



3D EDDY CURRENT TESTING – A method for fiber angle analysis of carbon fiber preforms

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Knowledge for Tomorrow

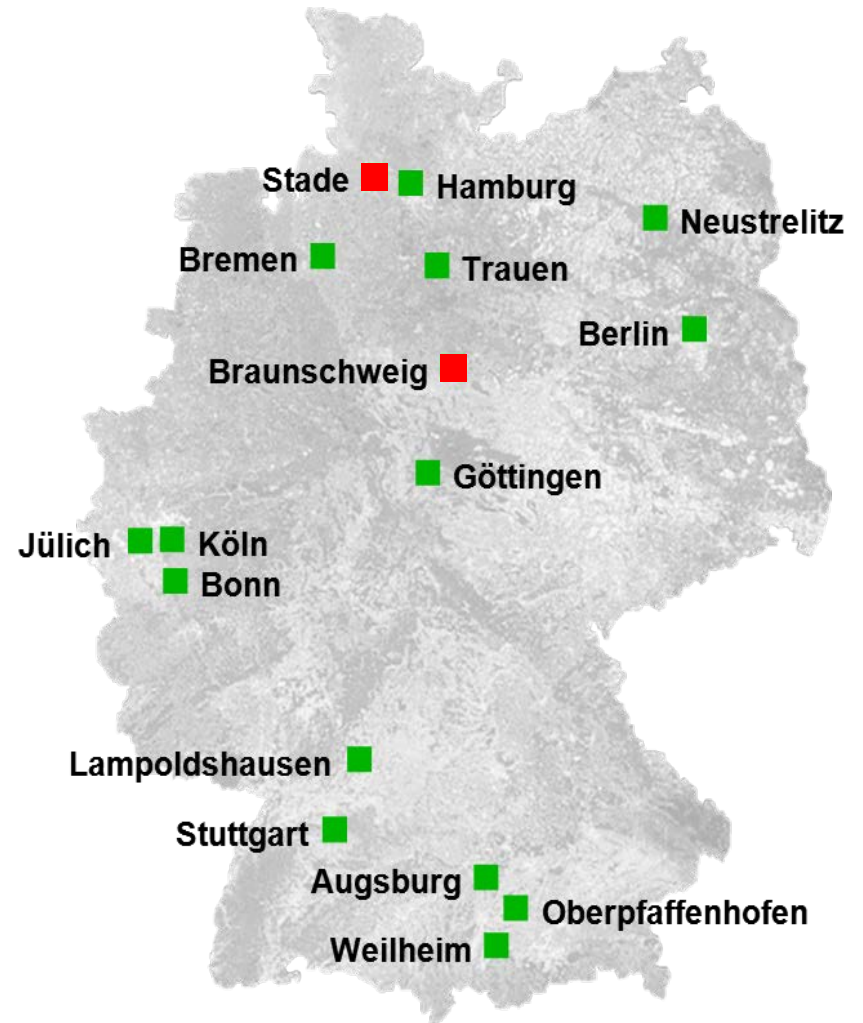


Overview of the DLR



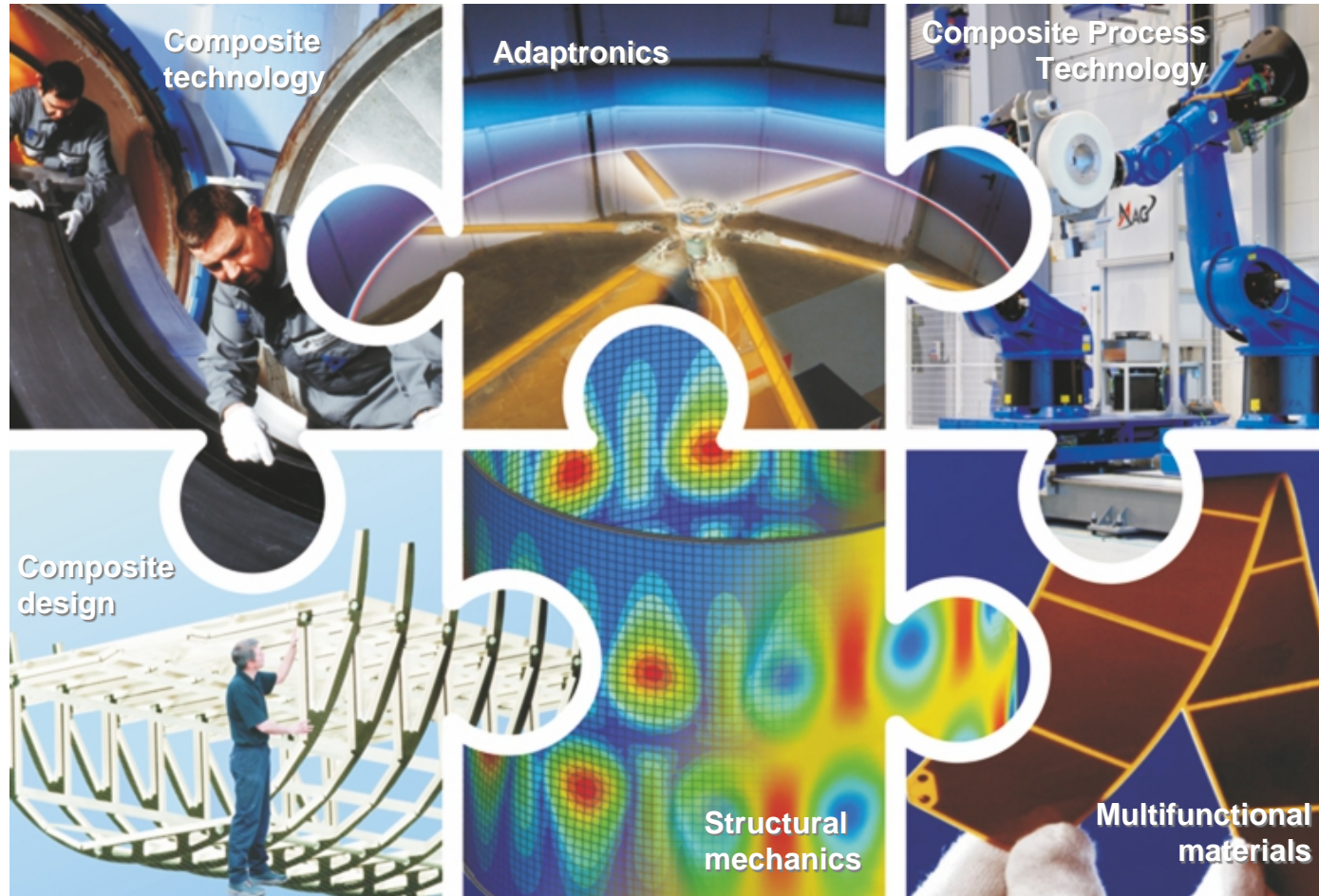
- 8000 employees
- 32 institutes or facilities
- 16 sites

DLR – German Aerospace Center





DLR - Institute of Composite Structures and Adaptive Systems : 6 Departments



ZLP Site Stade

