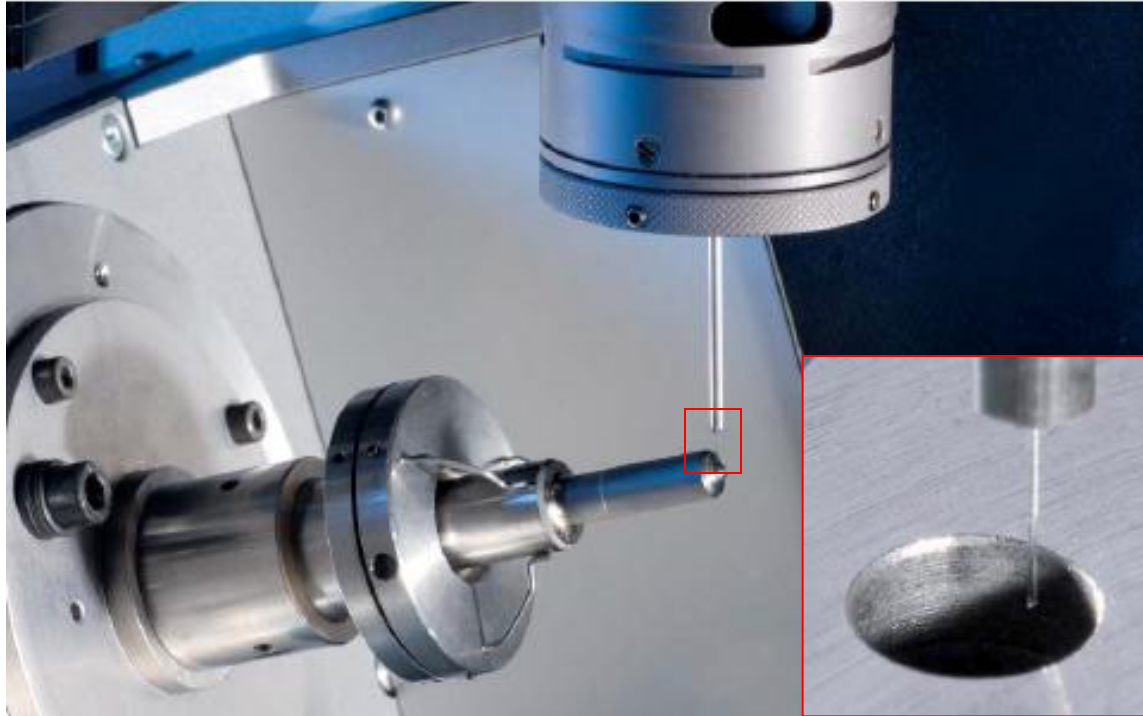
- 3D – probing deviation: $\approx 0,15 \mu\text{m}^*$



