JOINING
INNOVATION
AND EXPERTISE

ACCURATe project

Vicki James

Introduction

Aerospace

Composite

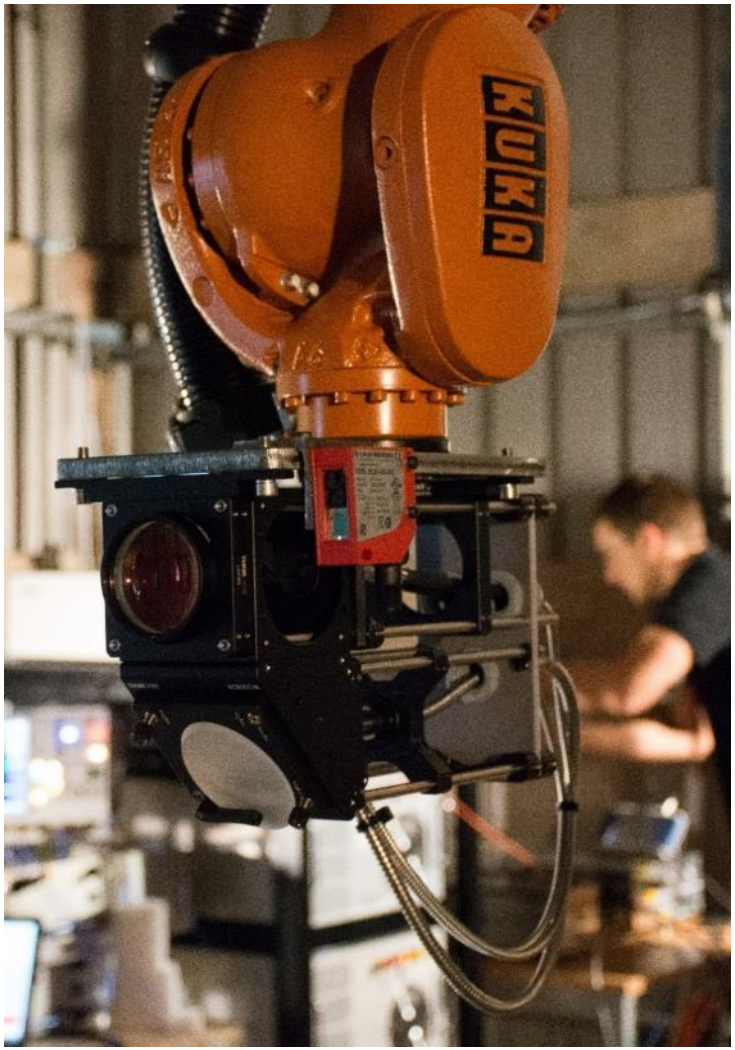
Components

Ultrasonic

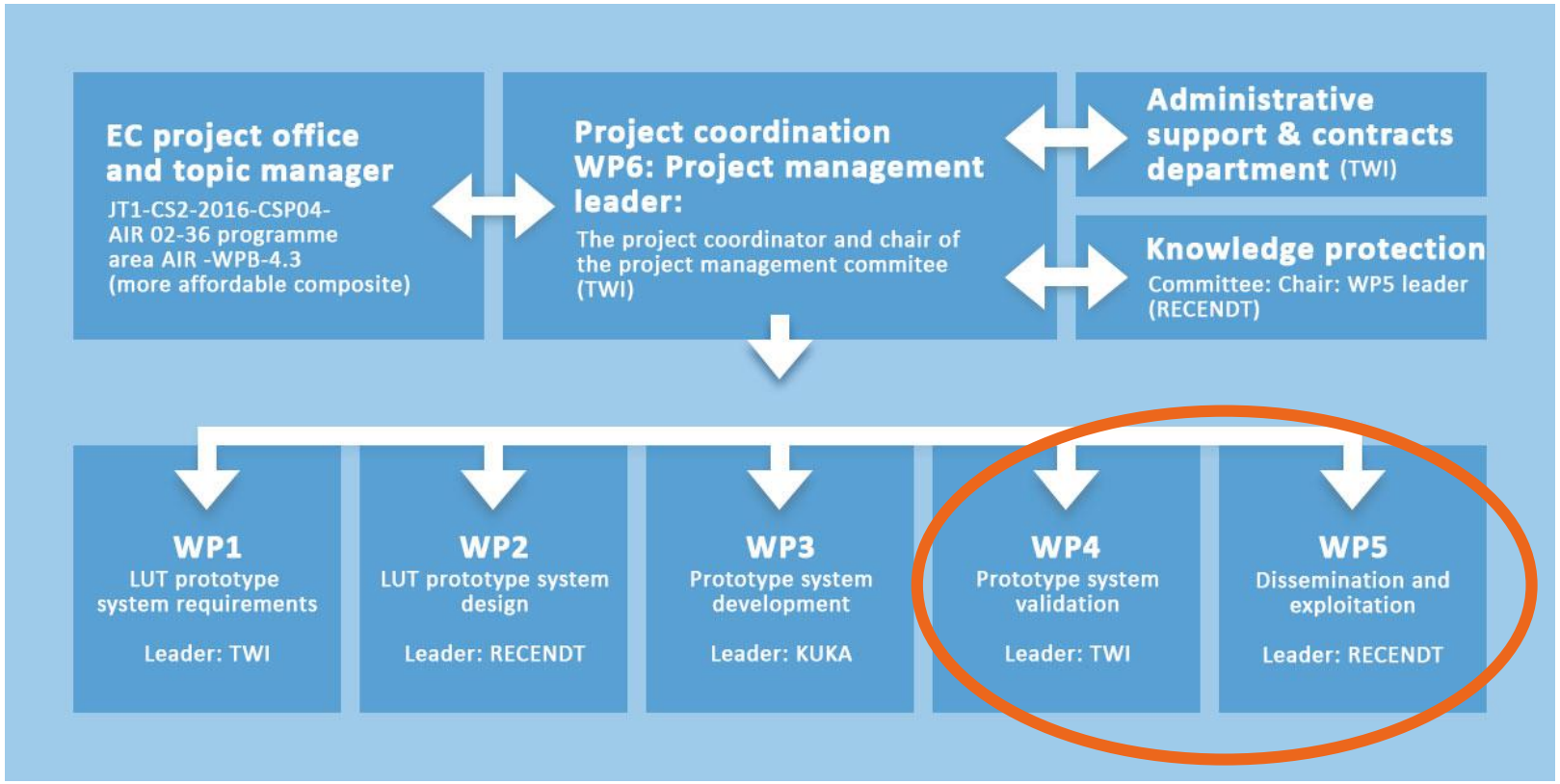
Robot

Assisted

Testing



Project Work Packages



Current Work Packages

The ACCURATe Project - Background

- Part of Clean Sky 2 framework
- Specifically “More Affordable Composite Fuselage”
- EU’s Horizon 2020 research and innovation programme
- c. €2M grant funding received
- 44 month project
- Project commenced June 2017