Team EVo – Netshape RTM parts in high volumes

Goals:

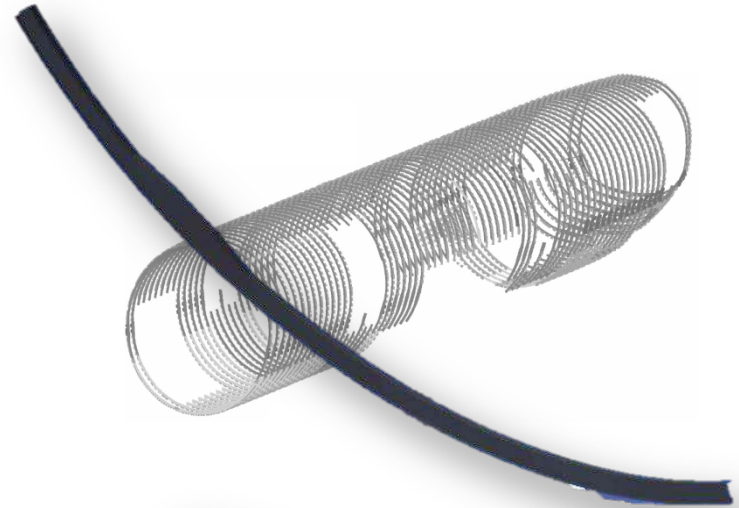
- Automated production of complex RTM parts
- 100,000 Parts/year
- Net-shape production

Research focus:

- Design and test of new draping technologies
- Injection concepts and simulation
- High precision trimming (< 0.1 mm)
- Integrated QA (Preforming and RTM)

Key facts:

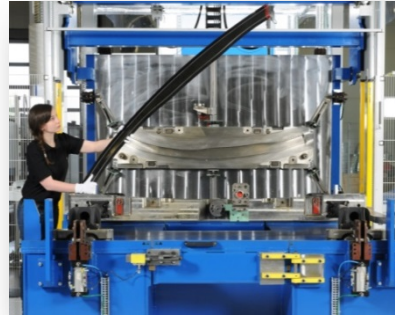
- Production line: 40 x 8m
- Max. part size: 2 x 2.5m
- RTM press: 500 tons



