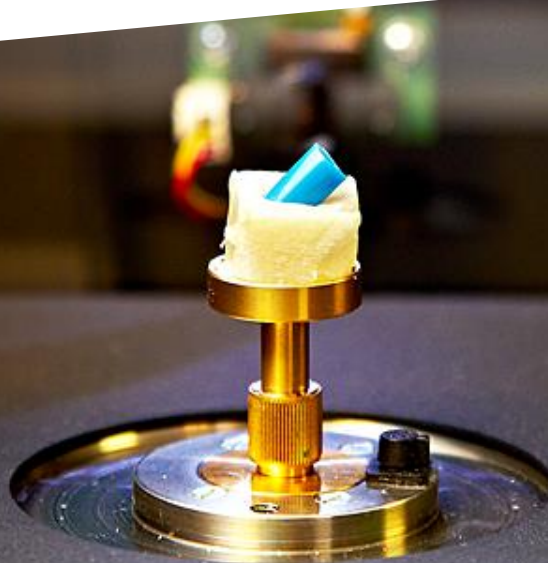




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it's all about innovation





# EMRP Project – Microparts

## Multi-sensor metrology for microparts in innovative industrial products

Maria Holmberg  
Metrology and Quality Assurance  
Danish Technological Institute



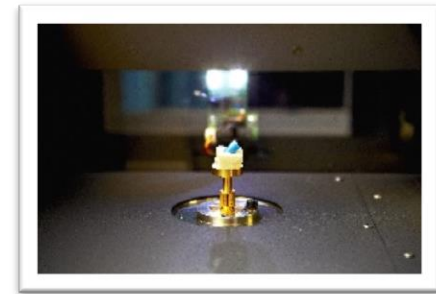
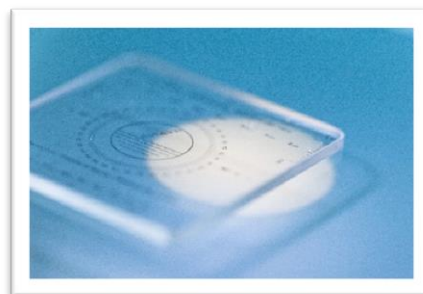
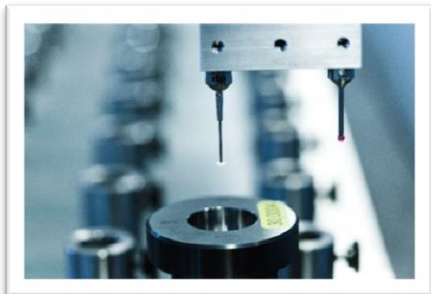
# EMRP Project - Microparts

Technical field – Length, Geometrical Measurements

To measure on microparts, or parts with microstructures, with complex geometry in industry

Improve measurement capabilities within multi-sensor coordinate metrology

- Tactile - accuracy
- Optical - speed
- CT (Computed Tomography) – inner structures



# EMRP Project - Microparts

June 2014 – May 2016

<http://www.ptb.de/emrp/microparts.html>



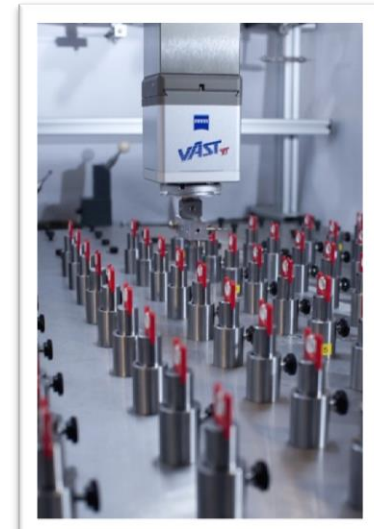
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- Work focused on accuracy and uncertainties using different probes
  - Tactile, smaller probes with increased accuracy
  - Optical, achieve traceability with reference measurements and non-linear modelling
  - CT, achieve traceability with reference measurements
- Uncertainties
- Combining data from different probes, including data fusion
- Workpiece-like reference standards
- Demonstration cases together with industry



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## Demonstration cases

Improve measurement capabilities at LEGO and Novo Nordisk

- Performing measurements at Metrology Institutes and Designated Institutes (state-of-the-art)
- Develop protocols, methods and tools (for example fixtures, programs, guide-lines etc.)
- Dialog with industry regarding their needs
- Test in laboratories
- Test and integration at site





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Demonstration cases

Industry/Production versus Laboratory Facilities



Not only 'hard technological challenges'...