Horizon 2020
European Union Funding
for Research & Innovation

Clean Sky
JOINT UNDERTAKING

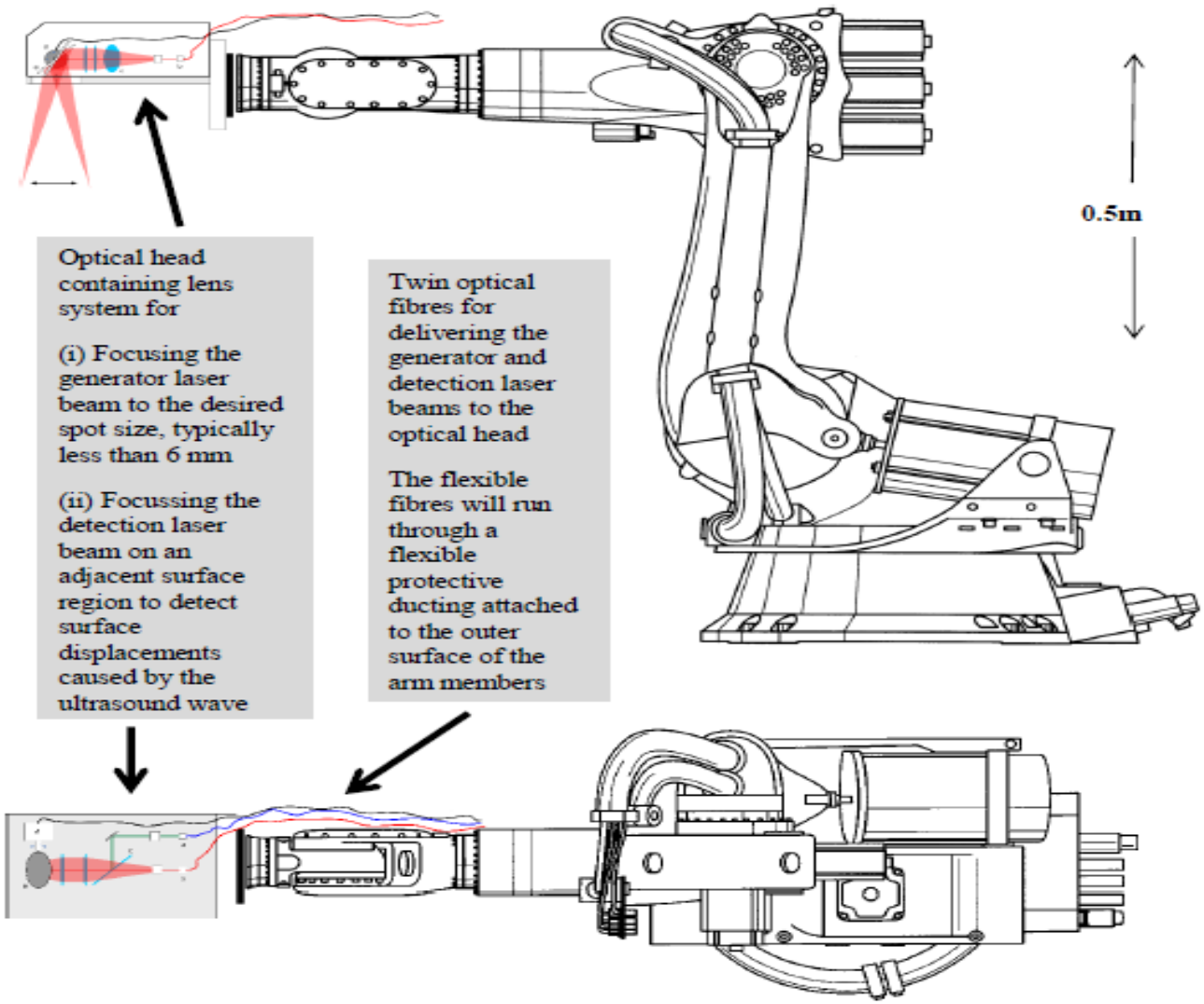
ACCURATe

The ACCURATe Project - Overview

- Composites are key to reducing fuel costs and emissions
- State of the art aircraft contain up to 80% by weight of composites in their load bearing structures
- Two key barriers to overcome:
  - (i) High cost of manufacture
  - (ii) Increased risks of both internal defects and impact damage leading to structural failure
- Hence the requirement for more efficient, effective and comprehensive inspection processes and systems

