EDDY CURRENTS for dry carbon fibers – a method for quality assurance in an automated facility

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2. Basics – Eddy Currents
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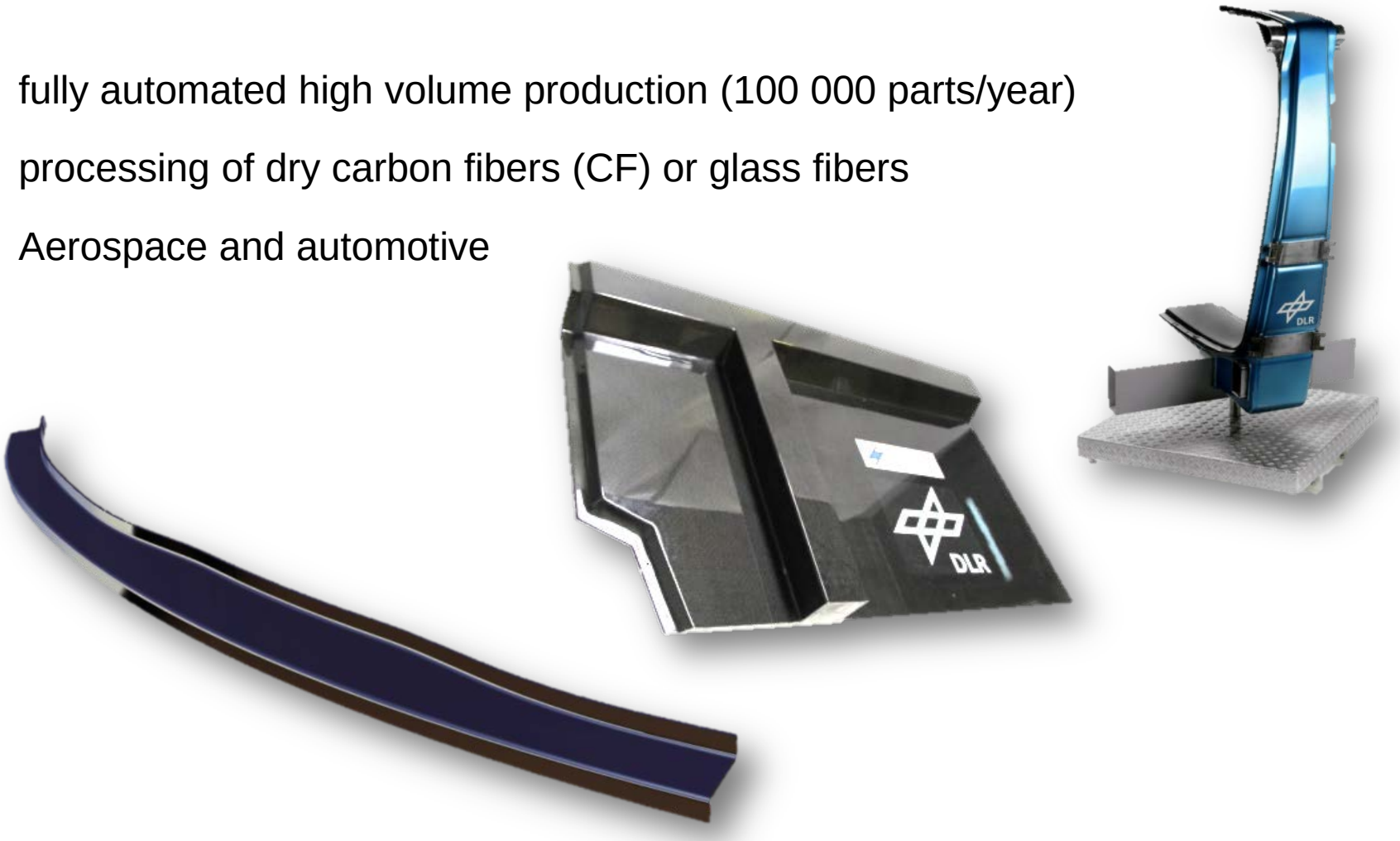
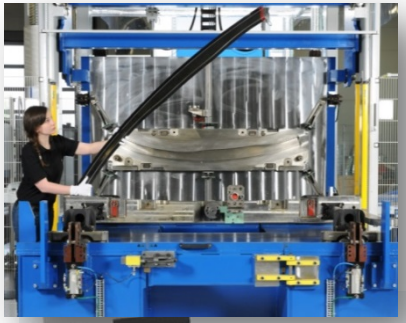
1. EVo - Endkonturnahe Volumenbauteile