- Time
- Data handling
- Competences/training
- Reproducibility
- Several production sites
- Documentation





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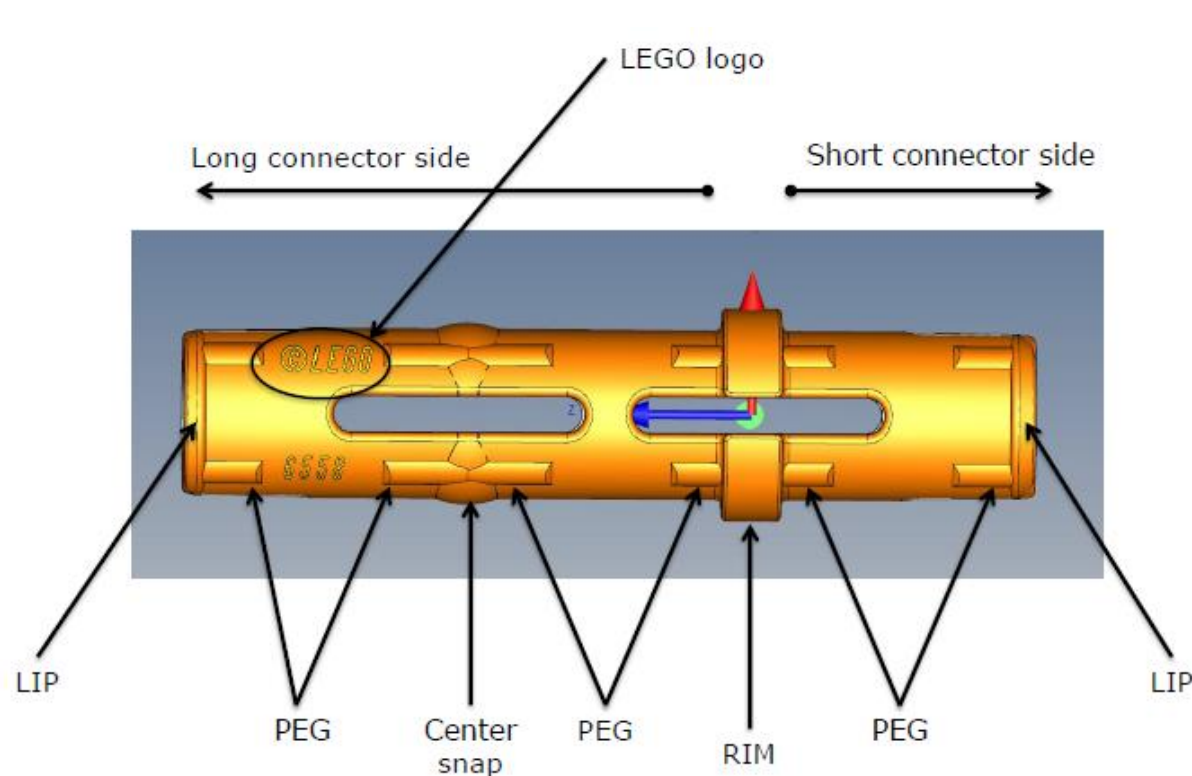
## Demonstration case – LEGO connector

Not possible to use ordinary CMM technology

Get reference measurements using  $\mu$ CMM

Develop protocol for optical measurements

Investigate the possibility to use CT







# EMRP Project - Microparts

## Demonstration cases – Novo Nordisk needle

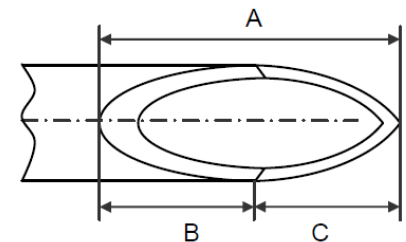
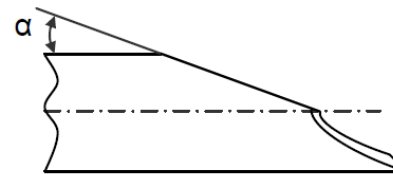
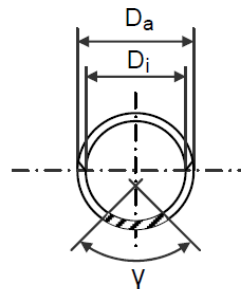
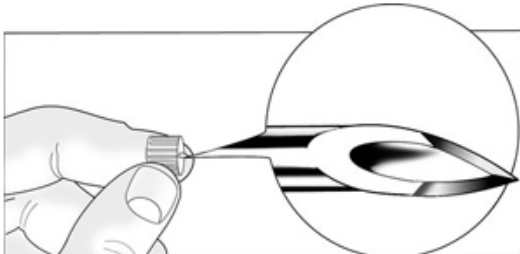
Measure internal diameters in a needle

Measure angles

Effect of coating

The following geometrical measures are tested

- $D_a$  - Outside diameter
- $D_i$  - Inside diameter
- $A$  - Point length
- $C$  - Secondary Bevel Length
- $\alpha$  - Primary Bevel Angle
- $\gamma$  - Combined Secondary Bevel Angle