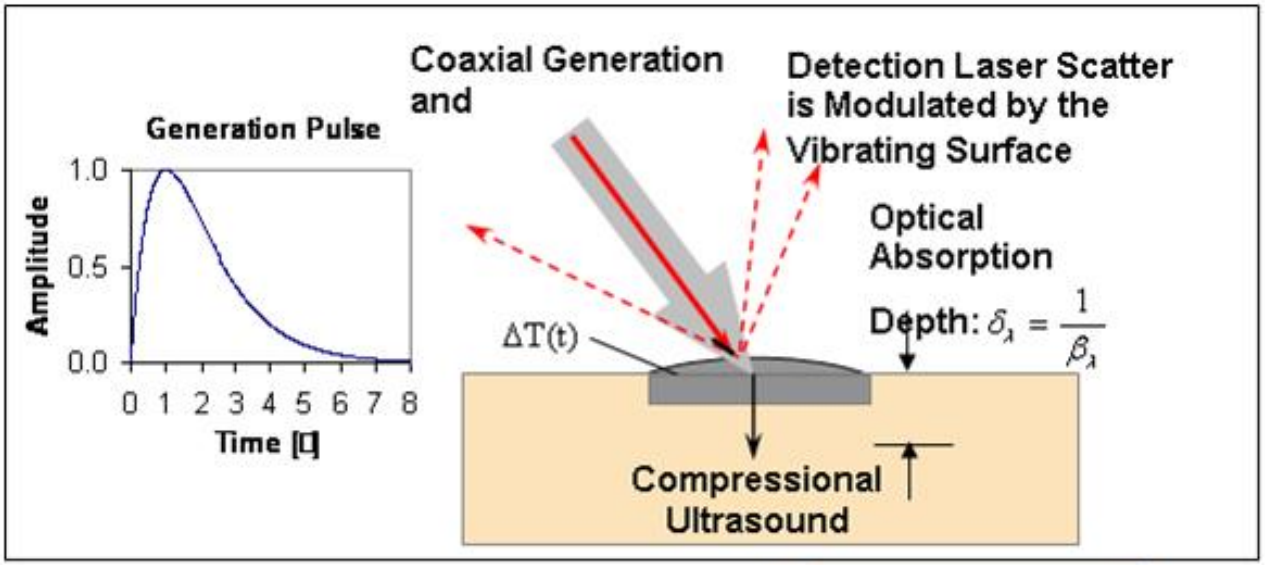
The history of LUT in Aerospace

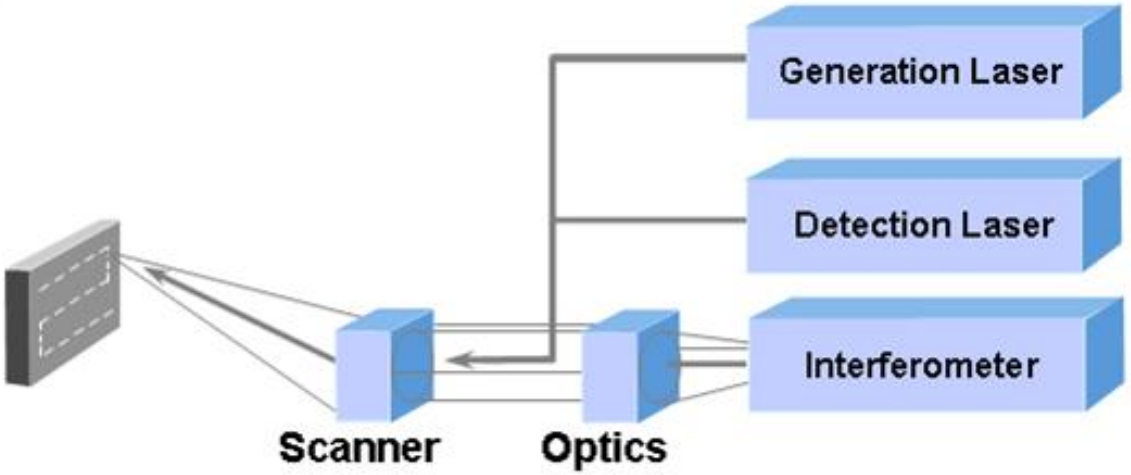
Why Laser ultrasonic testing?



