

SCIENTIFIC VISION DAYS 2024

Localization of Fabrics with Computer Vision for Composite Manufacturing



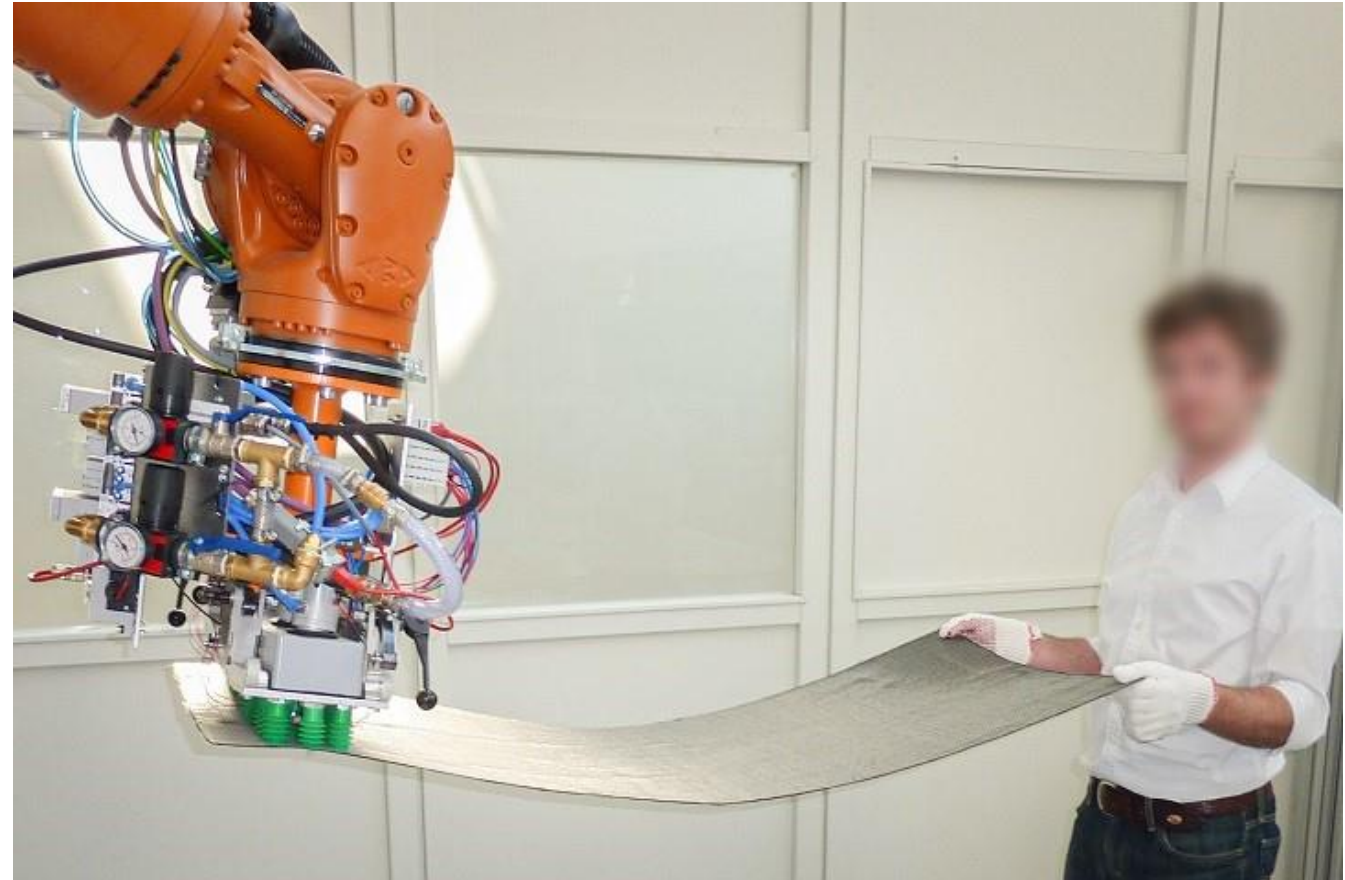
Project DrapeBot

- Human machine collaboration with industrial robots
- Collaborative draping of dry fibers as well as prepreg
- Aerospace (frame), maritime (propeller) and automotive (hood) use cases
- Process control by a MES
 - Robot movement execution
 - Quality assurance
 - Draping
 - Fixation
 - Worker/gesture detection
- Pick & Place but **WHERE** to pick????