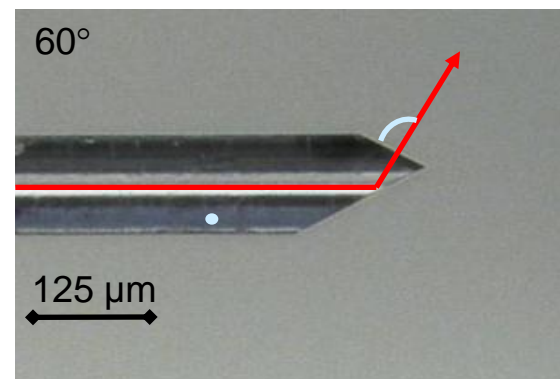
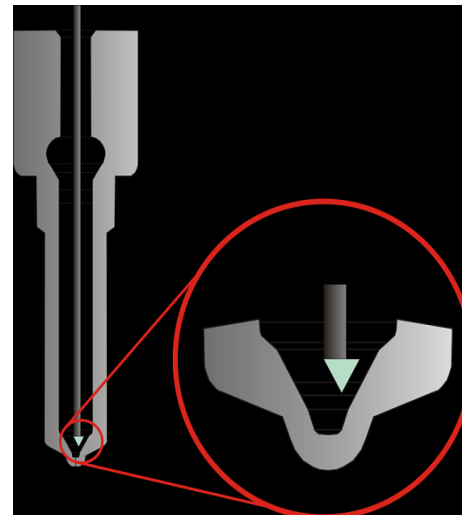
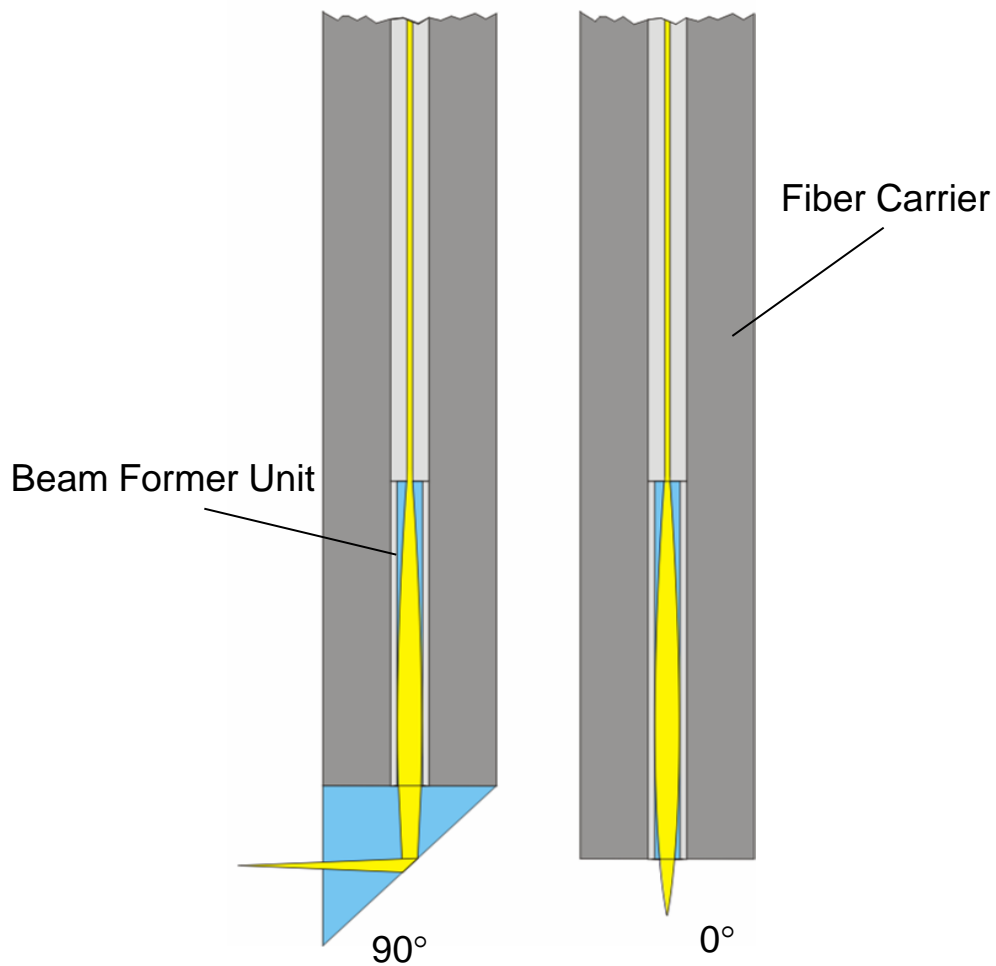
* measured on a reference sphere with VideoCheck UA and 3D correction of probing sphere form error

