

# CT for non-destructive testing of plastic joints

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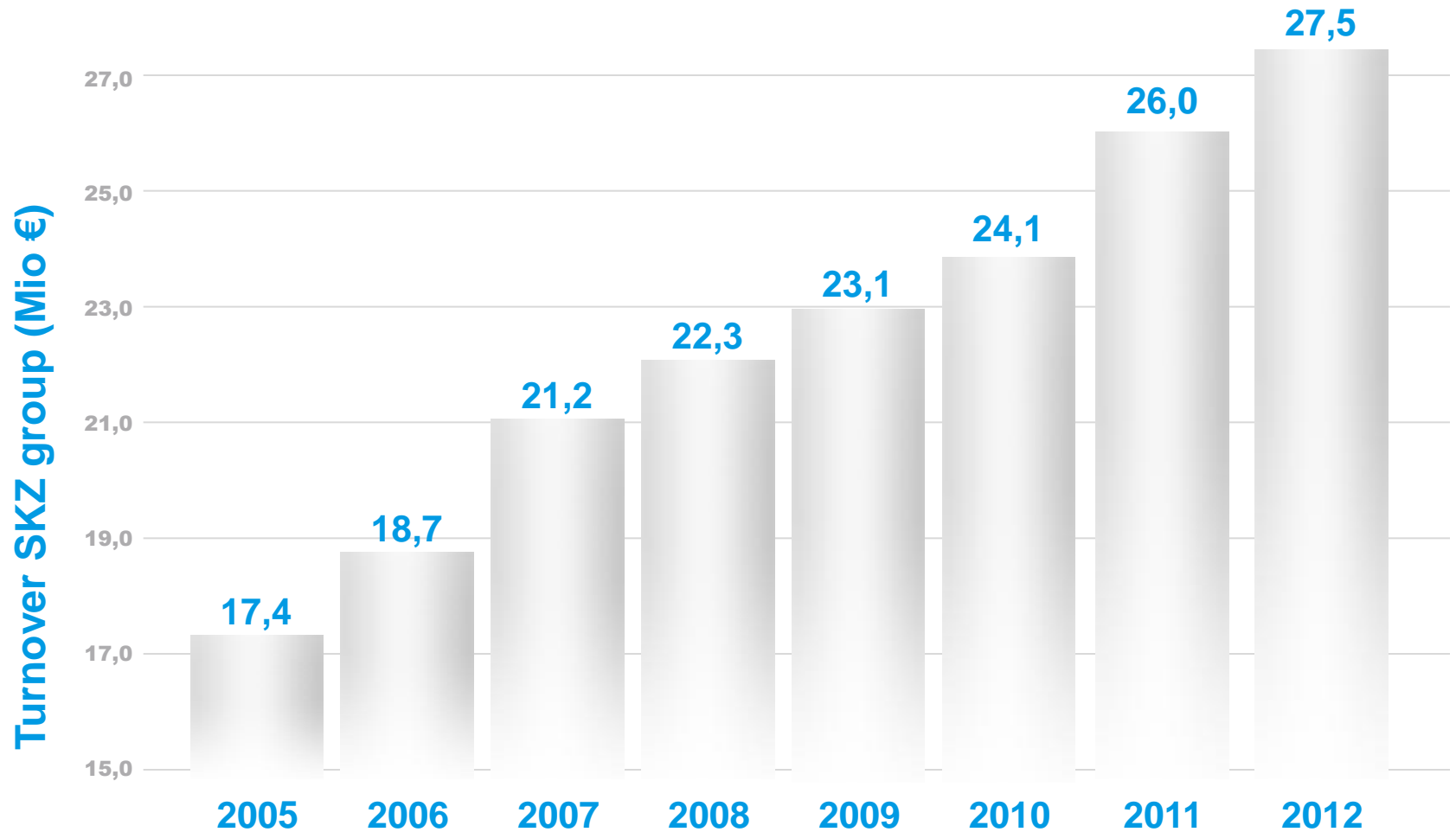
German-Austrian-Danish Workshop  
on Industrial CT Scanning, TUM, Munich