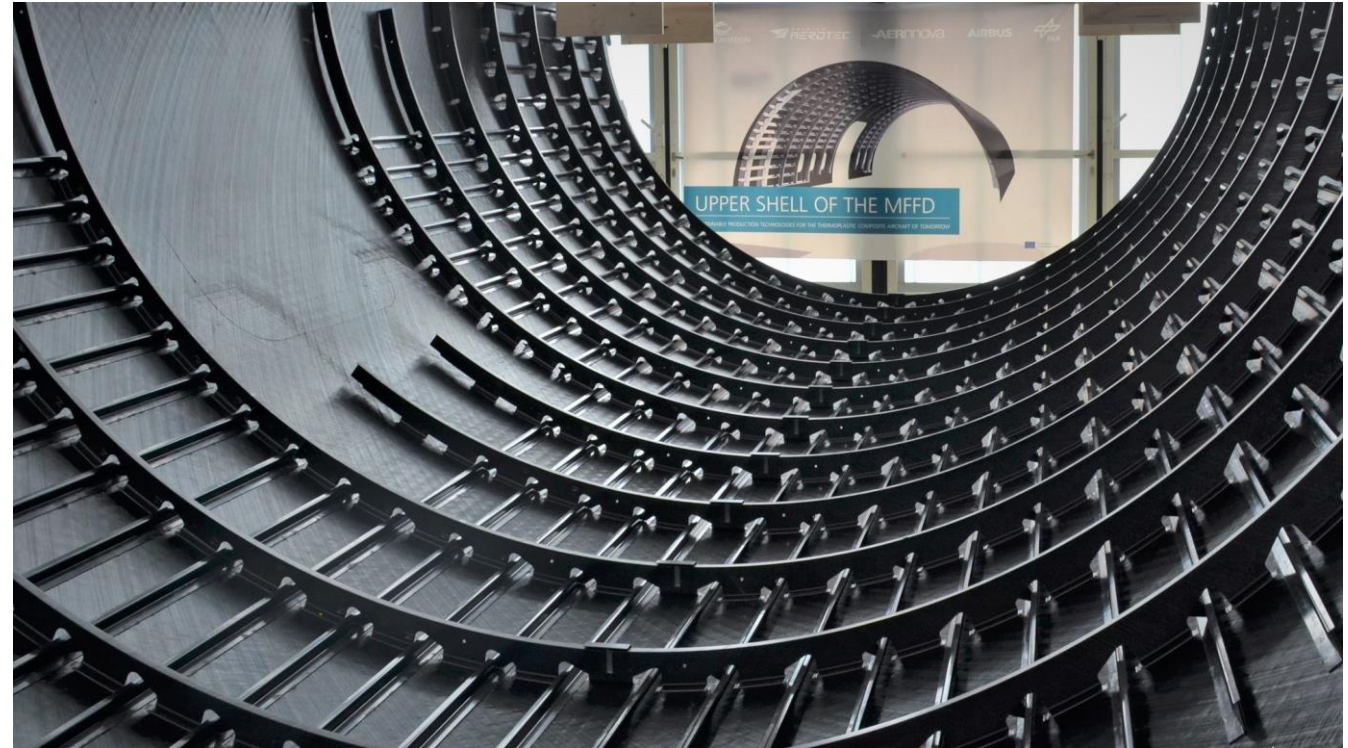
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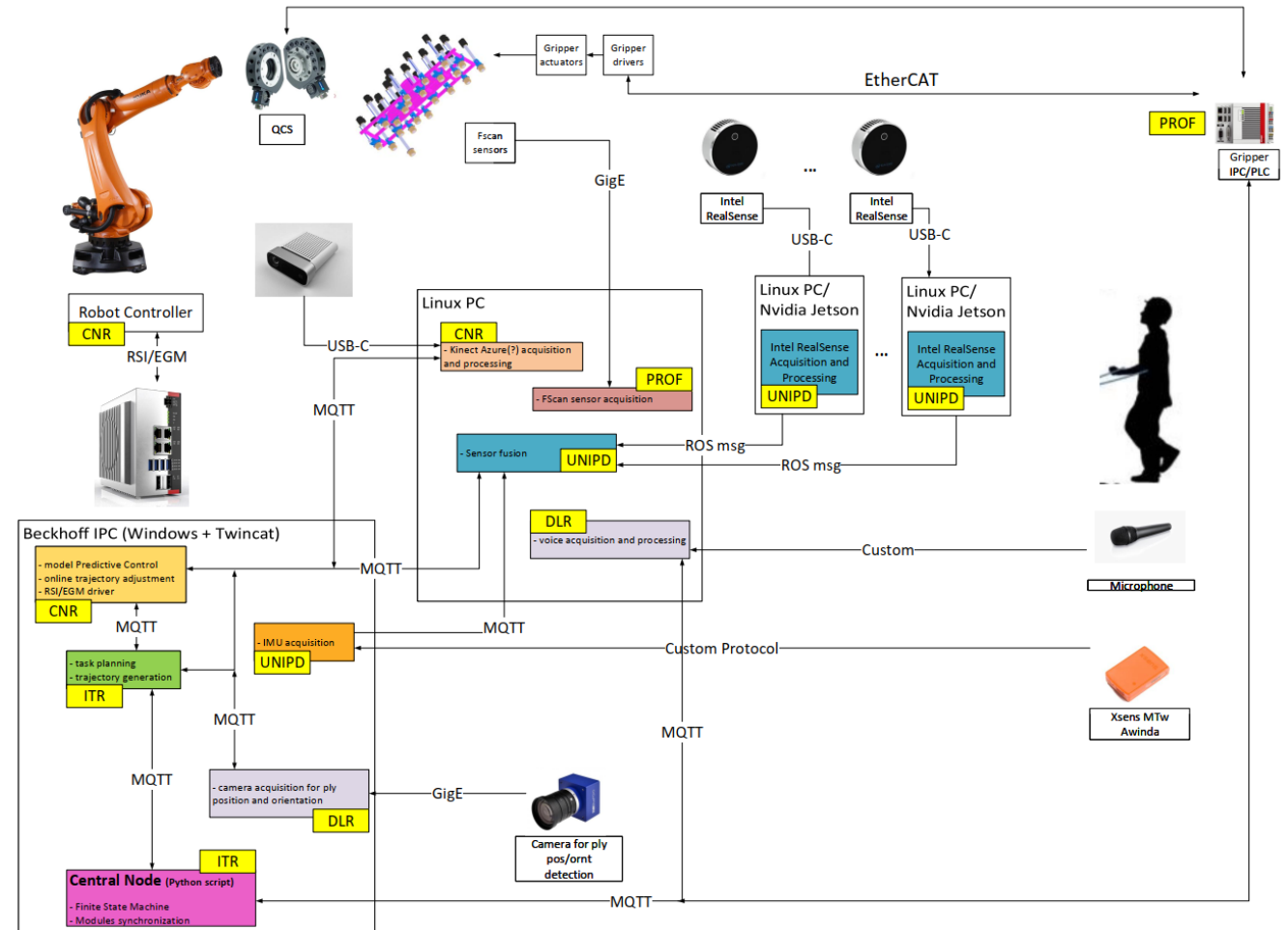