Project Partners

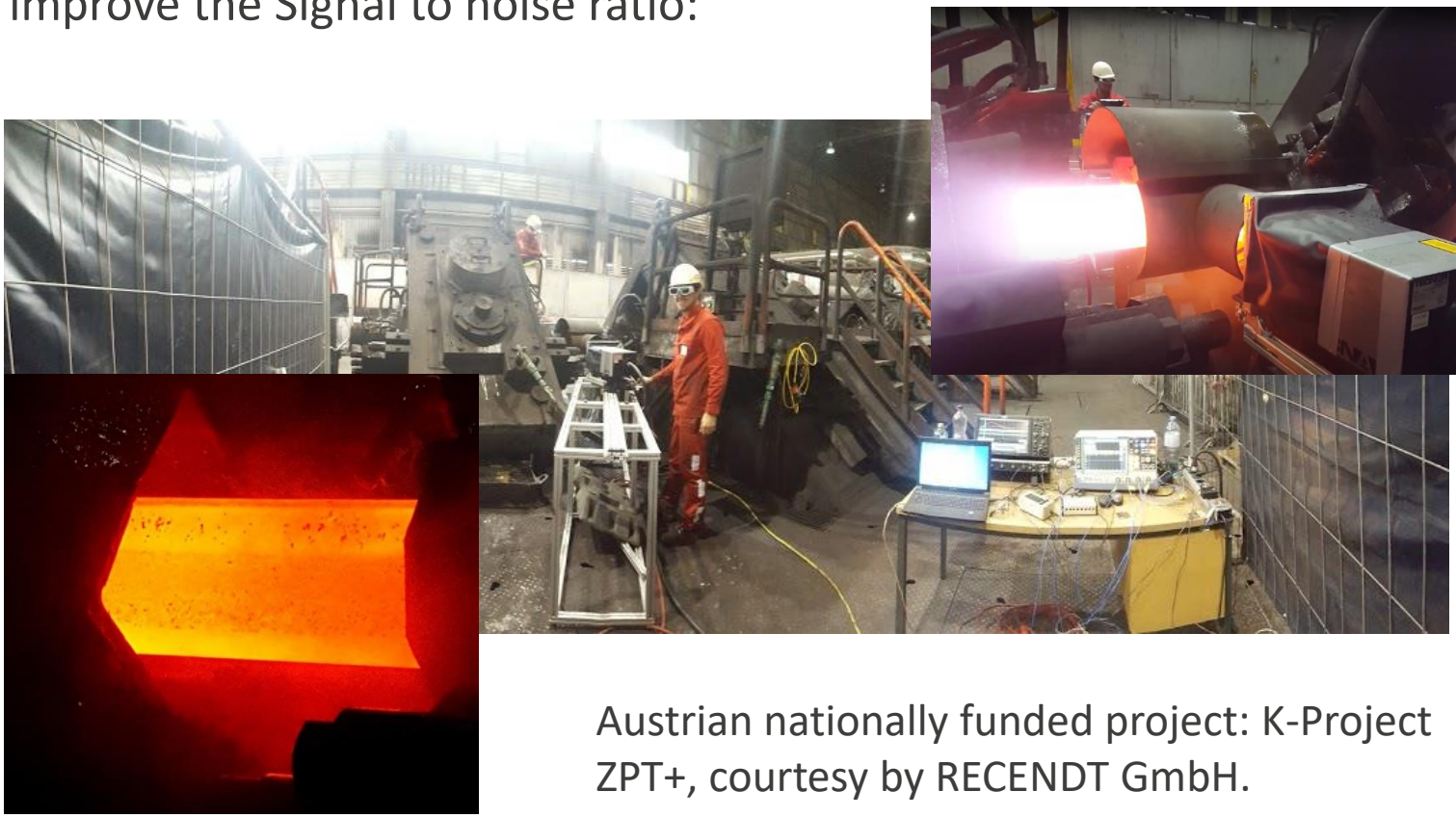
Laser Ultrasonic testing-LUT





The challenges of LUT

Defect detection in highly dampening materials and therefore requiring the detection of weak signals (caused by highly ultrasonic damping dampening materials) the project has aimed to create innovations to improve the Signal to noise ratio:



Austrian nationally funded project: K-Project ZPT+, courtesy by RECENDT GmbH.

Advantages of Laser UT

- High speed inspection process