EVo - Research Production Line

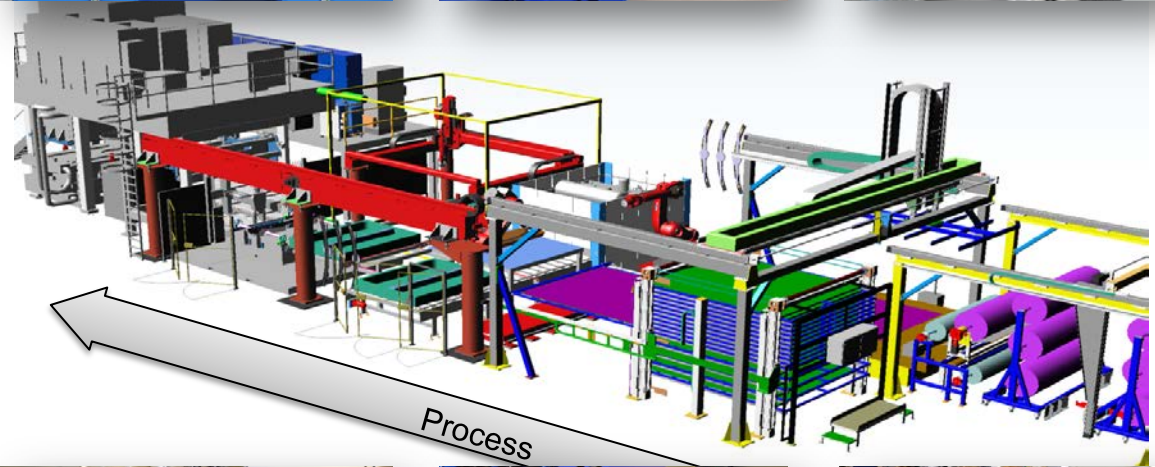
Ply-Preparation

- Textile-Storage
- Cutter
- Ply-Storage
- Portal-Vacuum-Gripper



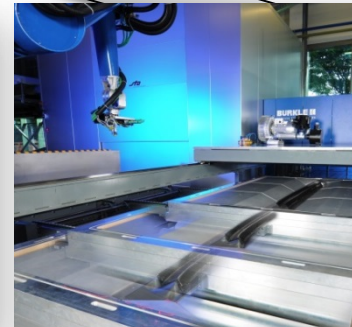
Netshape-Preforming

- Draping-Robot
- Consolidation-Press
- Handling-Robot
- Finetrimming-Robot



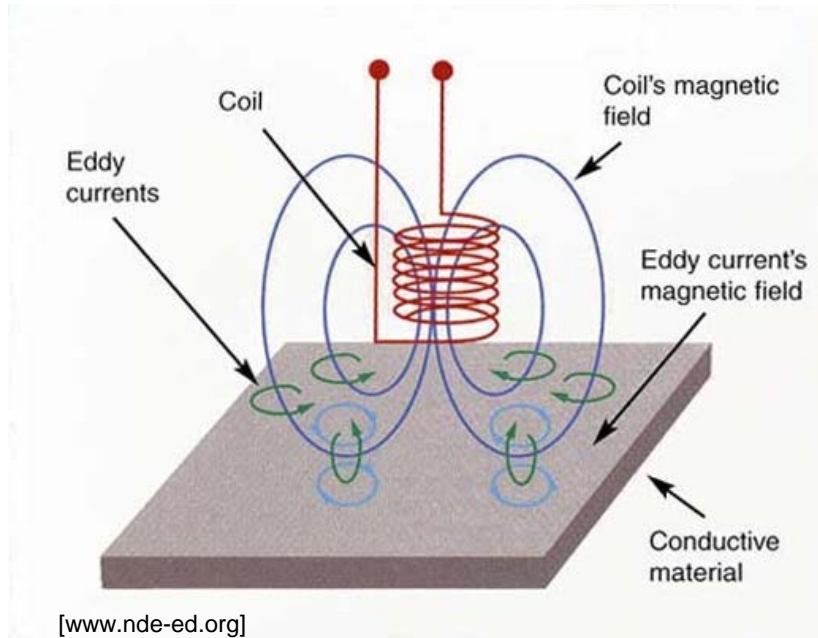
RTM-Line

- Movable Core-Mold
- 500t-Press
- 2 Component-Injection-Unit