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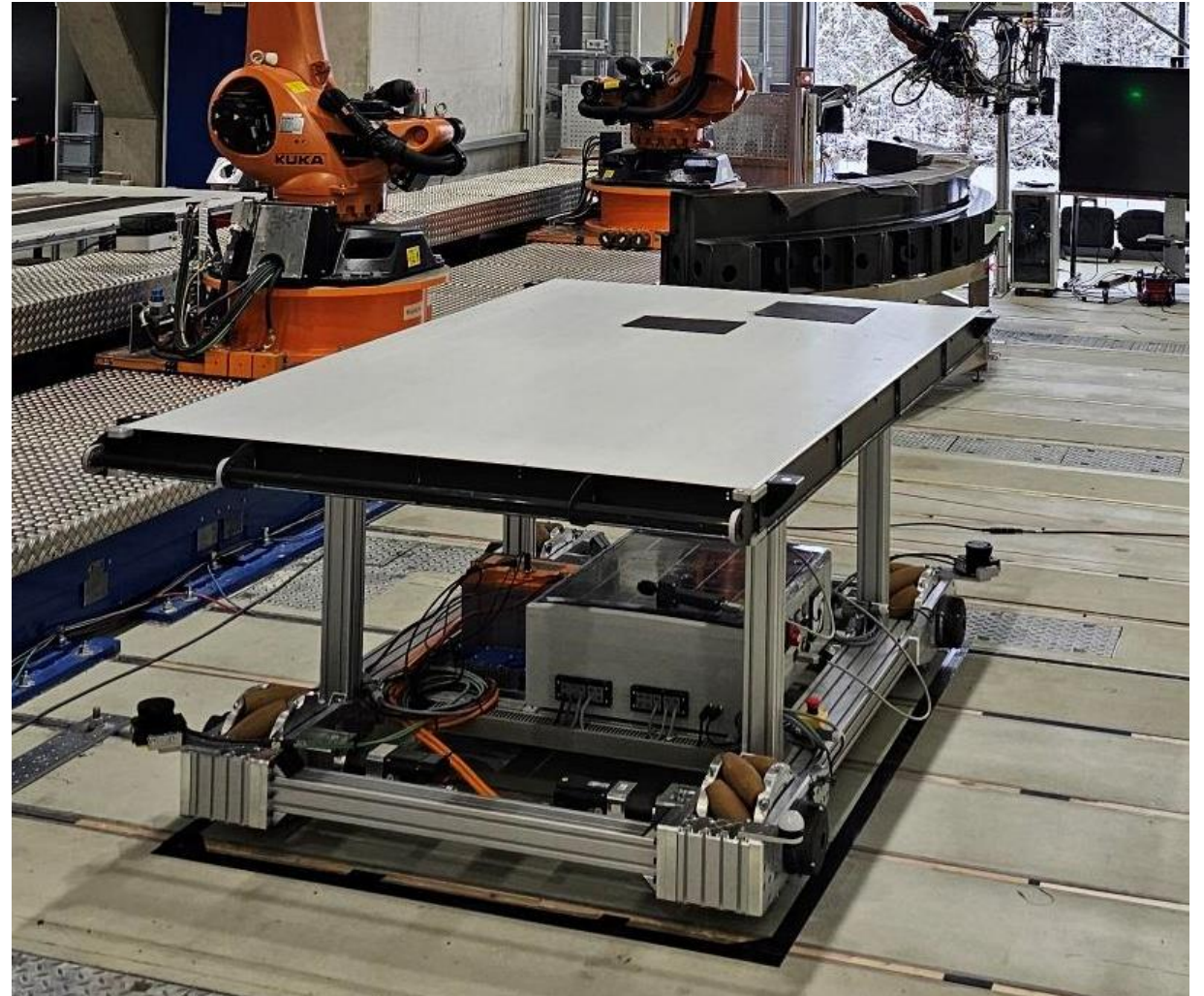
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