- **Introduction to the SKZ**
- **Focus: Non-destructive testing (NDT) on SKZ**
- **NDT with computed tomography**
  - **Inclusions on plastic parts**
  - **WPC (Wood Plastic Composites) joints**
  - **Failure detection for the electrofusion welding (HM)**
  - **Investigation of adhesive bonded plastic joints**
  - **Fibre orientation on plastic joints**
  - **Variance analysis on plastic parts**
  - **Non-destructive material analysis**
  - **Analysis of the concentration different plastic components**



Product quality	Training	Research	Certification	Consulting
 <p>Safety thanks to testing</p>	 <p>Training made in Germany</p>	 <p>Inventing the future</p>	 <p>Success through reliability</p>	 <p>A way to optimum</p>
<ul style="list-style-type: none"><li>• Product Inspection</li><li>• Product Certification</li><li>• Testing</li><li>• Service</li></ul>	<ul style="list-style-type: none"><li>• Conferences</li><li>• Seminars</li><li>• Inhouse-Trainings</li></ul>	<ul style="list-style-type: none"><li>• Component Properties</li><li>• Compounding and Extrusion</li><li>• Injection Moulding</li><li>• Joining</li><li>• Measurement Technology</li><li>• Material Development</li><li>• Sustainability</li><li>• European Center for Dispersion Technologies</li></ul>	<ul style="list-style-type: none"><li>• ISO 9001</li><li>• ISO 14001</li><li>• FW 605</li><li>• BS OHSAS 18001</li><li>• VDA 6.1</li><li>• ISO/TS 16949</li></ul>	<ul style="list-style-type: none"><li>• Material research</li><li>• Feasibility analyses</li><li>• Process analyses/ optimizations</li><li>• Mould proving</li></ul>



## Research and Development

### We improve materials

- Thermoplasts
- Elastomers
- Compounds
- Nano composites
- Functional materials
- Wood Plastic Composites

### We develop methods

- to evaluate materials
- to optimize production and quality assurance processes
- to gather and evaluate your process data

### We improve your economic efficiency

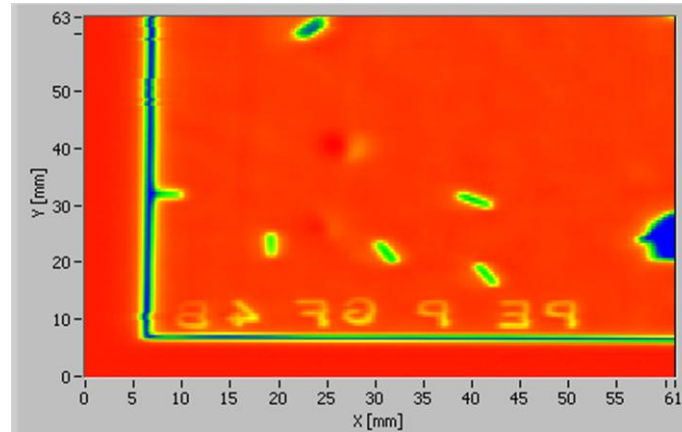
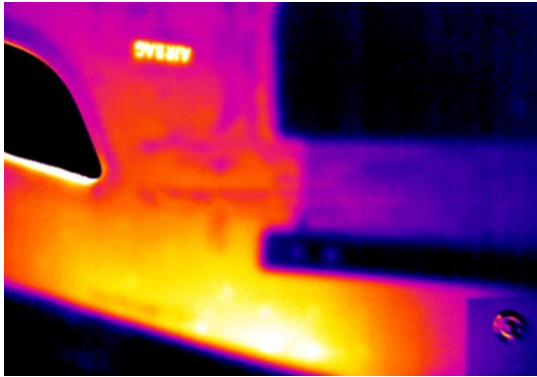
- Analysis and Optimisation of process efficiency as well as sustainability assessments
- Optimise processes as well as test methods

### We develop technologies

- to enable new field of applications for polymeric materials
- for the production of composite materials
- to reduce process steps

### We care about colour

- Processes to colour materials
- Design aspects
- Colour formulations
- Test methods



- Comparison of different methods
- Availability or at least knowledge of all relevant NDT methods
- Evaluating the best method for each individual task
- Further development of NDT methods
- Examples: ultrasonic, terahertz, microwaves, thermography, current testing, X-ray (tomography), shearography, MRT...