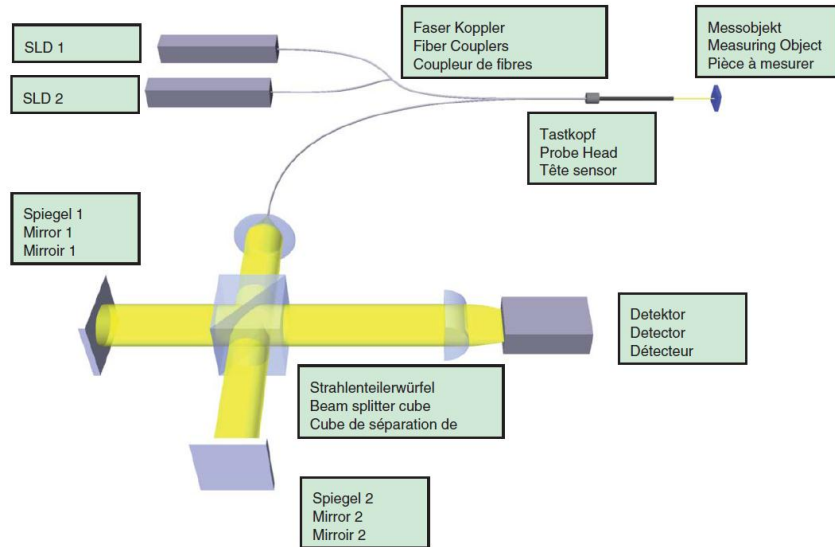


Werth Interferometer Probe WIP



Werth Interferometer Probe WIP

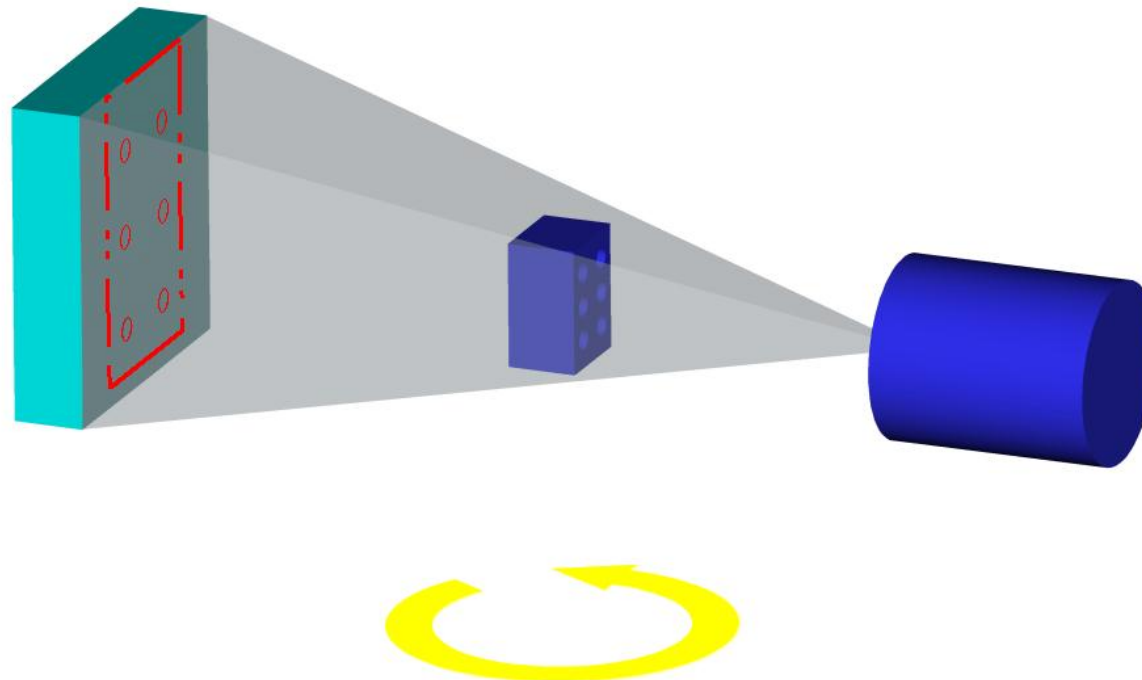




Technical Data

- Sensor principle: interferometry
- Working distance: 0.01-3 mm
- Measuring range: $\pm 150 \mu\text{m}$
- Probe diameter: 0.08-1 mm
- Probe length: 2.5-150 mm
- 0° up to 90° beam direction
- Probing error MPE for P1: $0.25 \mu\text{m}$