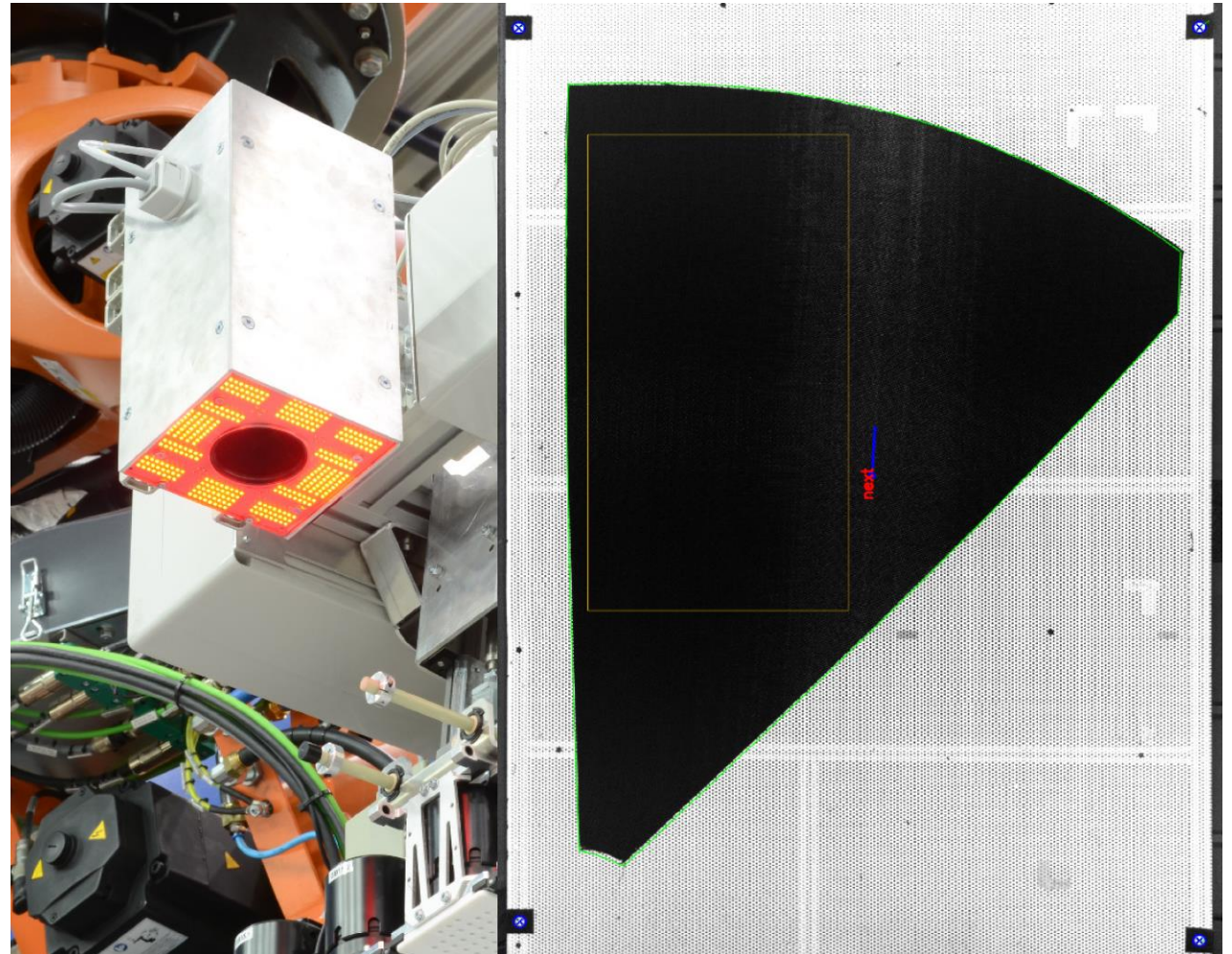
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DLR Pick & place system