- fully automated high volume production (100 000 parts/year)
- processing of dry carbon fibers (CF) or glass fibers
- Aerospace and automotive

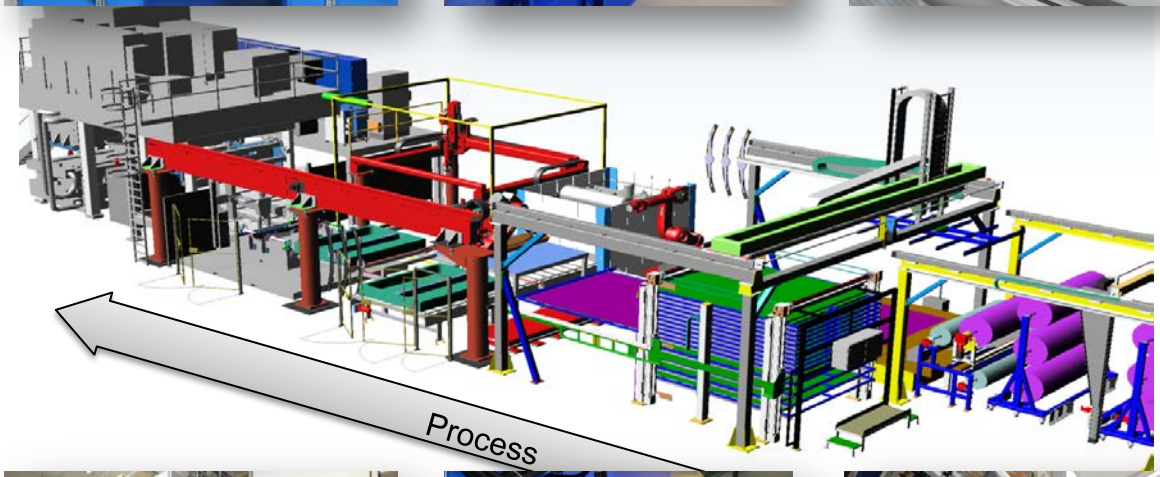


1. EVo - Research Production Line

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

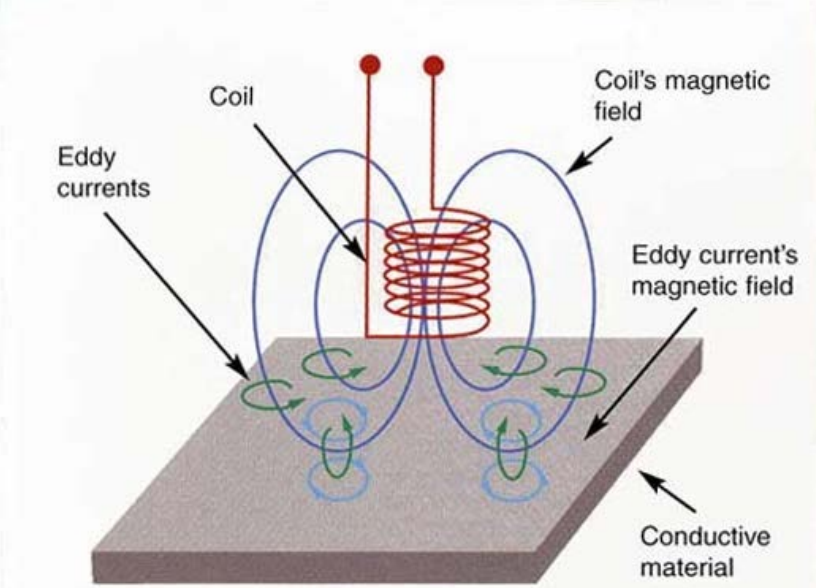


Netshape-Preforming
- Draping-Robot
- Consolidation-Press
- Handling-Robot
- Finetrimming-Robot