- Lightweight scanning head with small footprint
- Broadband UT frequency generation
- Low maintenance
- High accuracy
- Non contact
- No couplant

- Offline path planning and simulation for efficient working

Project Aims

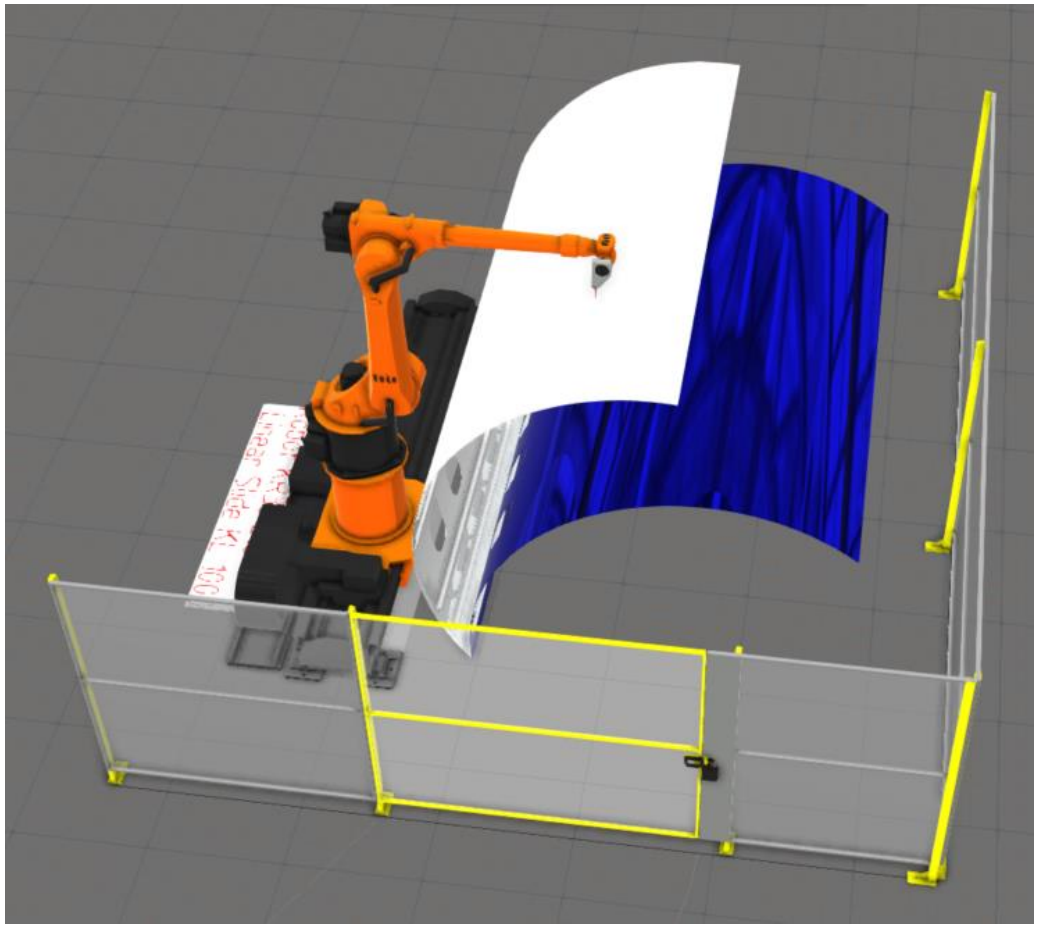
- Develop a prototype laser ultrasonic testing (LUT) system for non-destructive inspection (NDI) of :
  - Large scale aircraft hybrid and thick composite structures
  - Structures containing acoustic damping materials
  - Materials which highly attenuate ultrasound