- Optical system for cut-piece detection
- Specialized for dry carbon fibers



DLR Pick & place system



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Pick & place system adaptation requirements



- Cut-piece detection is encapsulated in MES software
- Camera is mounted on robot
- Camera and flash are specialized for dry carbon fibers

- Modularization of software to only use cut-piece detection
- Implementation of MQTT protocol
- Implementation of color camera
- Using ambient lighting
- Camera calibration with stationary camera

Pick & place system adaptation

Modularization and MQTT implementation

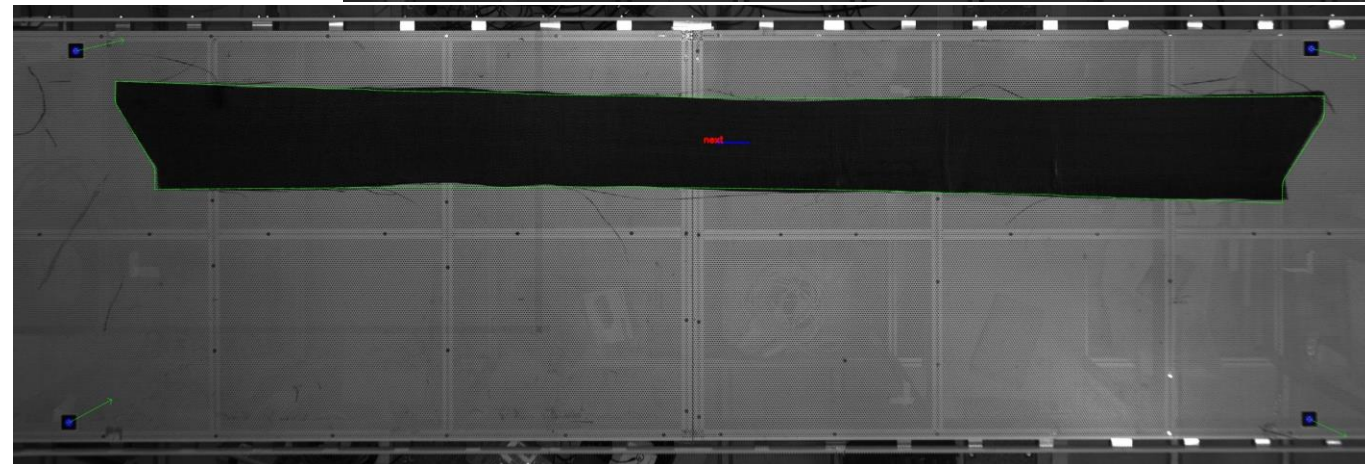
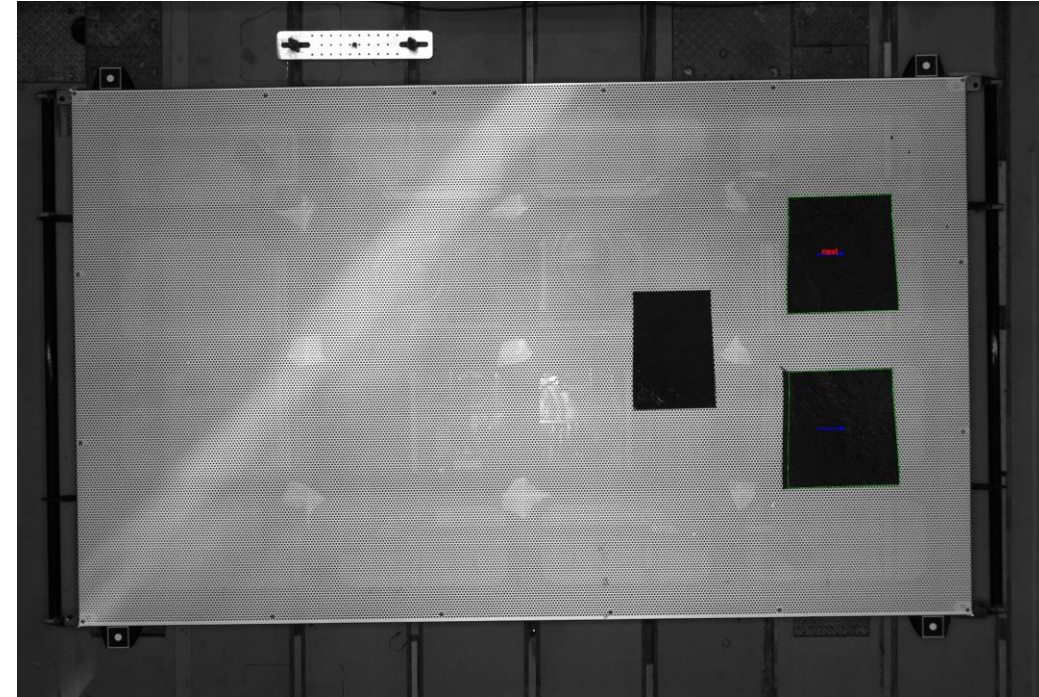


- DLR pick & place software is coded in C++