X-Ray Tomography



The Microfeature CT - CMM

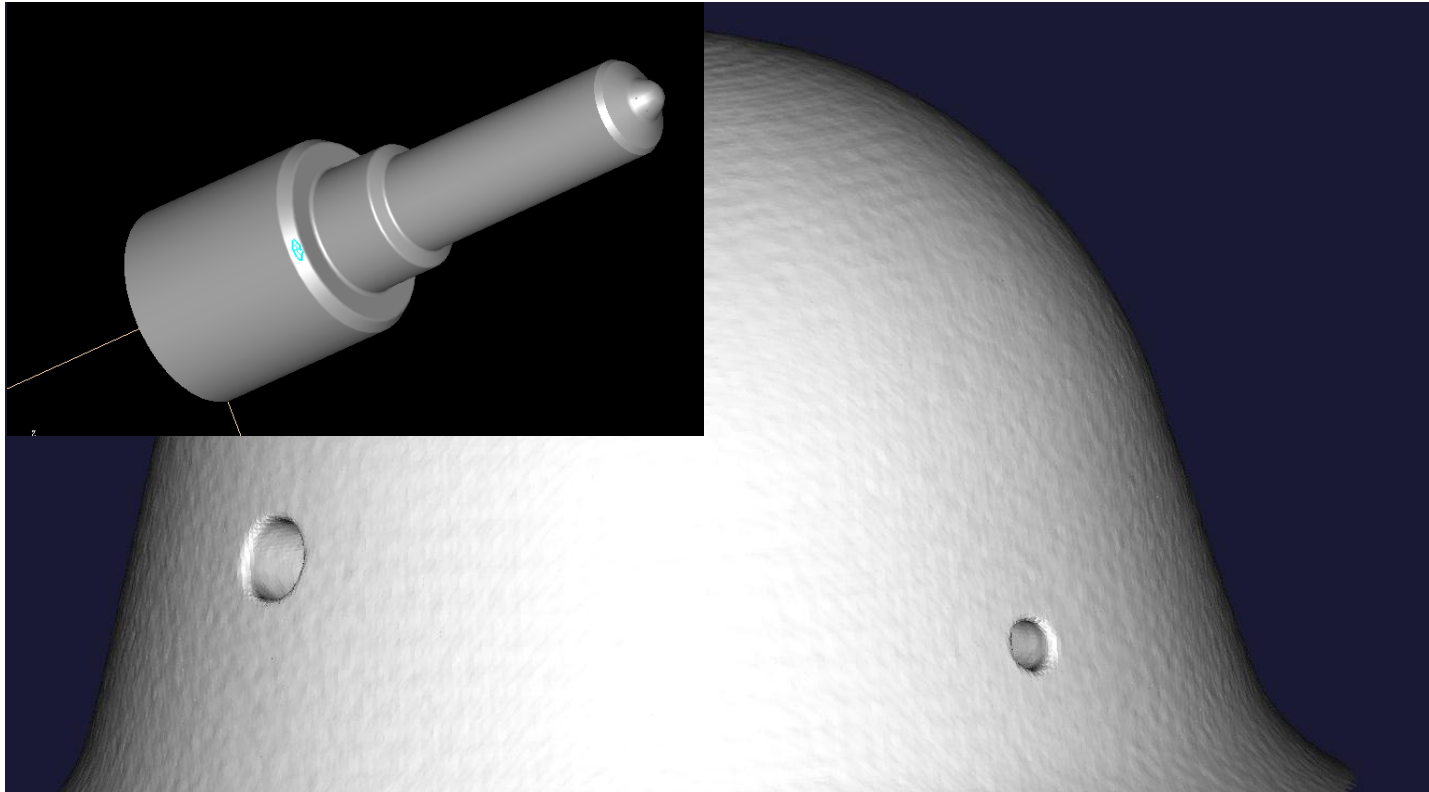


Werth TomoCheck®

Computer Tomography integrated in a Multisensor Coordinate Measuring Machine

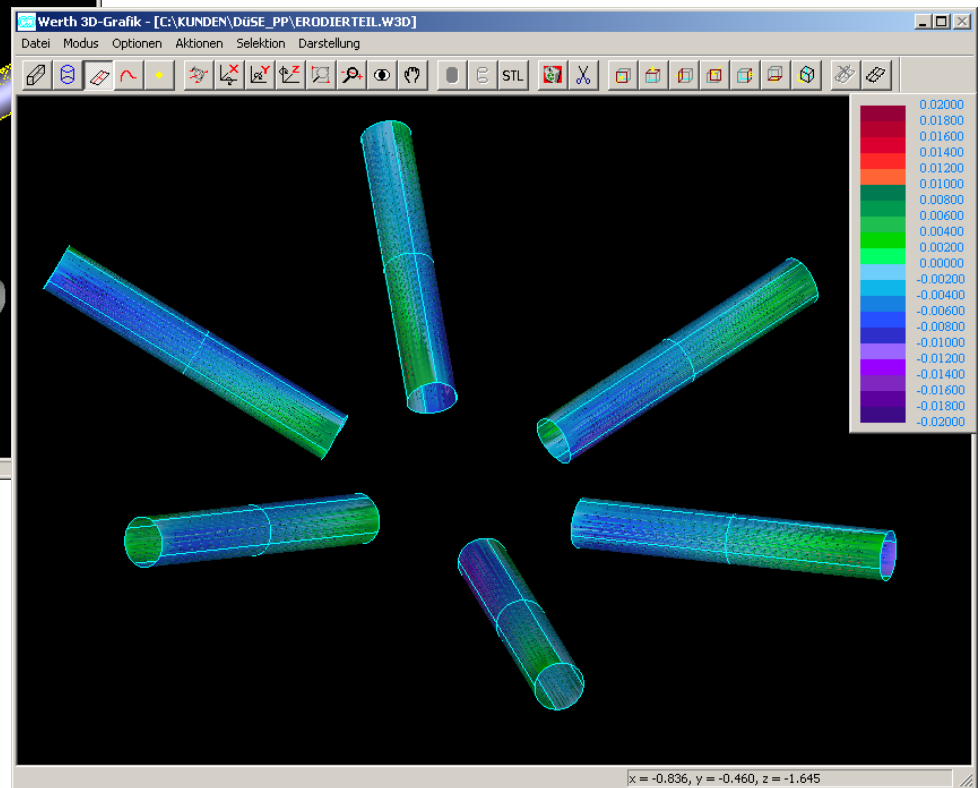
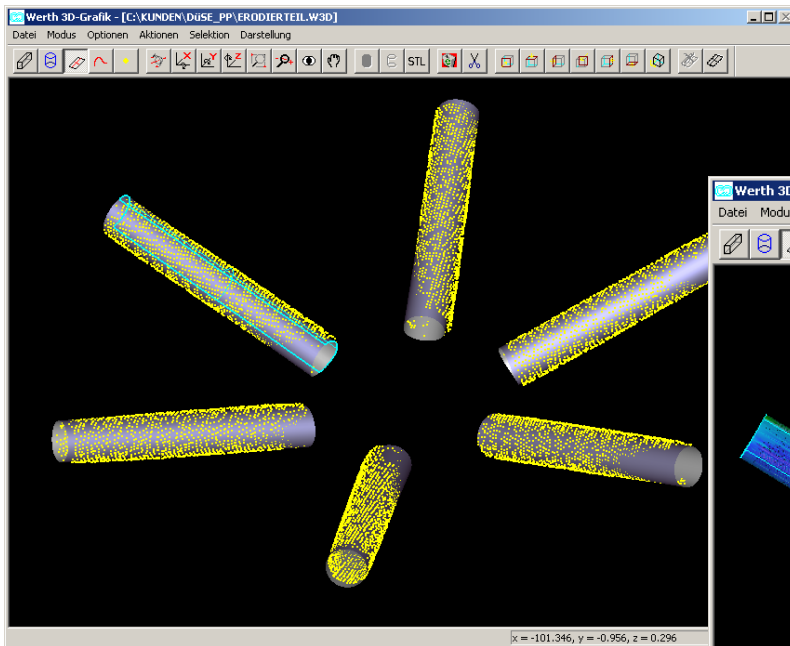
Measurement of an Injector Nozzle with the Werth TomoScope®