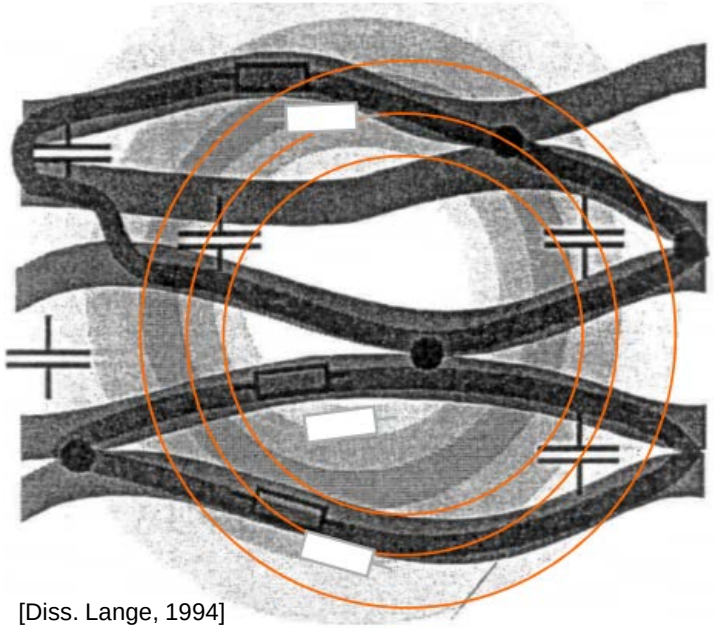
RTM-Line
- Movable Core-Mold
- 500t-Press
- 2 Component-Injection-Unit
- Curing-Oven

2. Basics - Eddy Currents



[www.nde-ed.org]

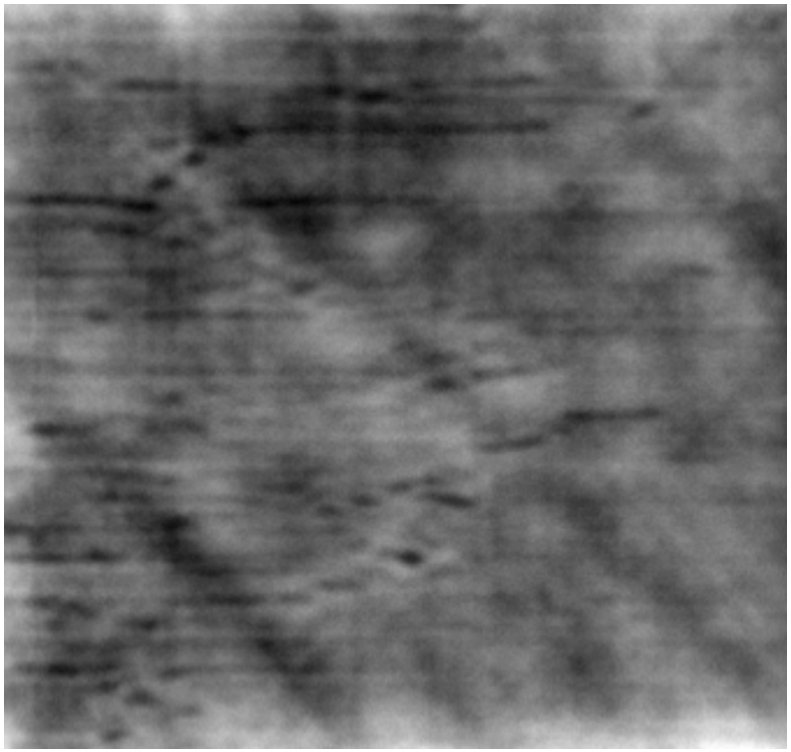
Schematic illustration of the generation of eddy currents