- Curing-Oven





Basics - Eddy Currents



Schematic illustration of the generation of eddy currents

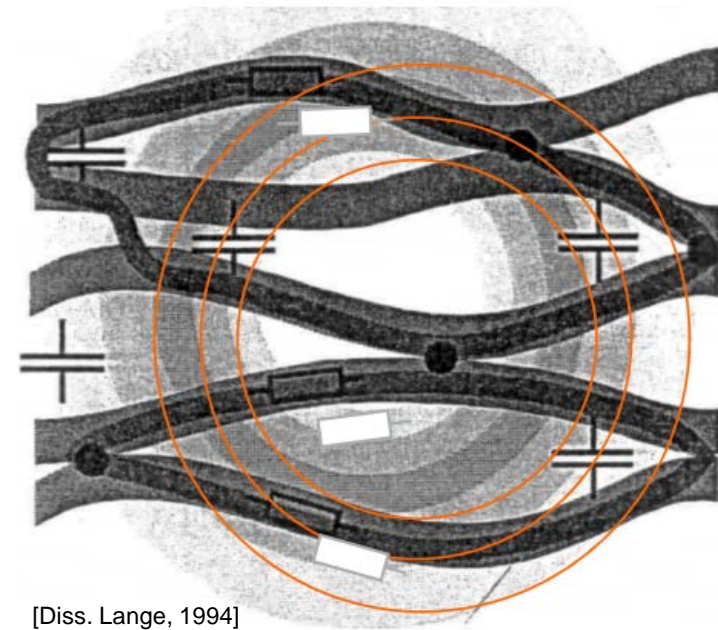
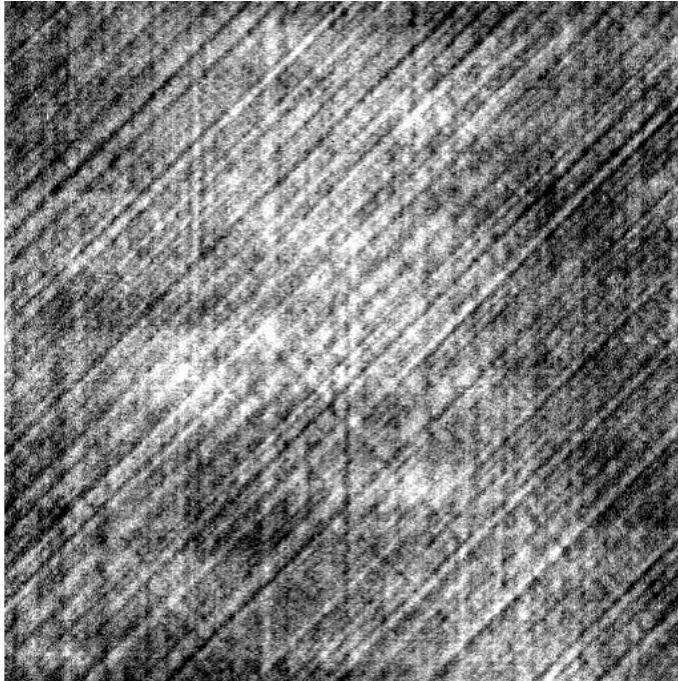


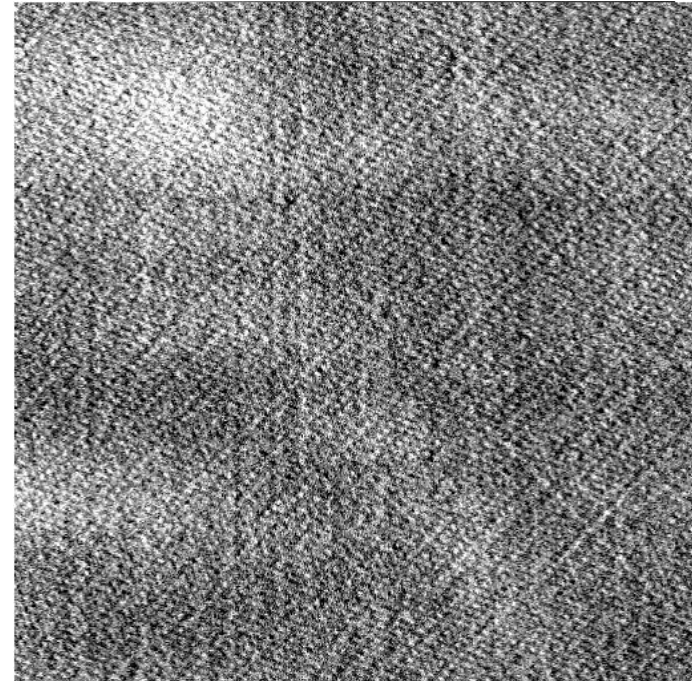
Illustration of the electric and capacitive coupling between the fibers



Basics – Eddy current pictures



Toho Tenax UD: (0/45/90/-45)_s



Hexcel G1157 UD: (45/-45/0/90)