Tomography result



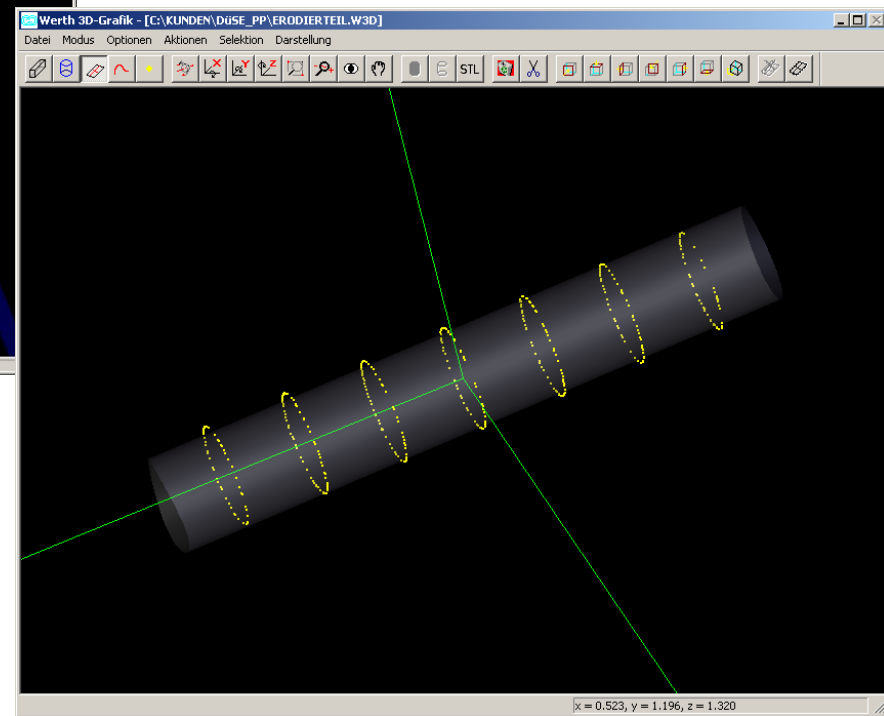
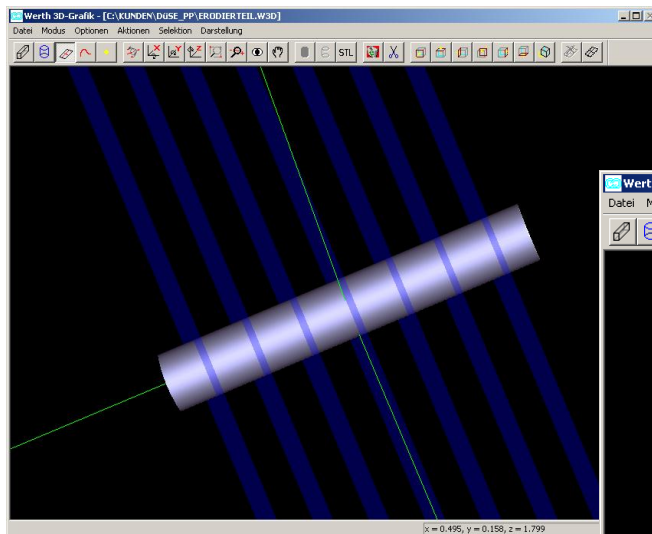
Measurement of an Injector Nozzle with the Werth TomoScope[®]