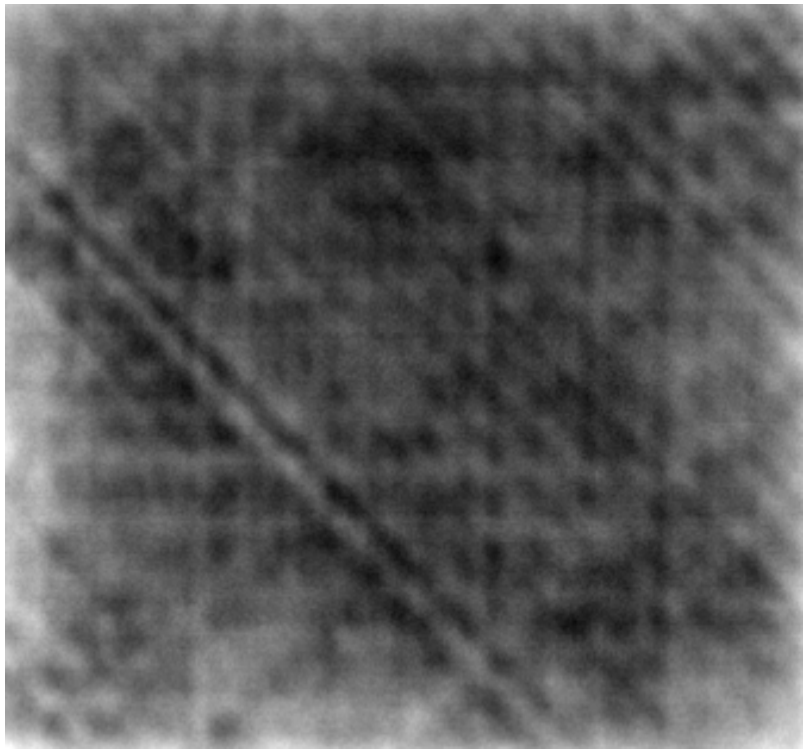


[Diss. Lange, 1994]