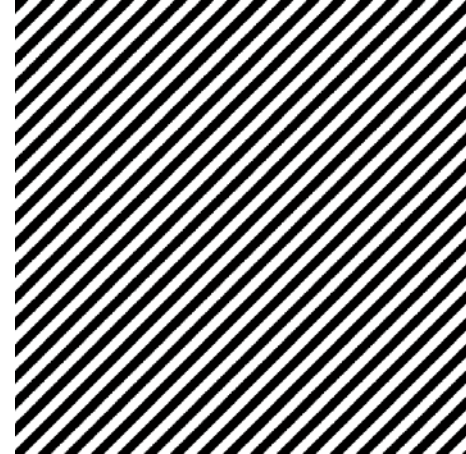
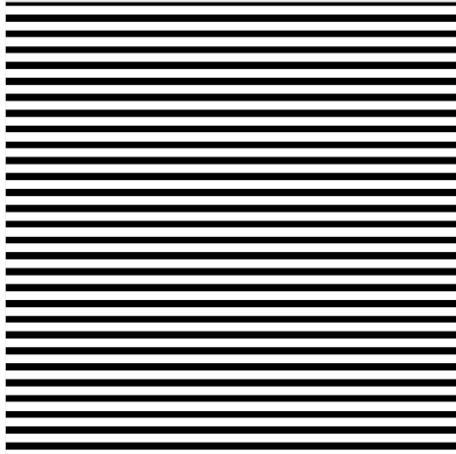
- Illustration of the conductivity of the material
- Up to 8 layers in depth demonstrated
- Detection of defects, like missing rovings, gaps, fuzz balls, insertions, undulations and the fiber angle