## Computed tomography on SKZ



**WENZEL®**

 **Volumetrik**



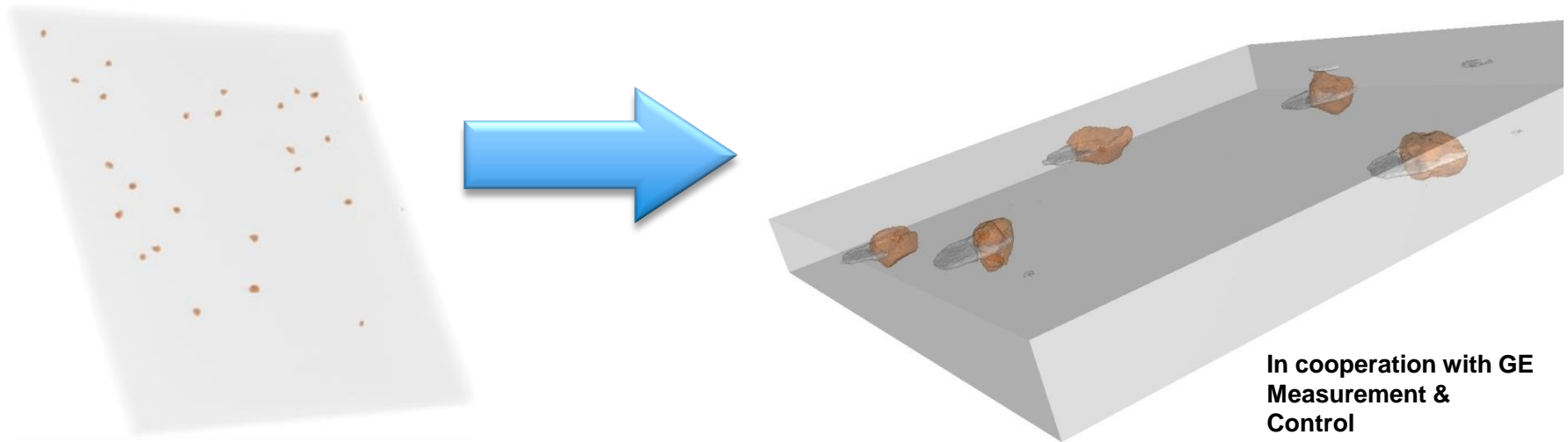
- Computed tomography-Workstation exaCT® S50
- maximum measurable component size:  
Ø 50 x 40 mm
- X-ray Source: 130 kV
- Detector: 1.6 Megapixel and about 40 µm pixelsize
- Detail resolution: 5 µm

- Computed tomography-Workstation exaCT® M150
- maximum measurable component size:  
Ø 150 x 250 mm
- X-ray Source: 125 kV
- Detector: 3.7 Megapixel and about 45 µm pixelsize
- Detail resolution: 40 µm