- Framework changed to more object-oriented programming
- Python wrapper was used to extract:
 - Camera handling
 - Computer vision calculations
 - Calculation of cut-piece coordinates

- Simple python script including MQTT package implemented in DrapeBot scenario

Pick & place system adaptation Result

- Modularized software is loading separate configuration files in respect to material carrier
- Detection triggered through MQTT
- Location published into MQTT



Pick & place system adaptation

Color camera

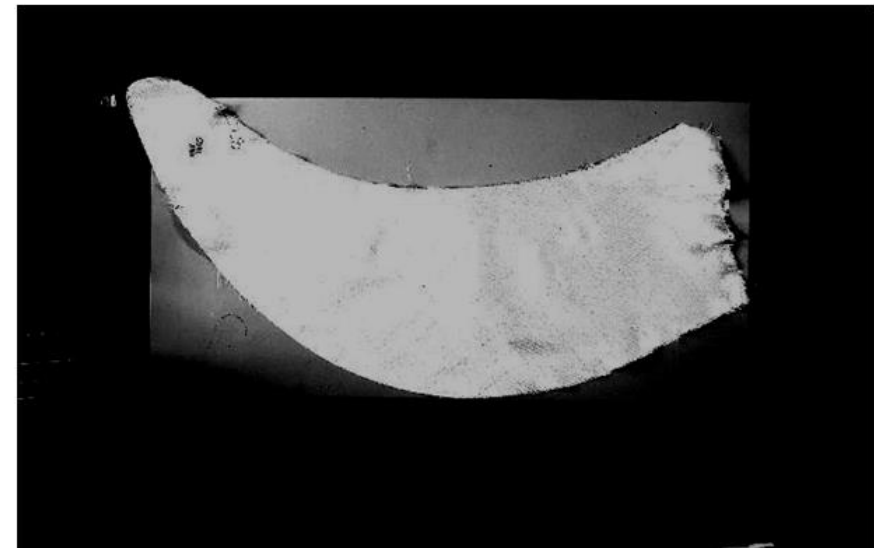
- Material range:
 - Prepreg with changing protection film color
 - Carbon fiber
 - Glass fiber
- Each color space is used separately
- Contrast enhancement in color space