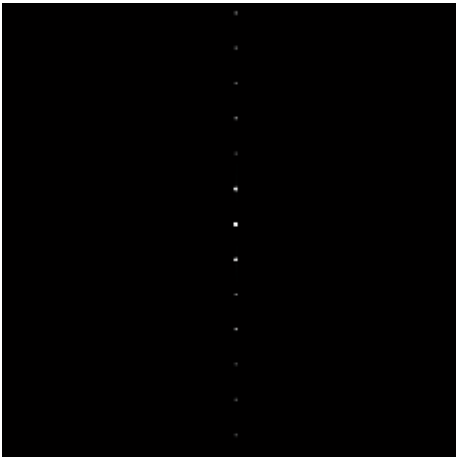


Basics - Fiber angle analysis

Image

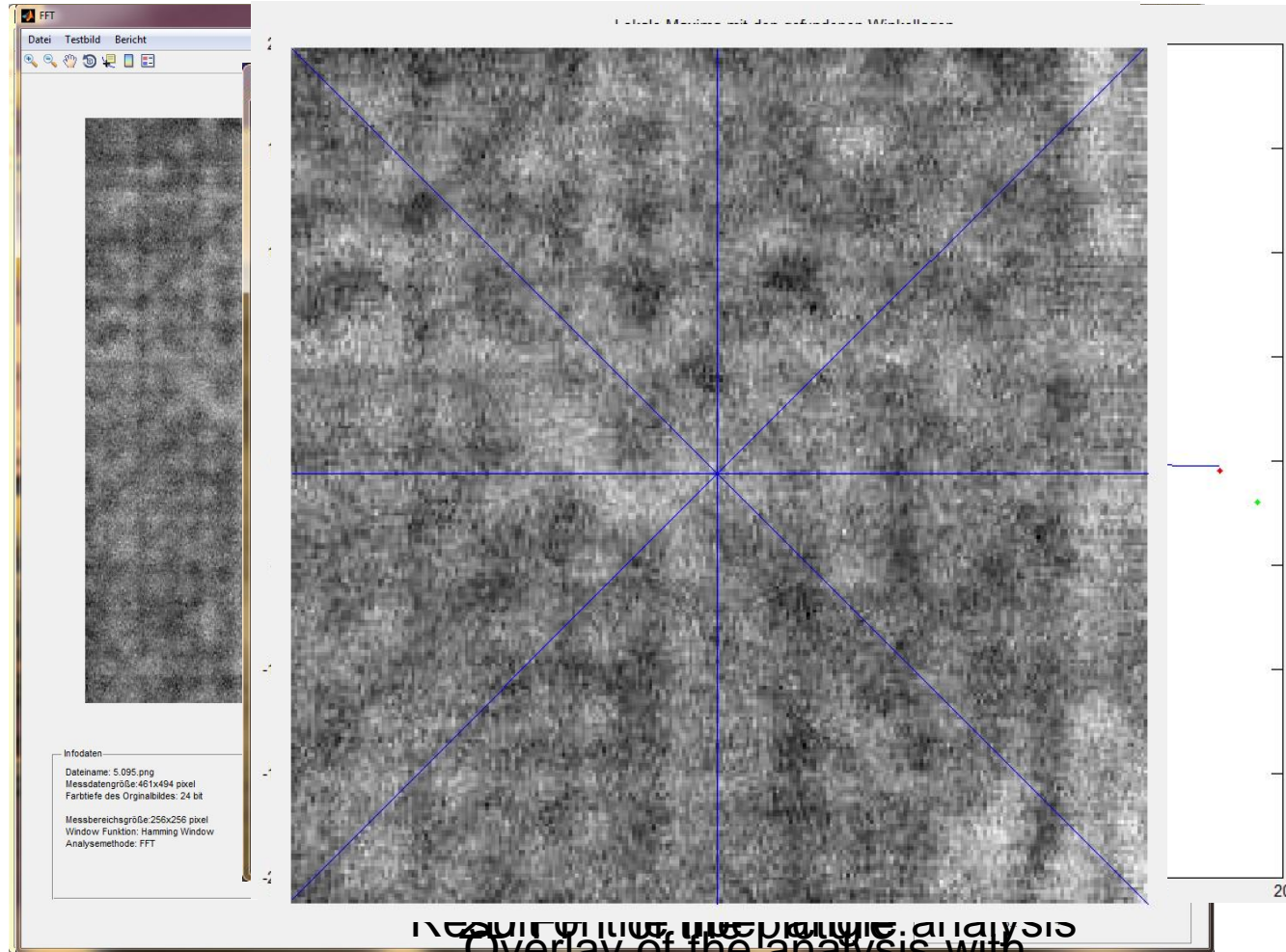


2D-FFT





Fiber angle analysis software

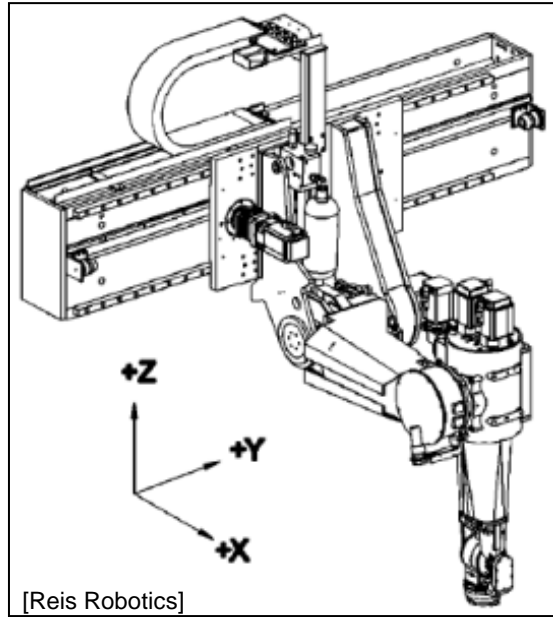


Overlay of the analysis with
Loading of the eddy current data
the original picture