## Inclusions on plastic parts

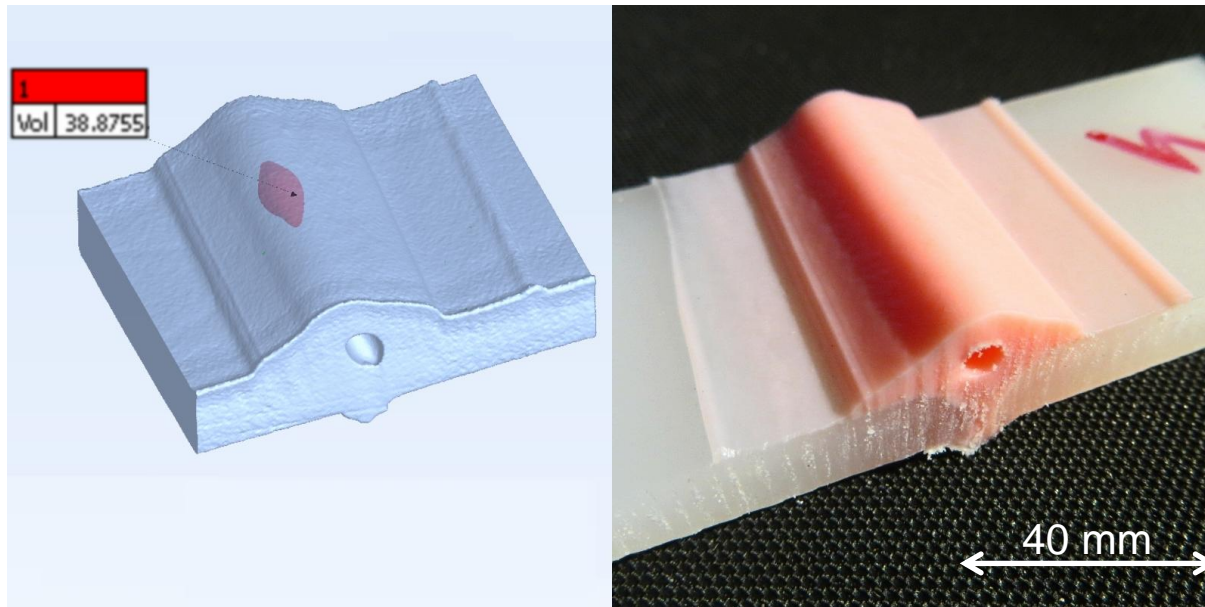
- The CT can be used as NDT measurement of shrink holes and inclusions in welded plastic parts
- Virtual sections for accurately positioning the fault are possible



HS welded PP-specimen (65 x 65 mm)  
with sand grains 0,8 - 1,2 mm

## Inclusions on plastic parts

- Hot gas welding parts can be non-destructive investigated for shrink holes
- Beside the position its also possible to mark the volume of the holes and check the seriosity of the defect



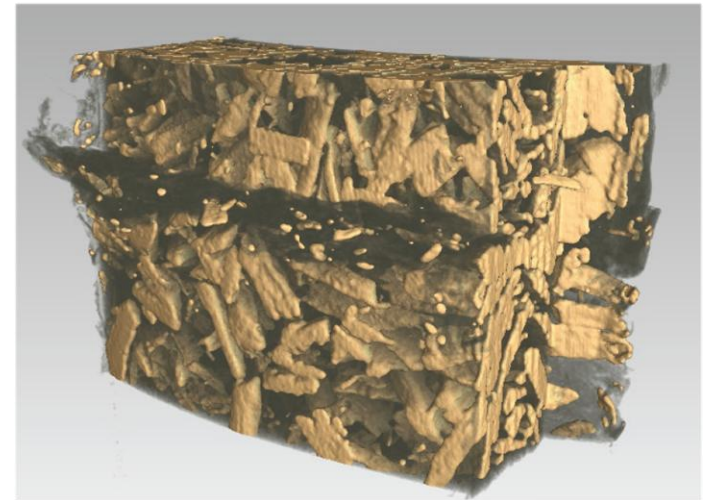
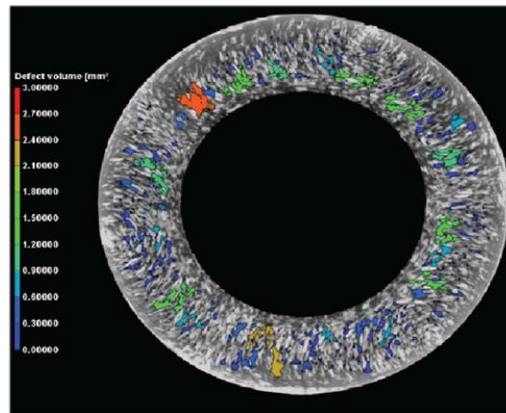
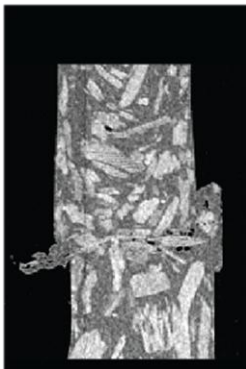
## WPC (Wood Plastic Composites) joints