Pick & place system adaptation

Color camera

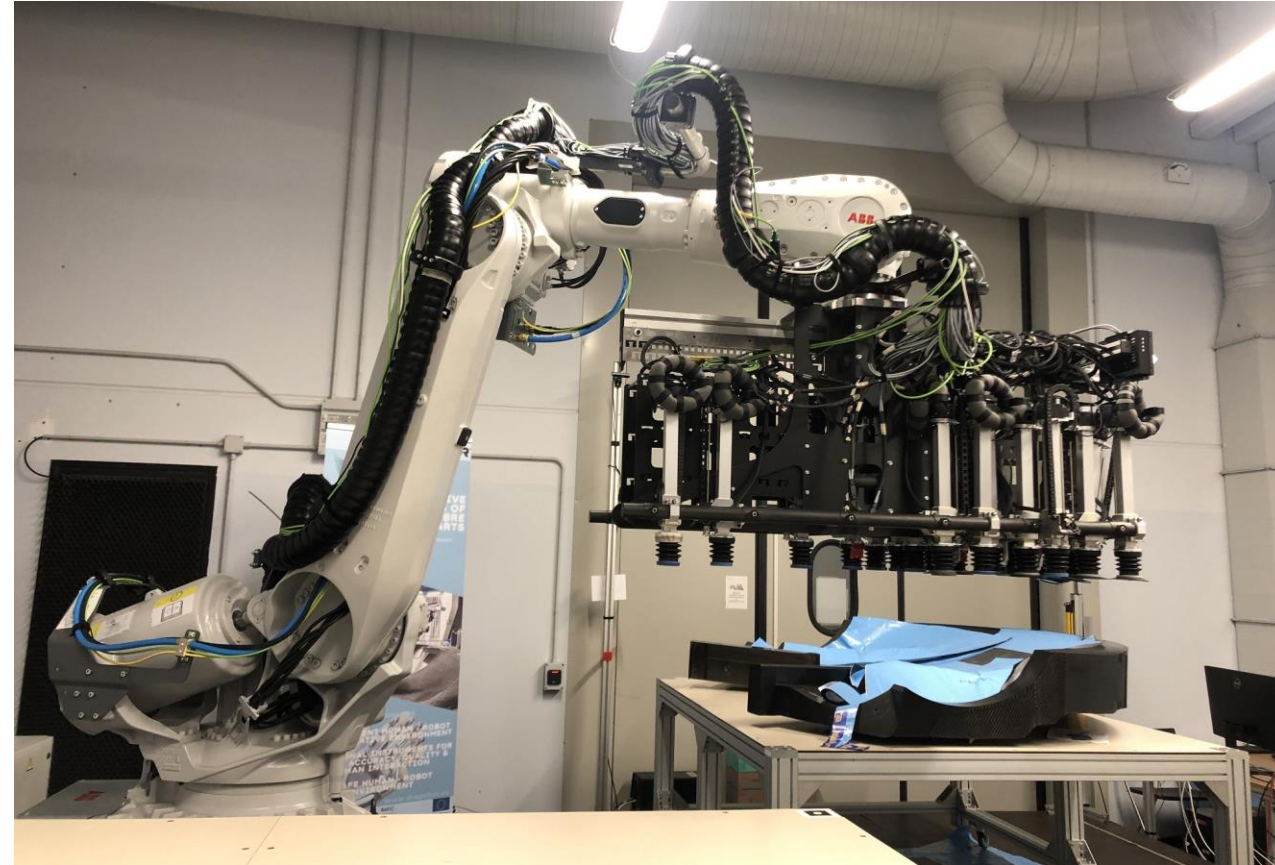
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Pick & place system adaptation

Ambient lighting and stationary camera calibration

- Camera stationary above material carrier:
 - Gripper space and infrastructure limited
 - Worker would be exposed to strong flash due to inverse square law
- Camera needs to be perpendicular to table
 - Larger distance -> higher pointing error
- Perspective transformation implemented