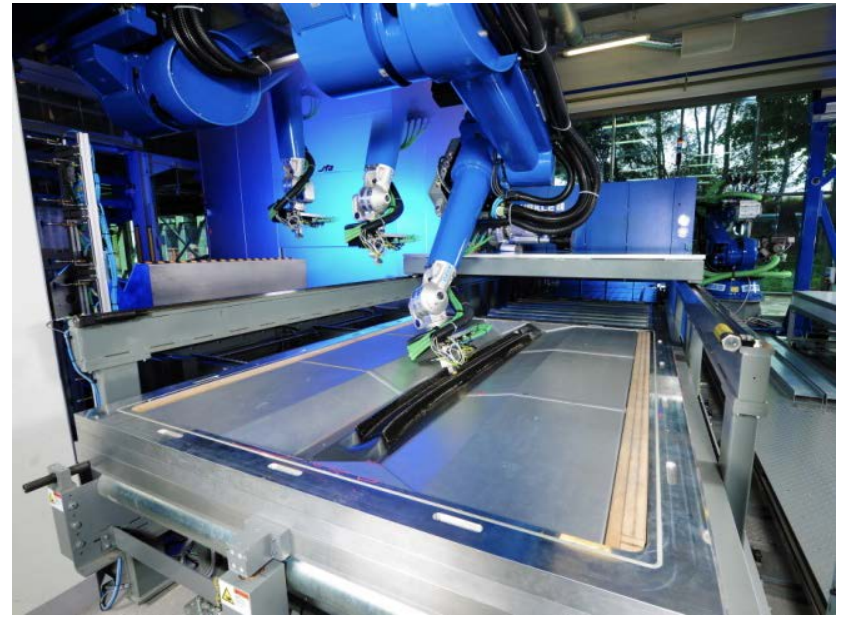




Mounting at the Robot



Drawing of the linear robot

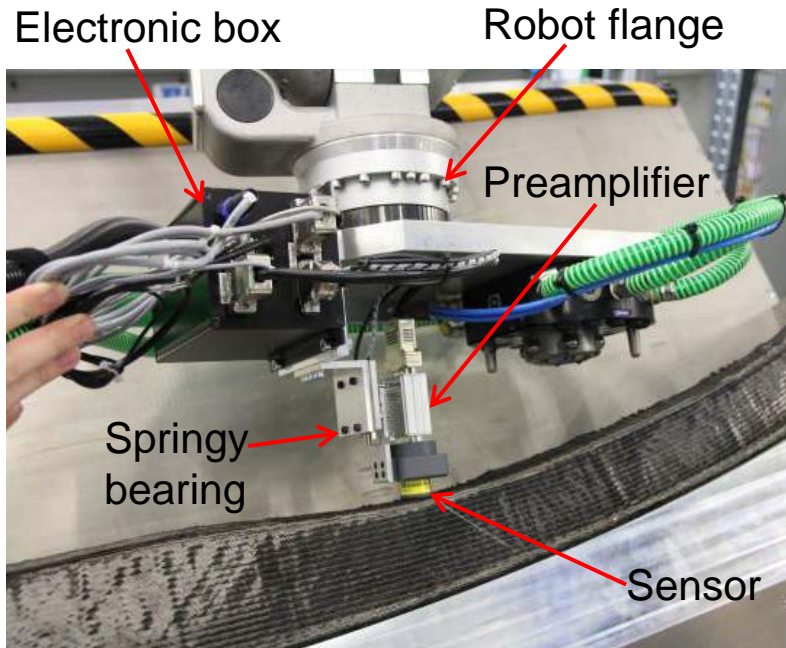


Robot on the way to a measurement

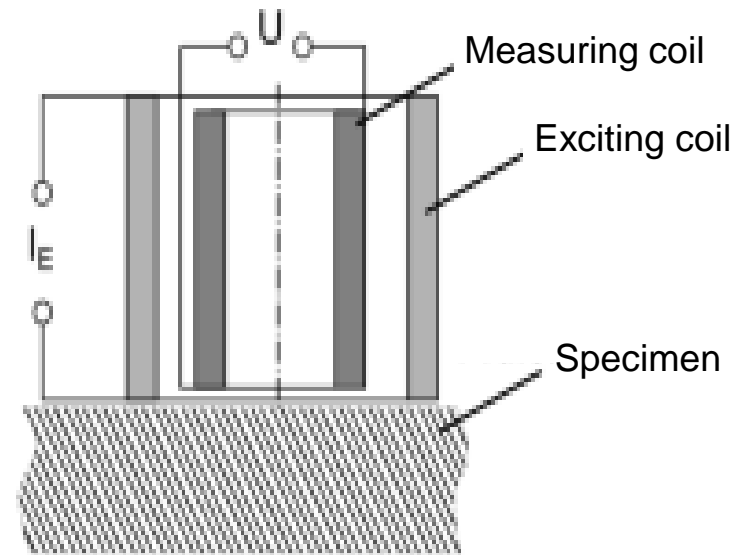




Mounting at the Robot



Mounting of the eddy current sensor

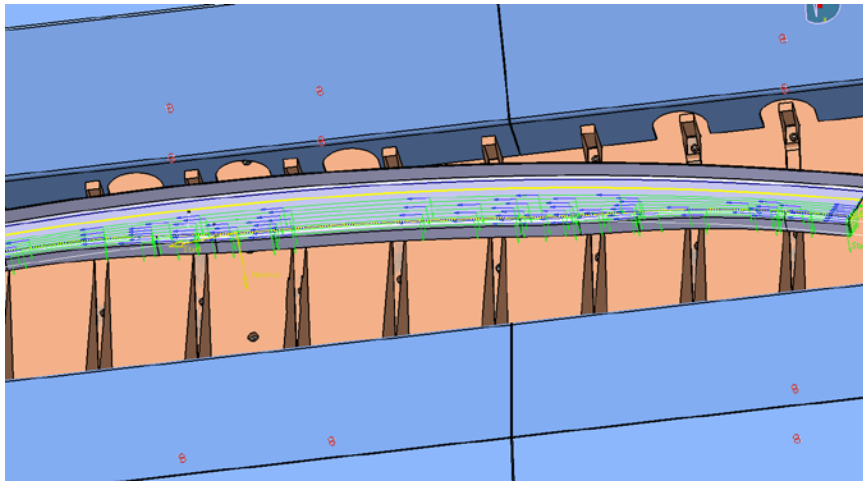


Drawing of an absolute sensor

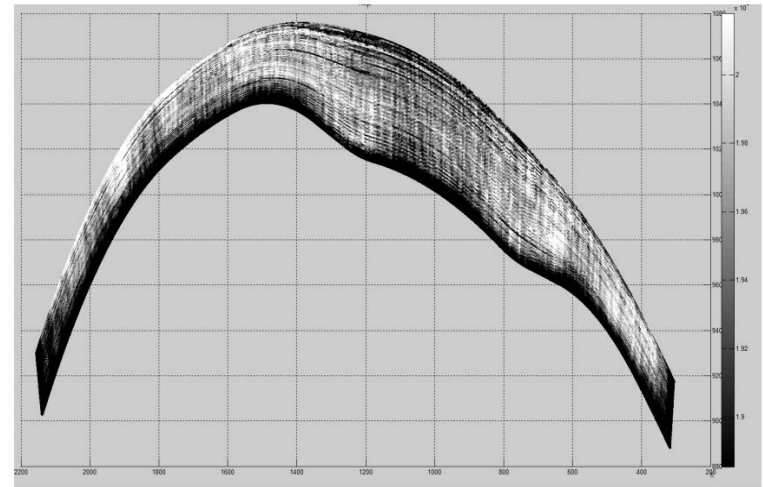




3D-Measurement



Offline programming of the robot path

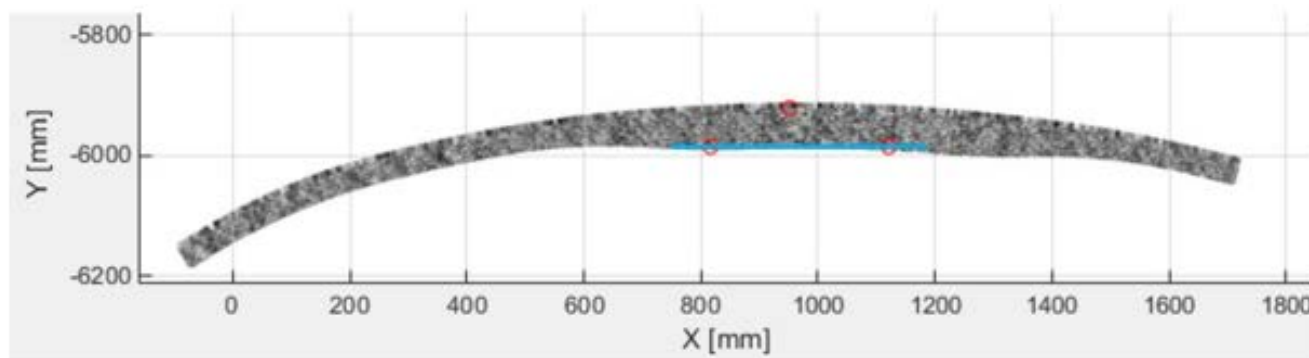


3D Eddy current data