Challenges of the project

- Laser & robot safety
- Inspection speed critical
- Laser power optimisation
- System vibration & noise
- Multiple systems integration
- Physical space constraints and robot reach

System Overview

- 6-axis robot mounted on linear track
- Fibre coupled, pulsed generation and detection lasers
- Interferometer and signal processing unit
- Fully integrated software for laser & robot control, data acquisition and data analysis
- Two position superpanel mounting fixture



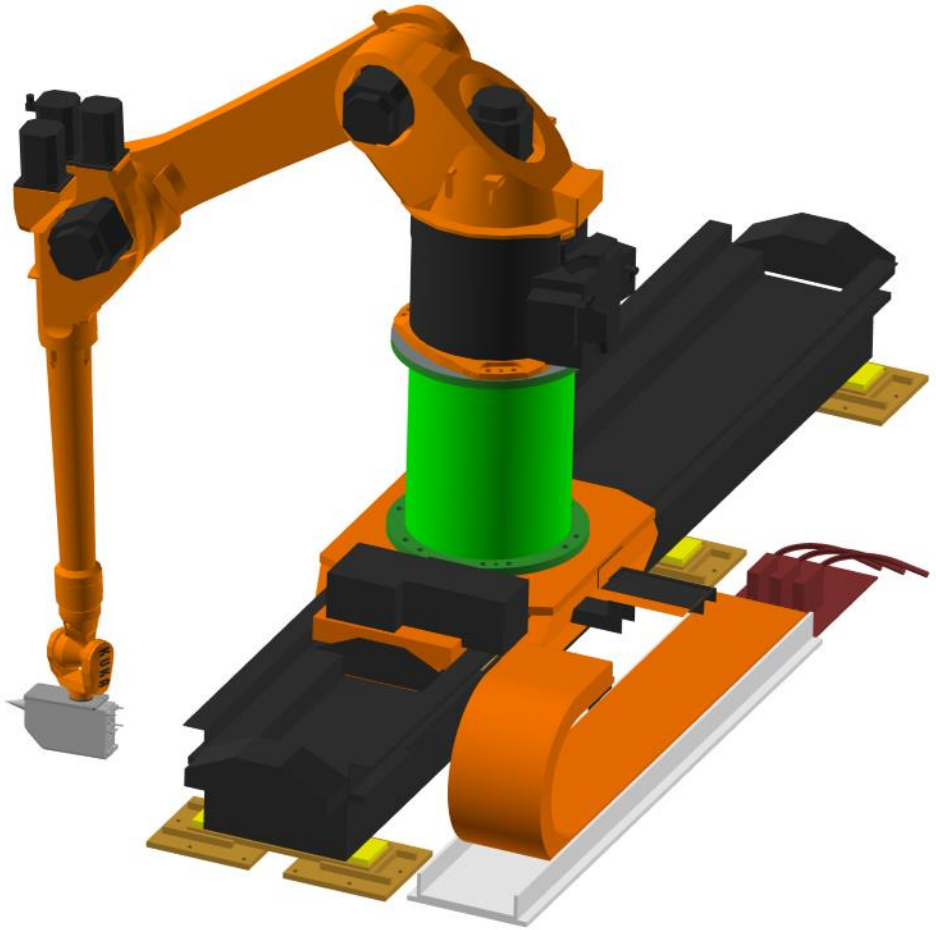
Specification and performance*

- Inspection cell size (m): 8 x 7 x 5 (W x D x H)
- Inspection material types: Hybrid composite laminates
- Largest component: c. 17m^2
- Maximum component thickness: 30ply + additional layers
- Inspection rate: >8m^2/h
- Minimum detectable defect size: 6mm square
- Robot positional accuracy: ±0.7mm
- Robot pose repeatability: ±0.1mm
- Minimum robot step size: 0.1mm
- Scanning index: 0.5 - 3 mm (0.5 mm increments)