# EMRP Project - Microparts

## CT Scanning

### Zeiss METROTOM 800

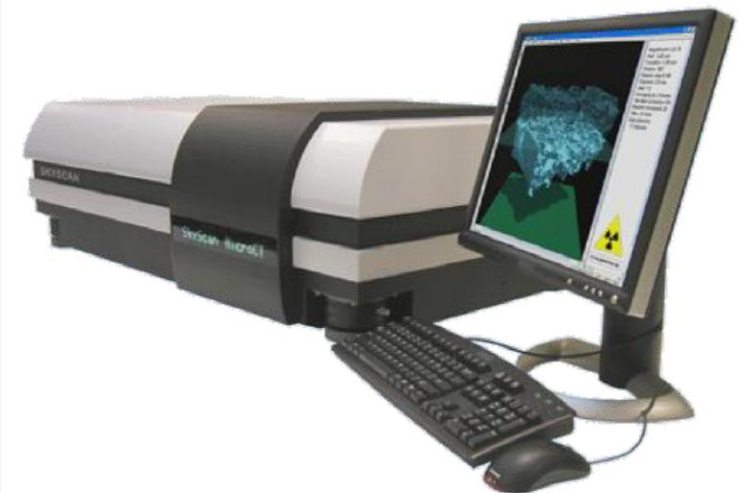
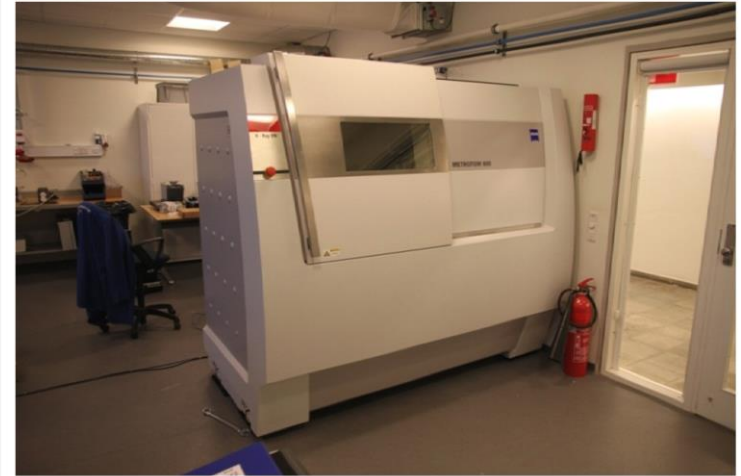
X-Ray: 130 kV  
Detector: 1900 x 1512 pixels  
Sample size: 12 x 15 cm (~ 4 kg)  
'Resolution': < 4  $\mu$ m

### Zeiss METROTOM 1500

X-Ray: 225 kV  
Detector: 1024 x 1024 pixels  
Sample size: 30 x 30 cm (~ 10 kg)  
'Resolution': < 10  $\mu$ m

### Bruker microCT, Skyscan 1172

X-Ray: 100 kV  
Detector: 4000 x 2300 pixels  
Sample size: 2 x 2 cm  
'Resolution': < 1  $\mu$ m