Illustration of the electric and capacitive coupling between the fibers

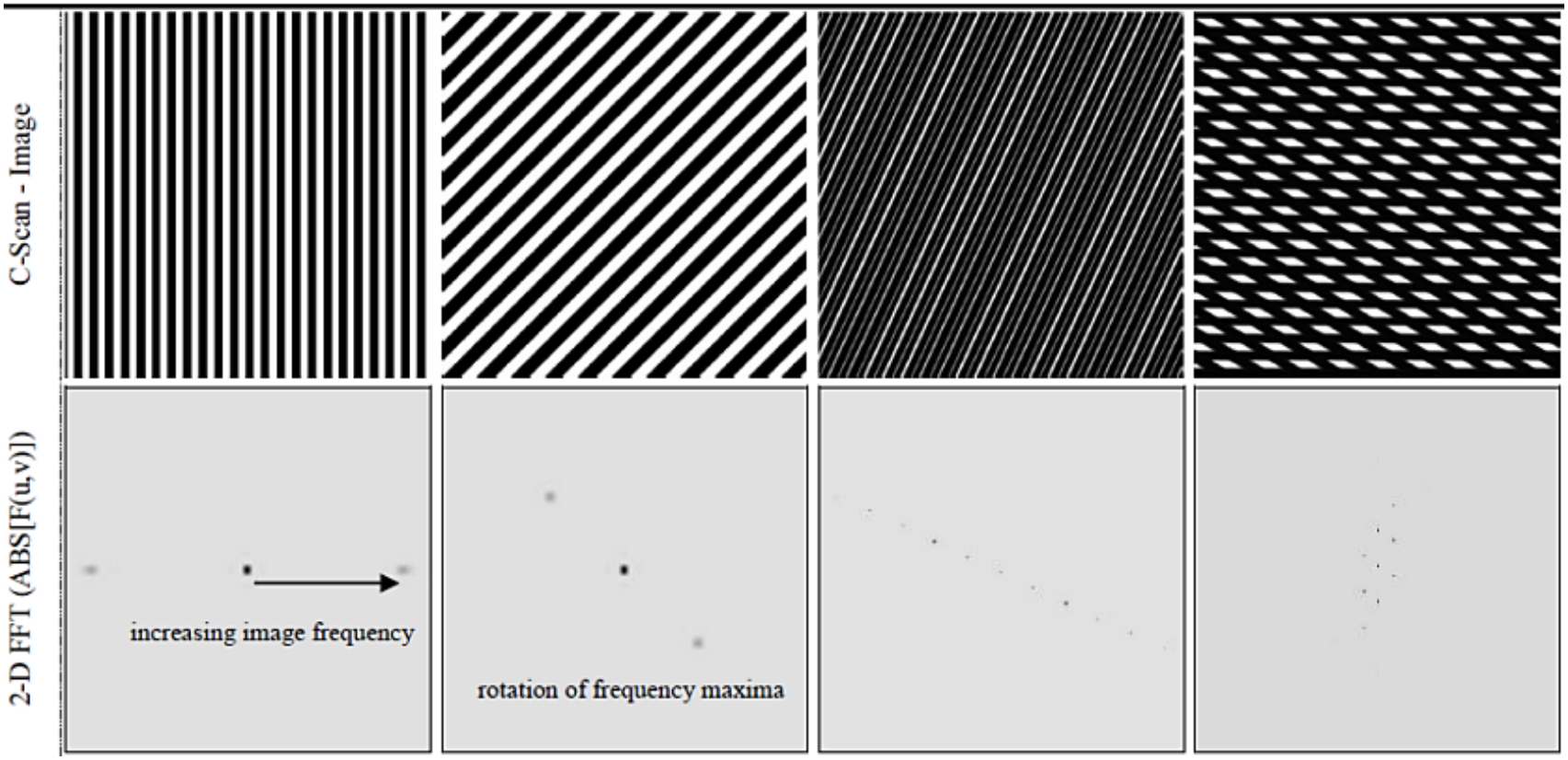
2. Basics – Eddy current pictures



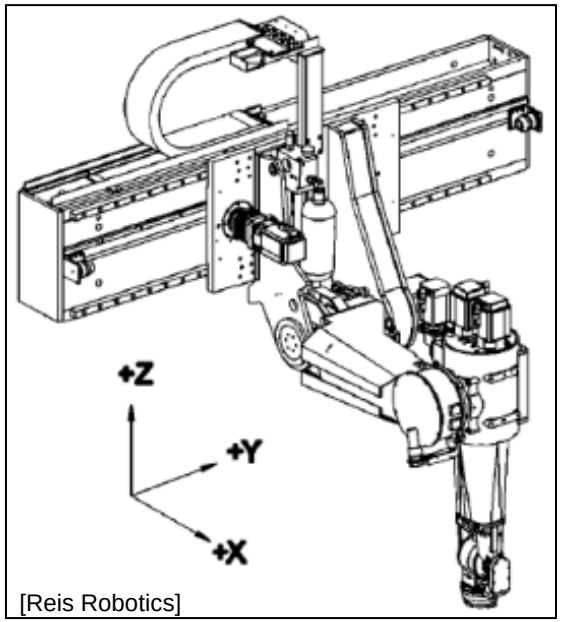