Results can be displayed either color coded



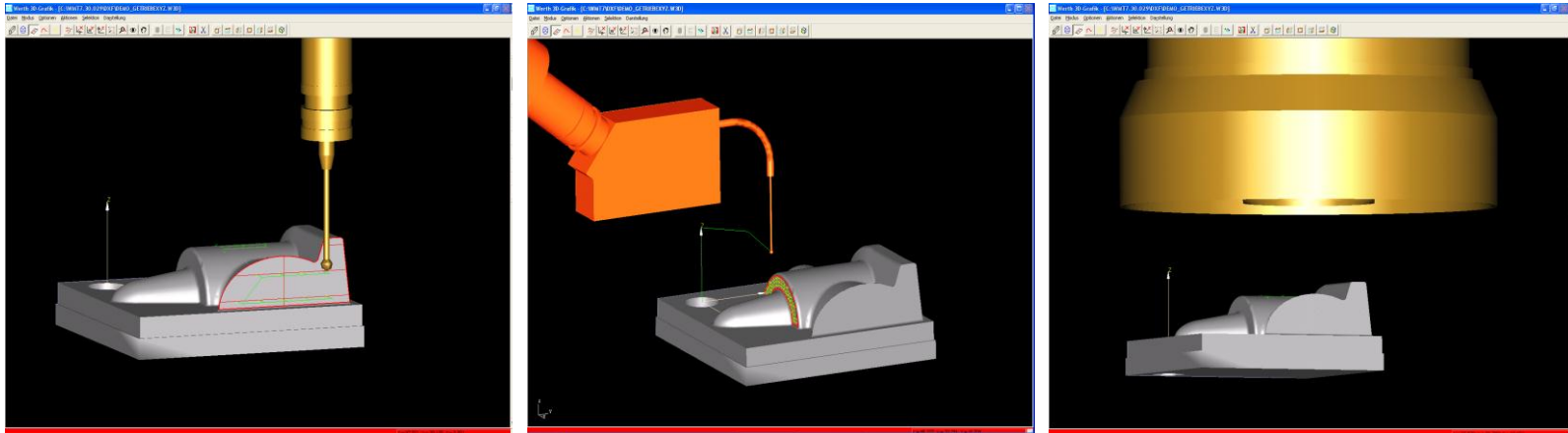
Measurement of an Injector Nozzle with the Werth TomoScope®

... as values which can be measured in defined areas. This Example shows how to measure the diameter devolution