- WPC is often used in building sector, automotive or furniture industry
- During the production process the parts has to be connected by bonding or welding
- Errors in the joint plane reduce the strength significantly
- Picture shows Ultrasonic-welded WPC-Parts



## WPC (Wood Plastic Composites) joints

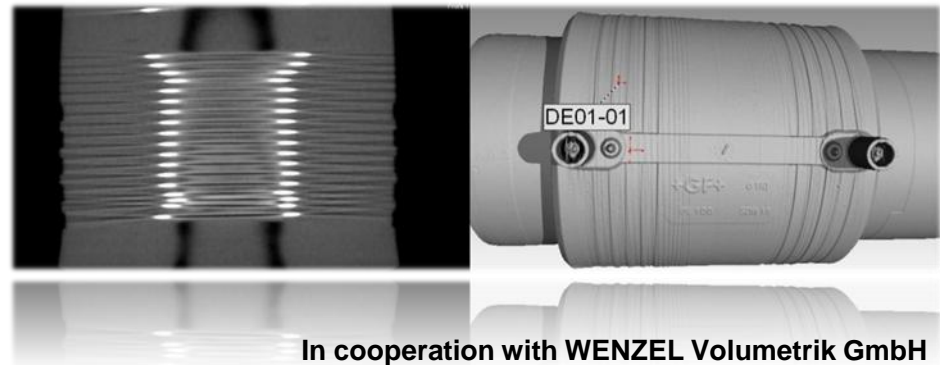
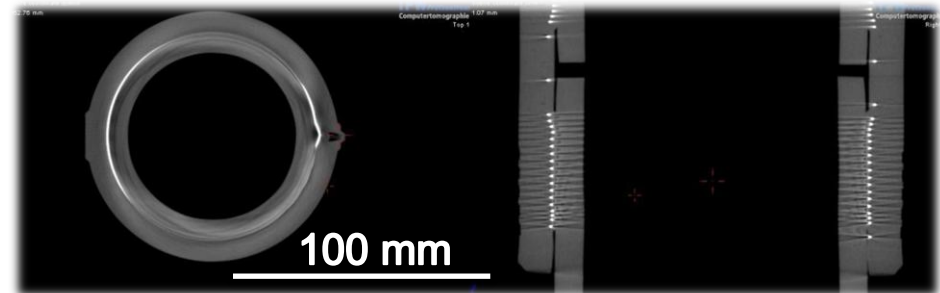
- Full 3d reconstruction shows the separation of plastic and wood
- Inclusions were detected automatically by the analysis software and displayed in color-coded
- The orientation of the wood fibers in the joining plane also affects the strength of the connection



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## Failure detection for the electrofusion welding (HM)