→ 2D illustration of the conductivity of the material

2. Basics - Fiber angle analysis

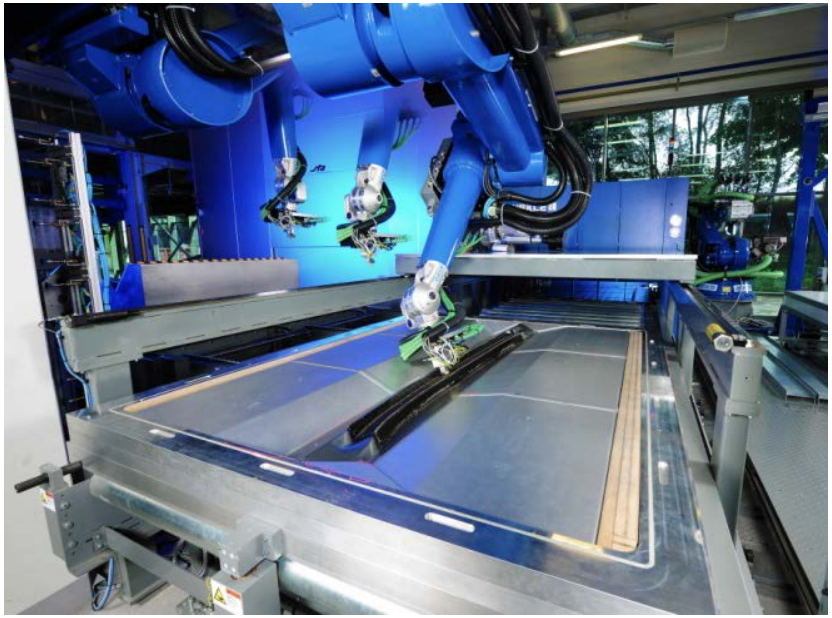


3. Mounting at the Robot



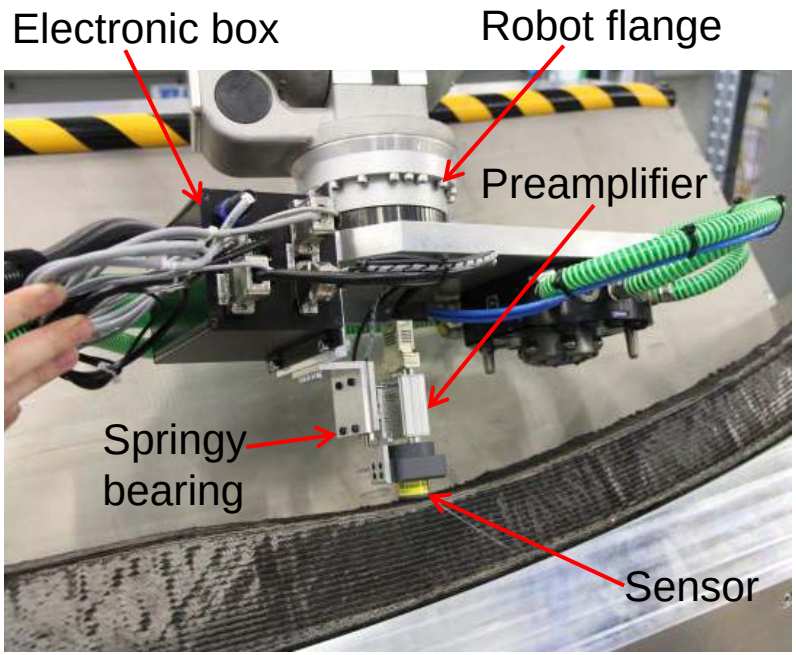
[Reis Robotics]