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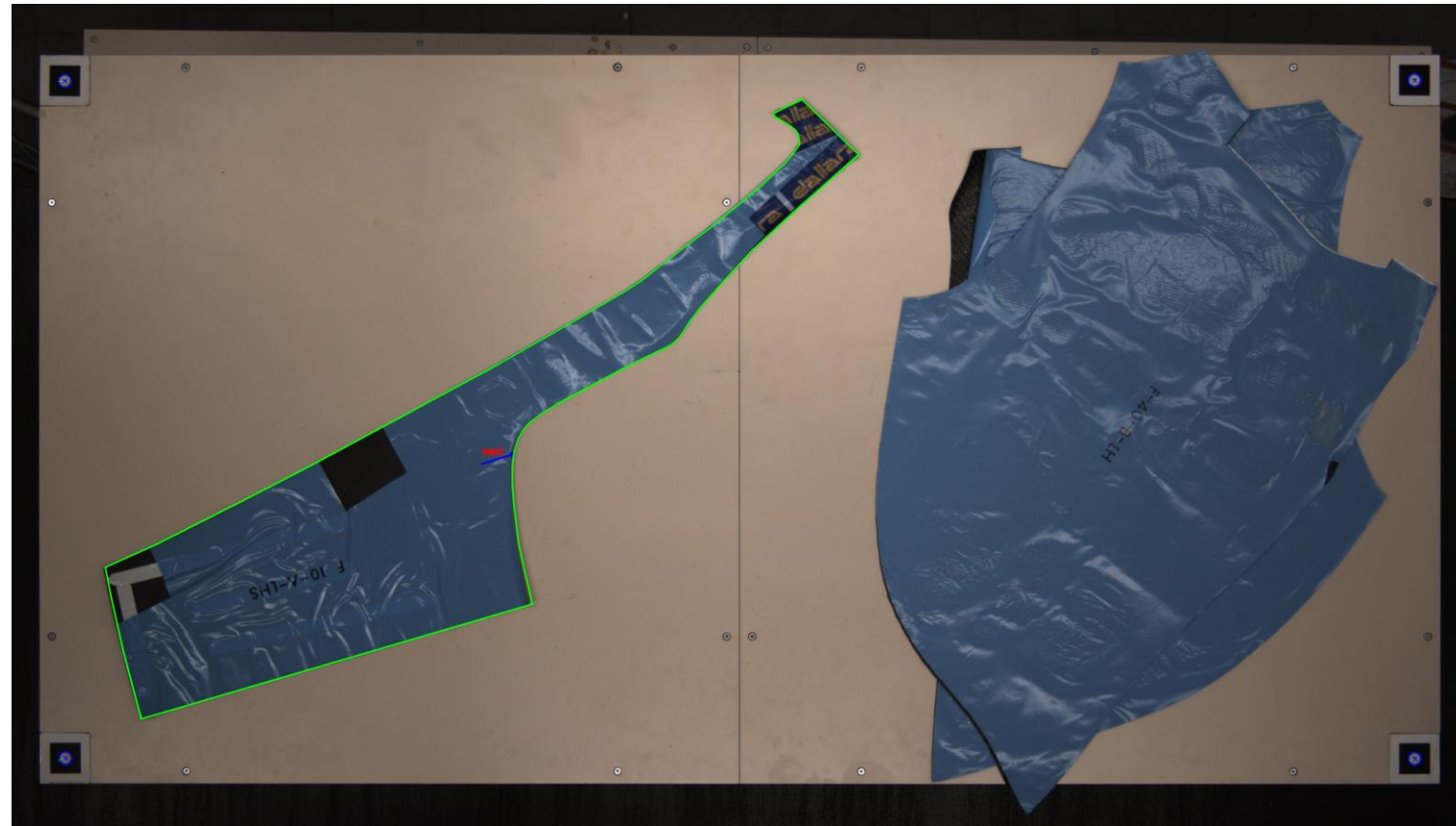
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Result

- Detection of several prepreg materials
- Coordinates published into MQTT network
- Gripped and transported by MES controlled robot actions



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Summary



- Cut-piece detection software extracted from main software
 - Python wrapper for simple interface implementation
 - Color camera implementation
 - Stationary camera calibration
-
- Cut-piece coordinate provision outside of encapsulated main software
-
- Easy adaptation and implementation of cut-piece detection for future use cases

Thank you!



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