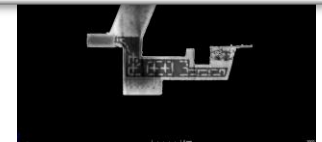
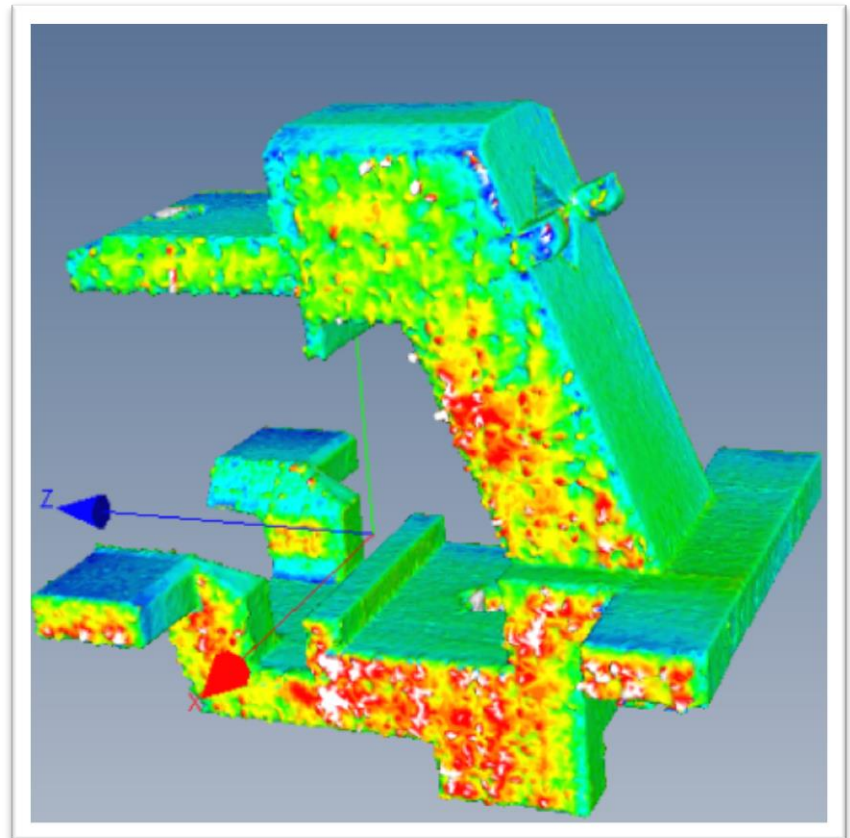
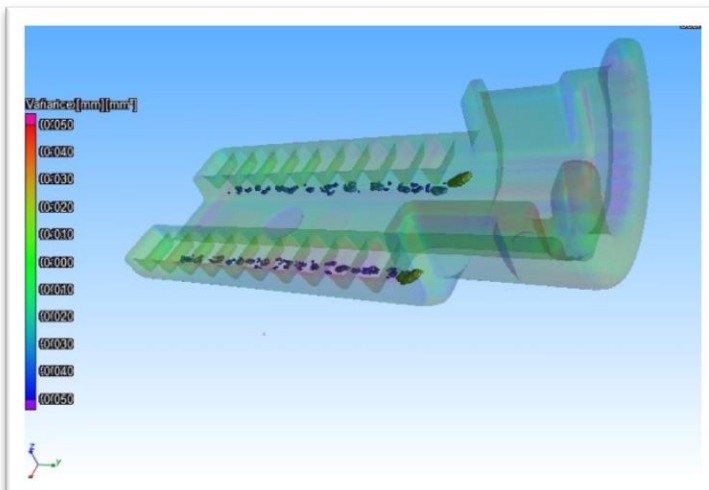
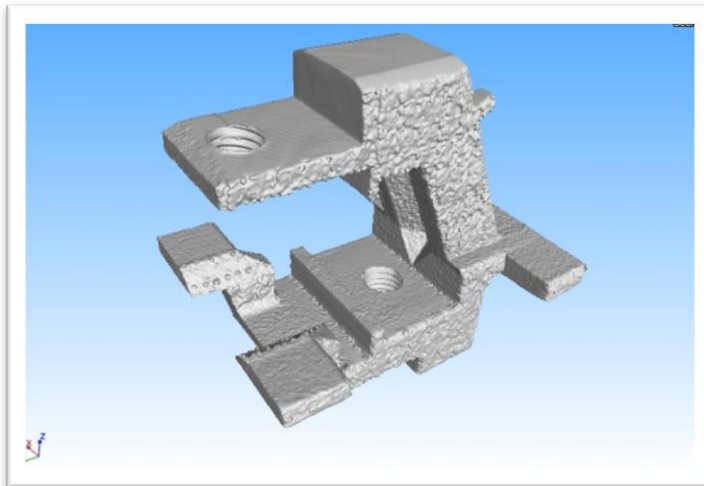




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## CT Scanning

Non-destructive 3D visualization of inner and outer complex geometries

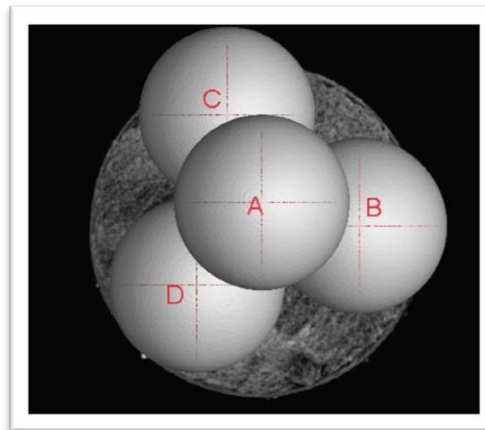


# EMRP Project - Microparts

## Traceability of CT measurements

Comparison of CT measurements of a calibrated item

Micro-tetrahedron calibrated with  $\mu$ CMM at PTB



Compare results from different CT Scanners

Relate to reference measurements performed with synchrotron-CT and  $\mu$ CMM

Compare to results obtained in 'industry environment'

Document impact on accuracy and uncertainties



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Braunschweig und Berlin



National Physical Laboratory



SIEMENS





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# EMRP Project - Microparts

<http://www.ptb.de/emrp/microparts.html>

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