SOFTWARE



3D CAD- Online – Control of the machine with CAD-data

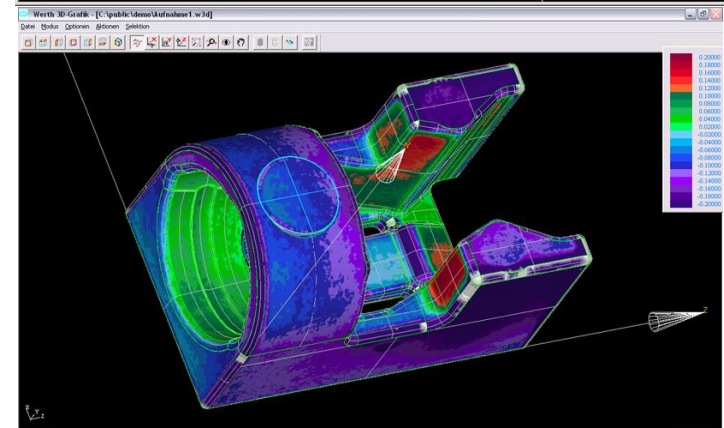
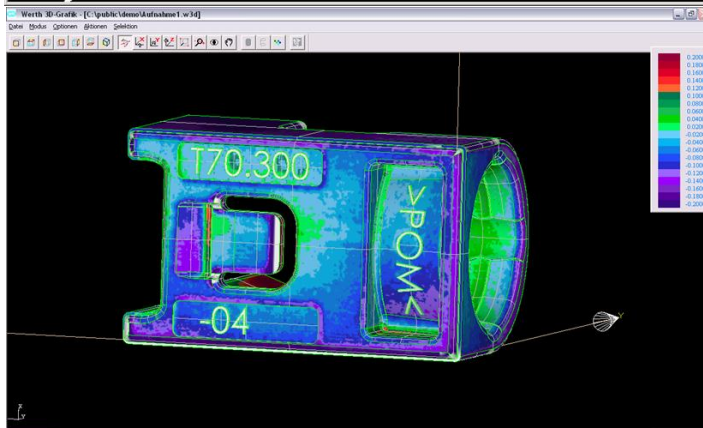
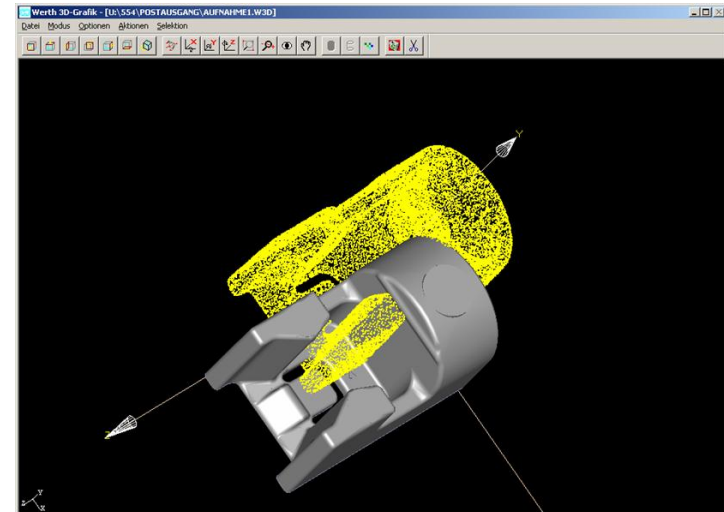
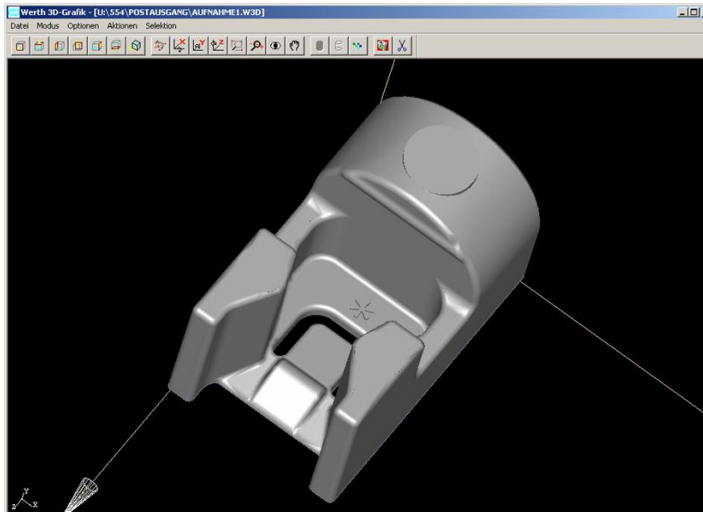
- Selection of an element
- CNC measuring process is calculated automatically
- Support of all sensors
- Measuring points can be defined on patches, curves, and points