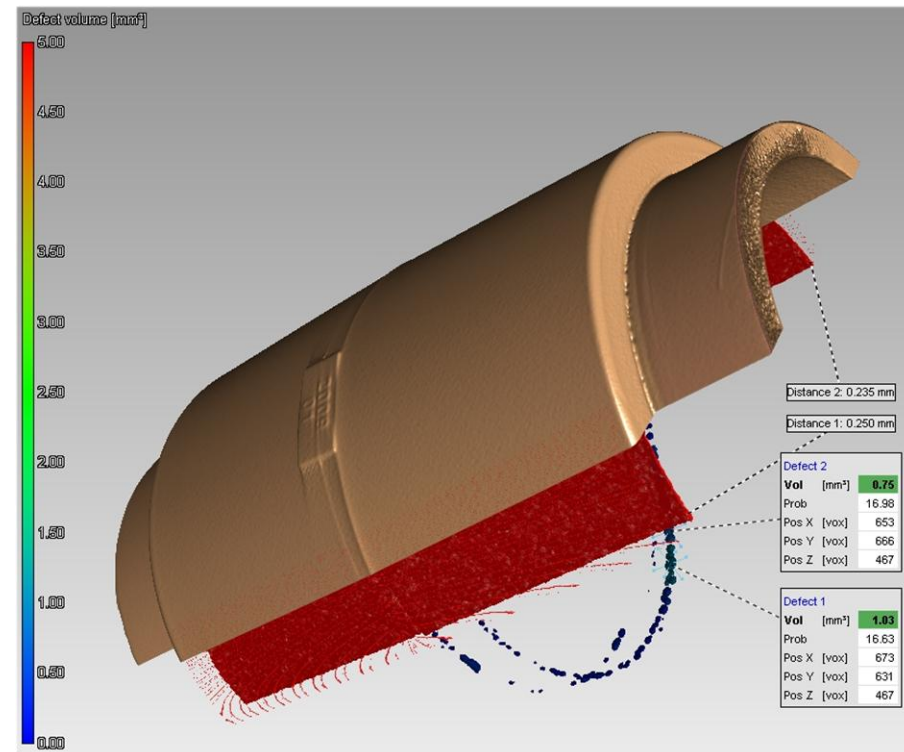
- The computed tomography is in principle very well for the examination of HM welding of polyethylene
- Detectable faults
  - ✓ Incorrect insertion of the pipe
  - ✓ Different gaps
  - ✓ Angular deviation
  - ✓ Inclusions of air or foreign matter in the joining seam
  - ✓ Movement of the heating coil



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## Investigation of adhesive bonded plastic joints

- SKZ already performed studies to determine correct adhesive amount for plastic parts
- Minimal density differences (0,05 to 0,1 g/cm<sup>3</sup>) between adhesive and plastic part can be, dependent on the X-ray source, successfully separated

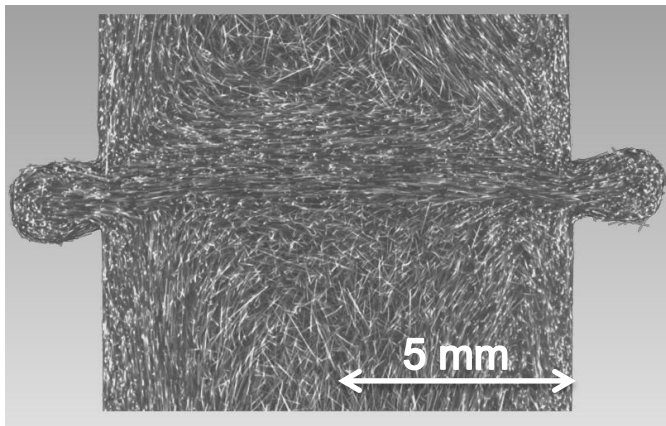


## Fibre orientation on plastic joints

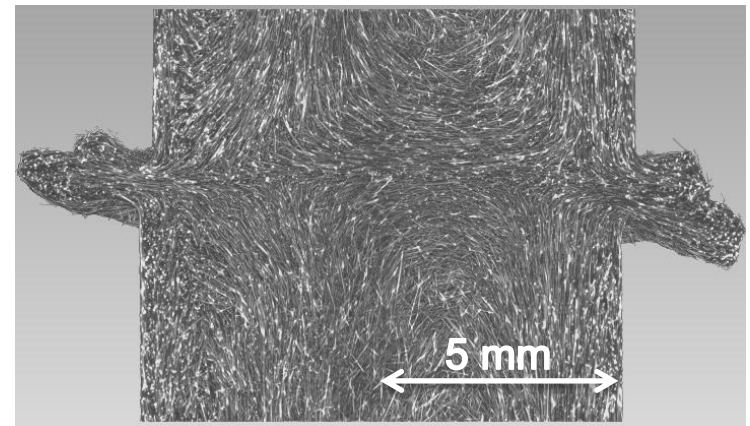
- SKZ research current the influence of the fiber orientation in the welding zone for filled thermoplastics
- In an orientation of fillers across the bond level, a significant decrease in weld strength is determined