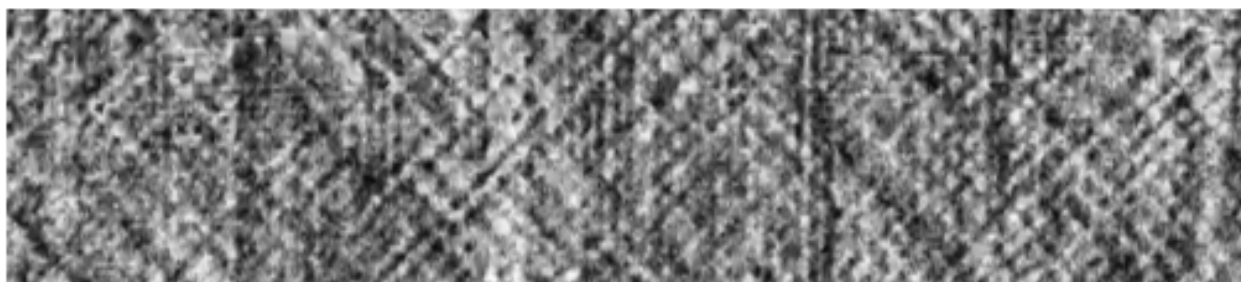




3D-Measurement



Interactive selection of the analysis area



Analyzable picture



Conclusion

- Detection of different kind of defects up to 8 layers in depth
- Fiber angle analysis based on FFT
- Measurement of 3D objects guided by a robot



Outlook

- Calculation of the accuracy of the measurement system
- Test of a newly designed 3D printed sensor
- Analysis of the whole frame, including the radii



THANK YOU FOR YOUR ATTENTION!

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