3D CAD- Offline - Programming without machine

- The measuring process is shown in the graphic

WinWerth 3D BestFit

color coded presentation of deviations



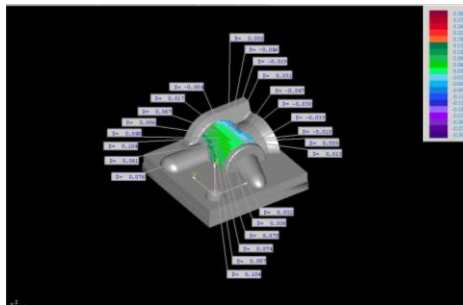
Numerical Output

```

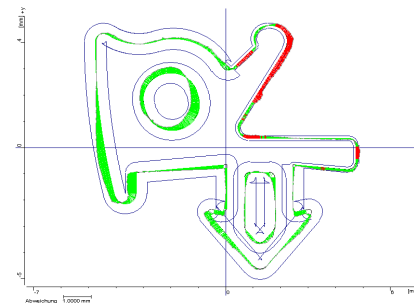
-----
      MESSPROTOKOLL | 35394 G I E S S E N |
-----|-----|
Kunde : Kael Lüberg | Datum: 17.12.2002
Teil : Kontaktfeder
Teil-Nr.: 8900000
Pzoz-Nr.: Luedel
Prüfer: J. Bahio
Bemerkungen : VC1P 4001200 33 CNC mit 3x-Optik

Werth Messtechnik / Datum: 17.12.1998 12:20 / Seite: 1
-----
SIT# ACT SET STOL LTOL DEV <TOL +/- DESIG
-----
#### Start Automatisch CIVERT4DESILIMBO2.D88
Dat: 2.1076 2.1500 0.0000 -0.0500 -0.0424 --- m215
T: 1.8842 1.9000 0.0000 -0.0500 -0.0438 --- m29
T: 8.9409 8.5000 0.2000 -0.1000 0.1409 --- m25
Z: 1.9021 2.0000 0.1000 -0.1000 -0.0969 --- m2
#### Loop ended: L1 1/35
Dat: 2.1231 2.1500 0.0000 -0.0500 -0.0549 --- m215
T: 1.8611 1.9000 0.0000 -0.0500 -0.0399 --- m29
T: 8.9985 8.5000 0.2000 -0.1000 -0.0985 --- m25
Z: 1.9049 2.0000 0.1000 -0.1000 -0.0911 --- m2
#### Loop ended: L1 2/35
Dat: 2.1244 2.1500 0.0000 -0.0500 -0.0234 --- m215
T: 1.8606 1.9000 0.0000 -0.0500 -0.0394 --- m29
T: 8.8607 8.5000 0.2000 -0.1000 0.1807 --- m25
Z: 1.9048 2.0000 0.1000 -0.1000 -0.0852 --- m2
#### Loop ended: L1 3/35
  
```

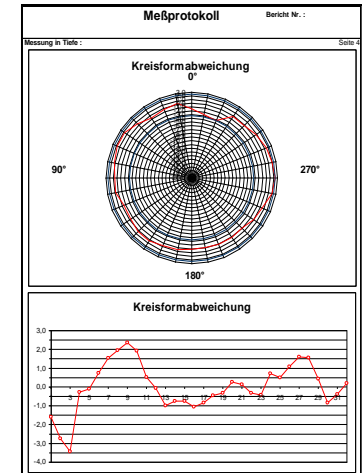
3D Nominal / Actual Comparison



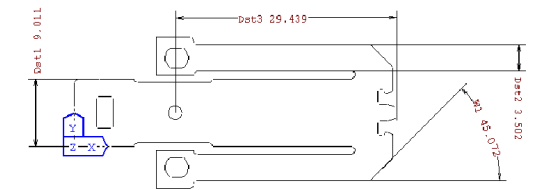
2D Nominal / Actual Comparison



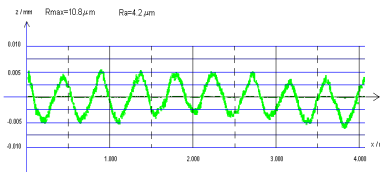
Formplot



Graphical Presentation



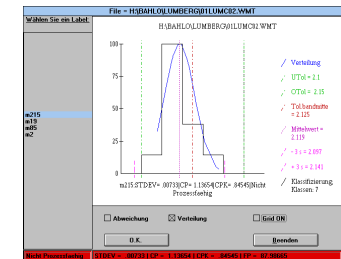
Roughness Plot



First Article Inspection Report

Prüfergebnisse			
01	Funktionsprüfung	<input type="checkbox"/>	Erreichte/nicht erreicht VDA
02	Montageprüfung	<input type="checkbox"/>	Erreichte/nicht erreicht
03	Werkstoffprüfung	<input type="checkbox"/>	Erreichte/nicht erreicht
04	Zielerreichungsprüfung	<input type="checkbox"/>	Erreichte/nicht erreicht
05	Prüfung der Dimensionen	<input type="checkbox"/>	Erreichte/nicht erreicht
06	Prüfung der Oberflächenbeschaffenheit	<input type="checkbox"/>	Erreichte/nicht erreicht
07	Prüfung der Oberflächenbeschaffenheit	<input type="checkbox"/>	Erreichte/nicht erreicht
08	Prüfung der Oberflächenbeschaffenheit	<input type="checkbox"/>	Erreichte/nicht erreicht
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16	Prüfung der Oberflächenbeschaffenheit	<input type="checkbox"/>	Erreichte/nicht erreicht
17	Prüfung der Oberflächenbeschaffenheit	<input type="checkbox"/>	Erreichte/nicht erreicht

Statistics



- The integration of “scanning sensors for dense point clouds“ in Multisensor CMM’s opens new horizons in the metrology field.

- For more information see www.werth.de



Questions ?