### Aim:

- Analysis of the filler orientations
- Development of an innovative tool for the reduction of the filler orientation



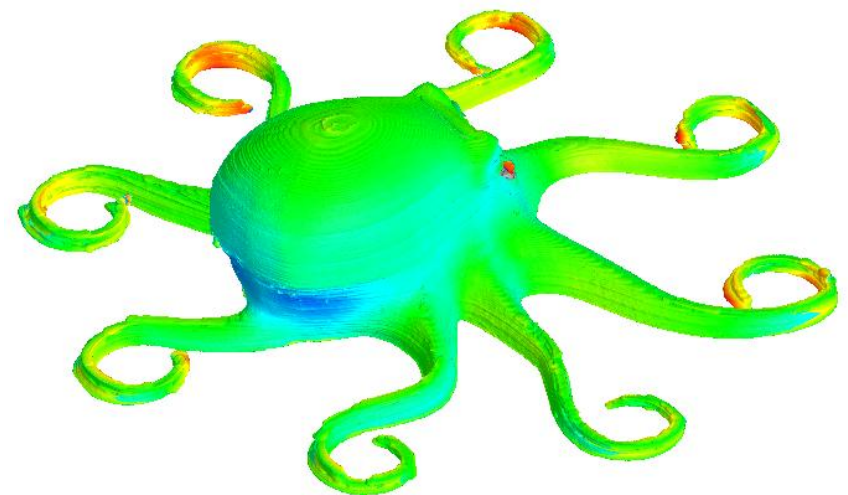
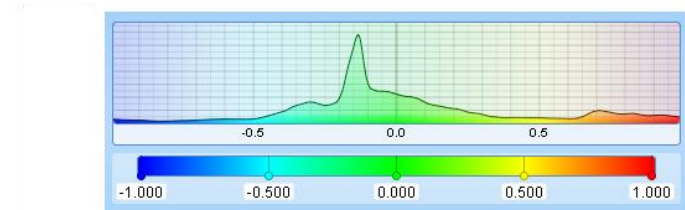
High fibre orientation, welding pressure too high



Low fibre orientation

## Variance analysis on plastic parts

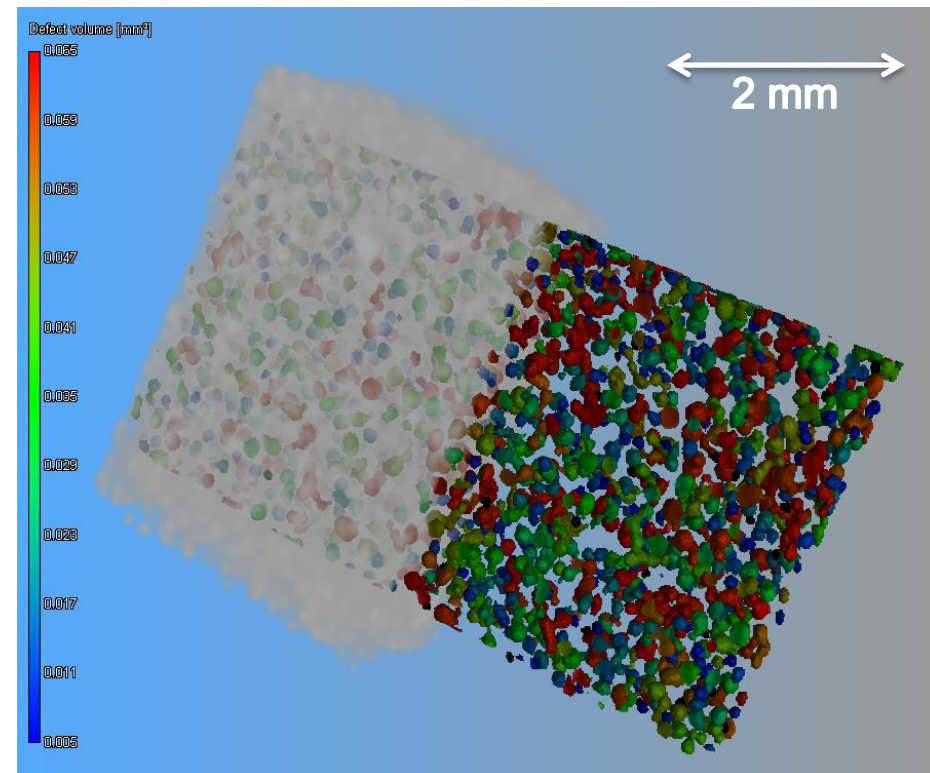
- With the iCT it is possible to measure the dimensioning of plastic parts
- The difference between proper component and the draft of it are shown color coded