Drawing of the linear robot

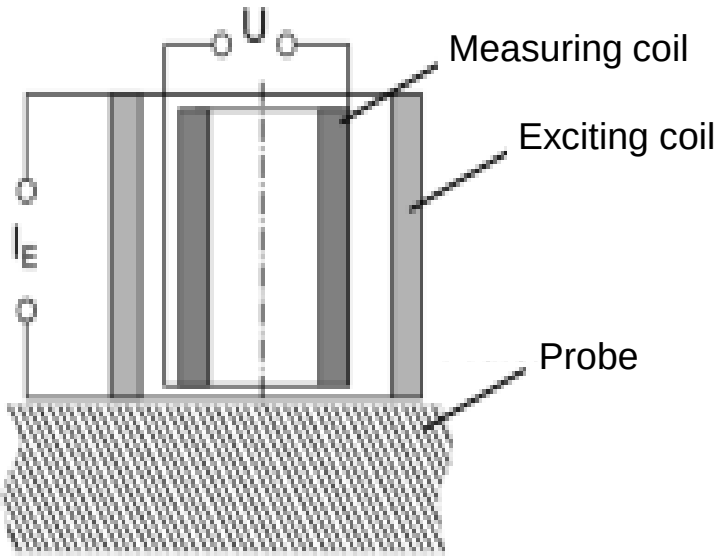


Robot on the way to a measurement

3. Mounting at the Robot



Mounting of the eddy current sensor EddyCus® Integration Kit

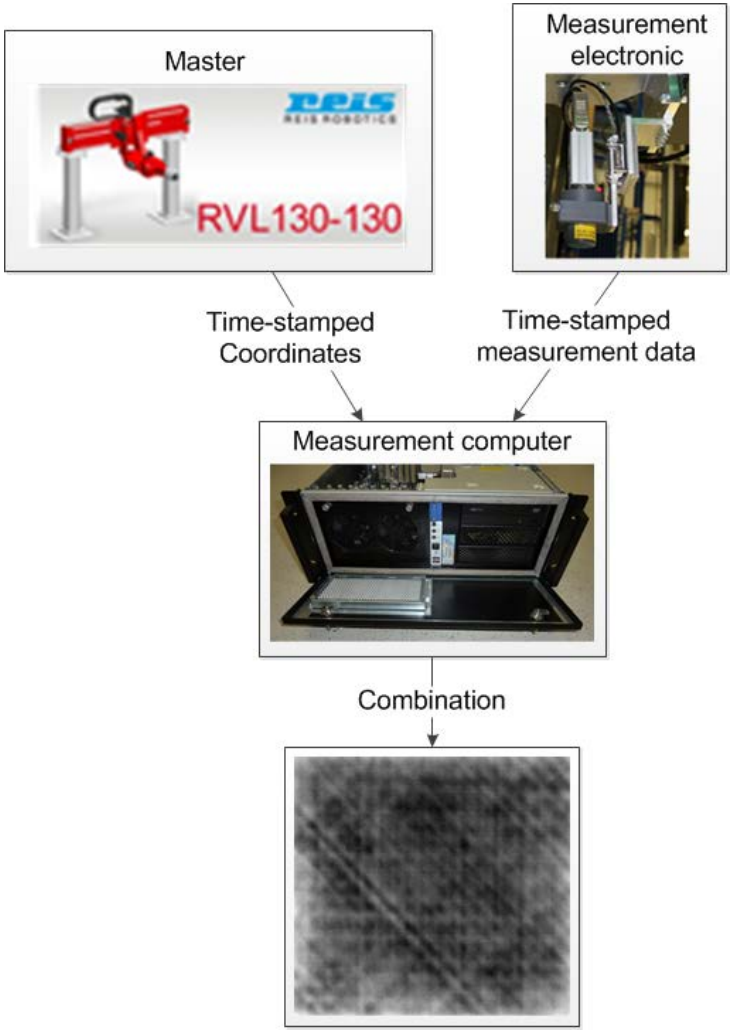


Drawing of an absolute sensor

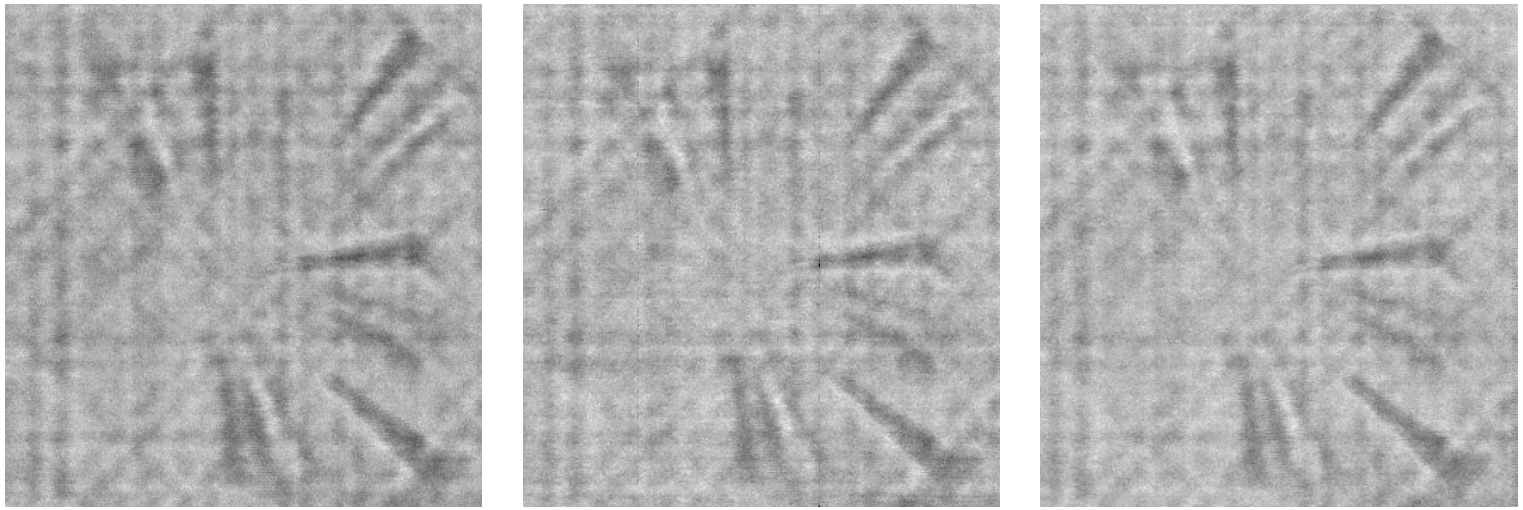
4. Coordinate transfer and data combination

- Robot sends coordinates by ProfiNet to the measurement computer
- Every coordinate contains a timestamp
- Eddy current electronic sends time-stamped data to the measuring computer

- Combination of measurement data (400 Hz) and coordinates (120 Hz)



5. Results - Contact pressure



From left to right: light, middle, strong contact pressure

Results:

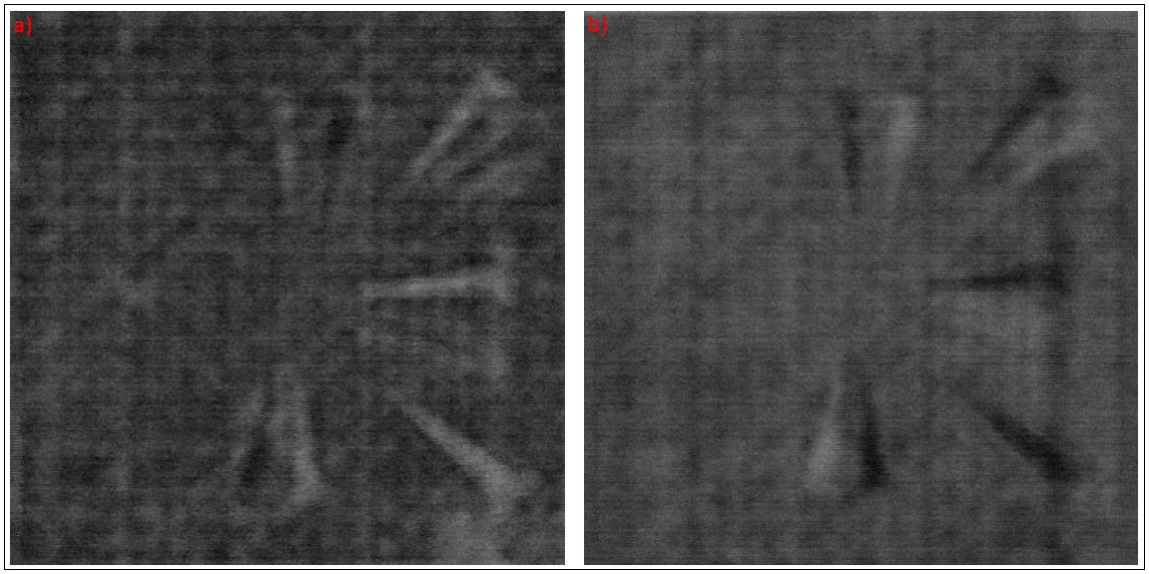
- Almost no optical difference
- Analyzed fiber angle shows no significant difference

→ Contact pressure has no significant influence for consolidated material

5. Results – Robot speed

- Measured four frequencies at once with 400 Hz
- Robot speed for accurate pictures: 100 mm/s
- Speed of 200 mm/s still gives acceptable pictures
- Faster measurement is at probes of 200x200mm because of acceleration times not possible

5. Results - Carrier material



carrier material: aluminium isolating carrier material

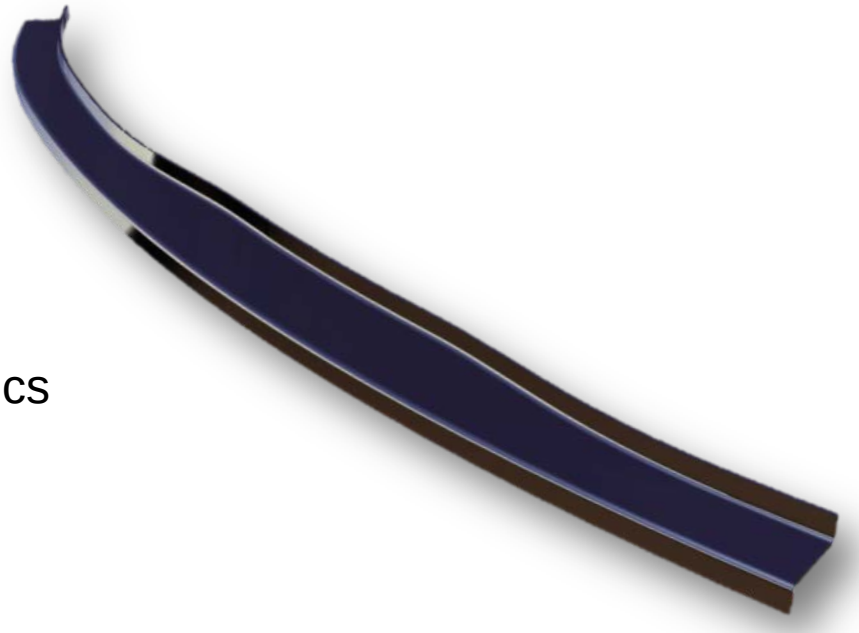
Results:

- conductivity of the carrier material is not influencing the measurement
- measurements directly on tools are possible

6. Conclusion

- Innovative and precise measurement system
- Potential for industrial application at many tasks in composite production
- carrier material has no influence
- Layer detection also at deeper lying layers

7. Outlook



- Experimental investigation of 3D-parts
- Automation of the fiber angle analysis
- Analysis of the draping of multiaxial fabrics
- Analysis of corners

THANK YOU FOR YOUR ATTENTION!

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