* Design parameters

Robotic system

- KR30-L16 robot manipulator
- KL1000 Linear Track with 2700mm travel
- KRC4 Robot Controller
- 5200mm wide loading doors & cell access doors
- Integrated Fortress Interlock door locking / access system



Laser Systems

Generation Laser:

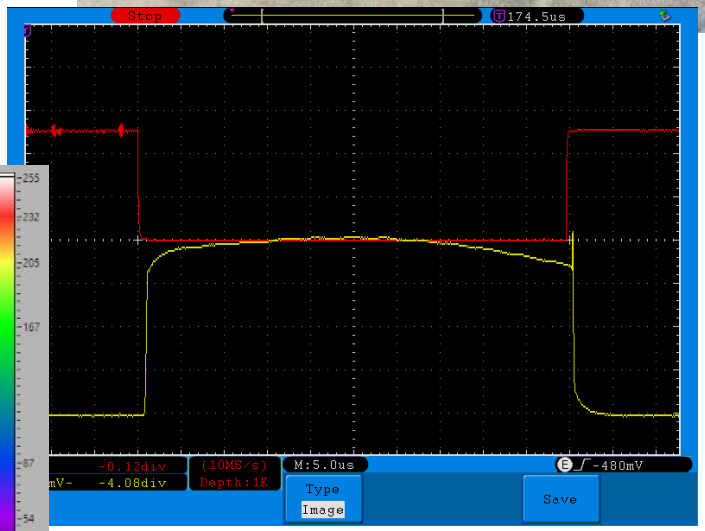
- Type: diode pumped solid state laser
- Wavelength: 532 nm
- Pulse length: 10 ns
- Pulse repetition rate: 400 Hz
- Beam diameter: 4 mm
- Pulse energy 30 mJ (at fibre output)

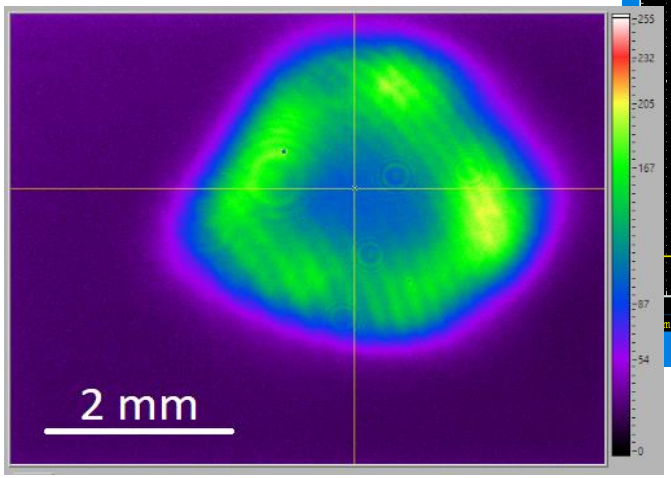
Detection Laser:

- Type: diode pumped continuous wave / Nd:YAG laser
- Wavelength: 1064 nm
- Pulse repetition rate: 400 Hz
- Pulse length: 50 µs
- Pulse energy 29mJ (at fibre output)

Optical Systems

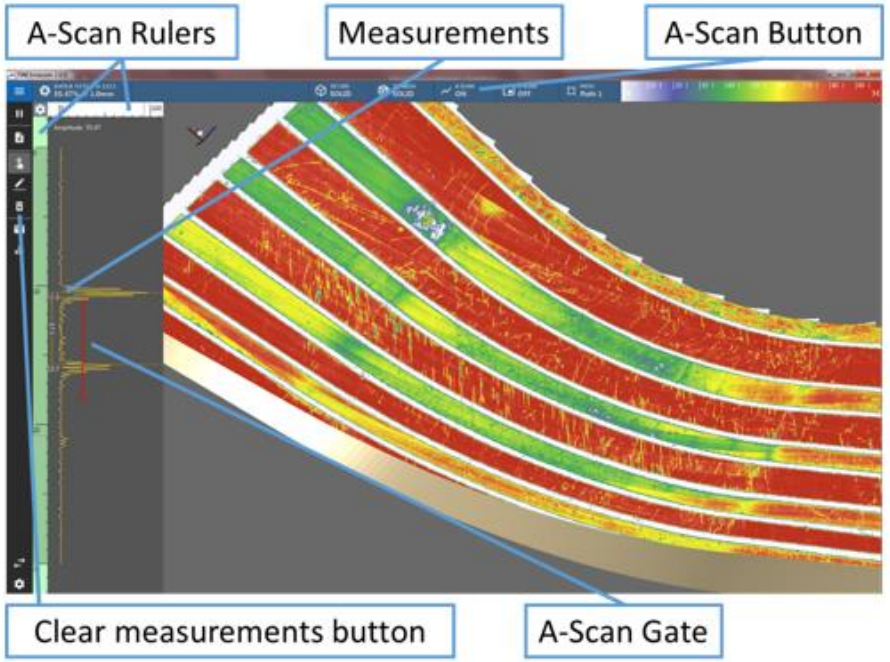
- Passive optical laser head
- Fibre coupled to stationery two wave mixing (TWM) interferometer unit
- Back scattered light from sample surface converted to amplitude changes
- Amplitude changes measured by photodetectors (photodiodes)