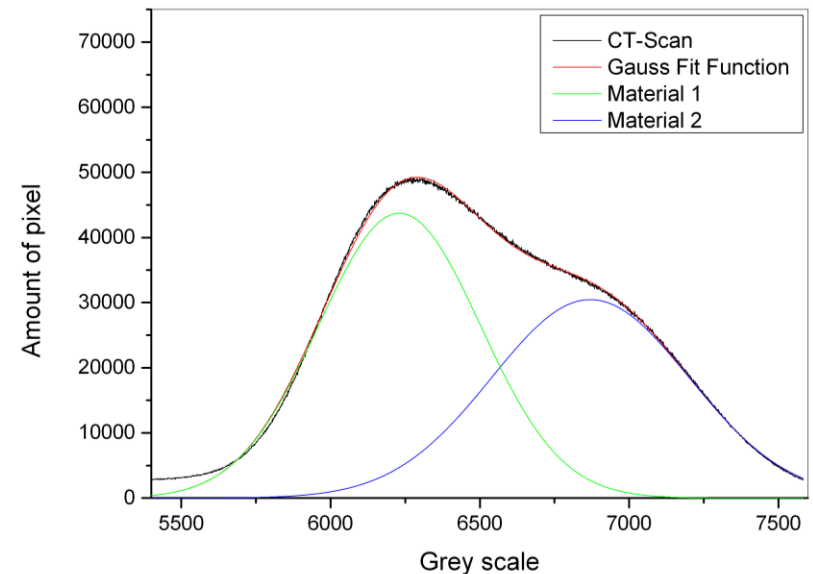
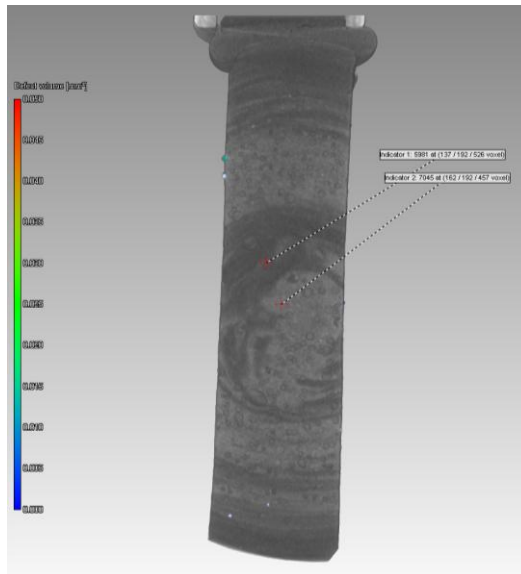
## Non-destructive material analysis

- Due to the very high resolution, computed tomography is suitable for non-destructive material analysis.
- Possible applications:
  - ✓ Particle/ volume size distribution
  - ✓ Characterization of Compounds
  - ✓ Particle size change through processing steps



## Analysis of the concentration different plastic components

- SKZ researching plastics, in which the filler content over the cross section varies continuously
- This different filler content, respectively the different densities, can be made visible by the CT



Thank you for your attention



For more information  
please visit our Website  
[www.skz.de/forschung/fuegen](http://www.skz.de/forschung/fuegen)

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