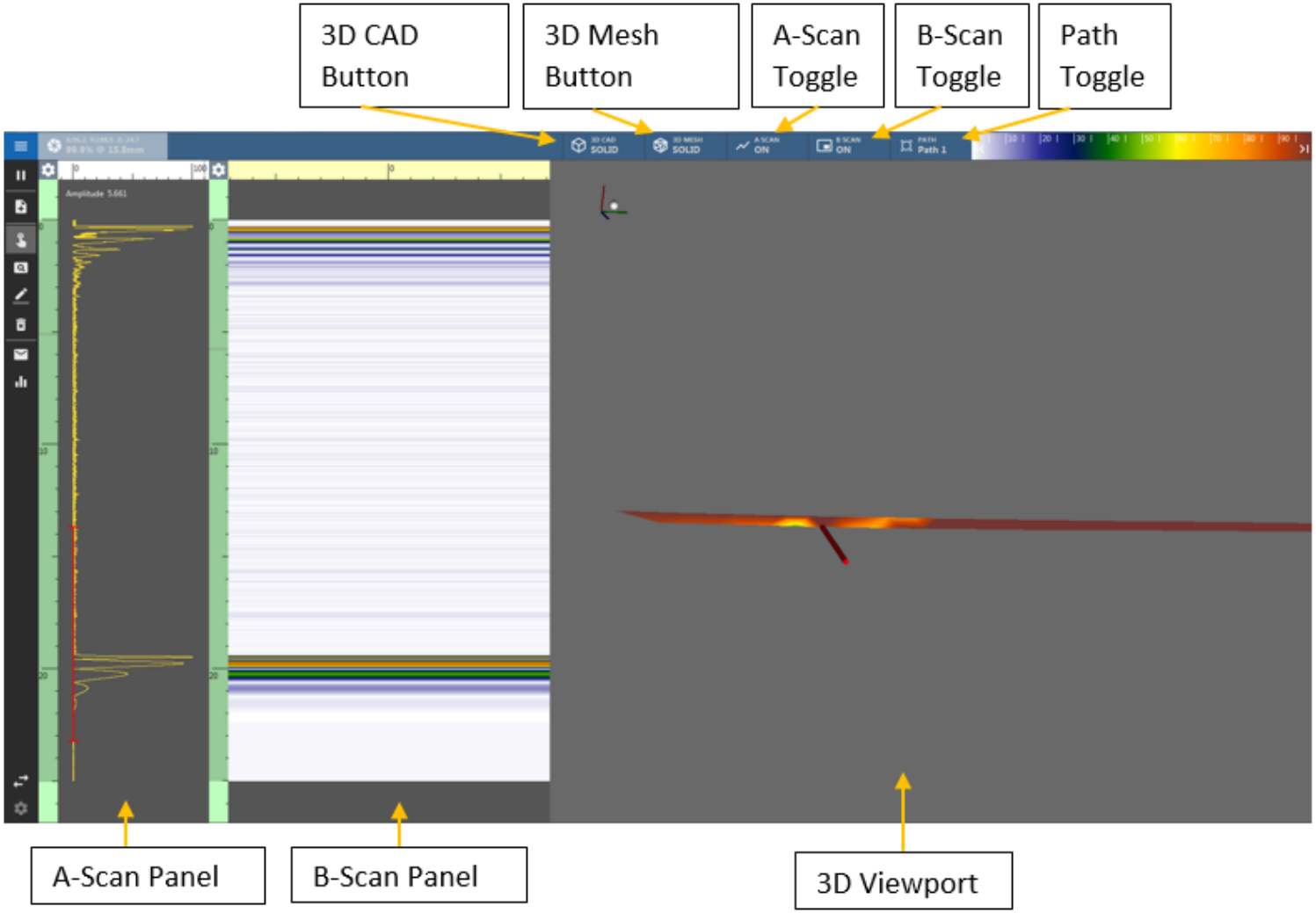


Software

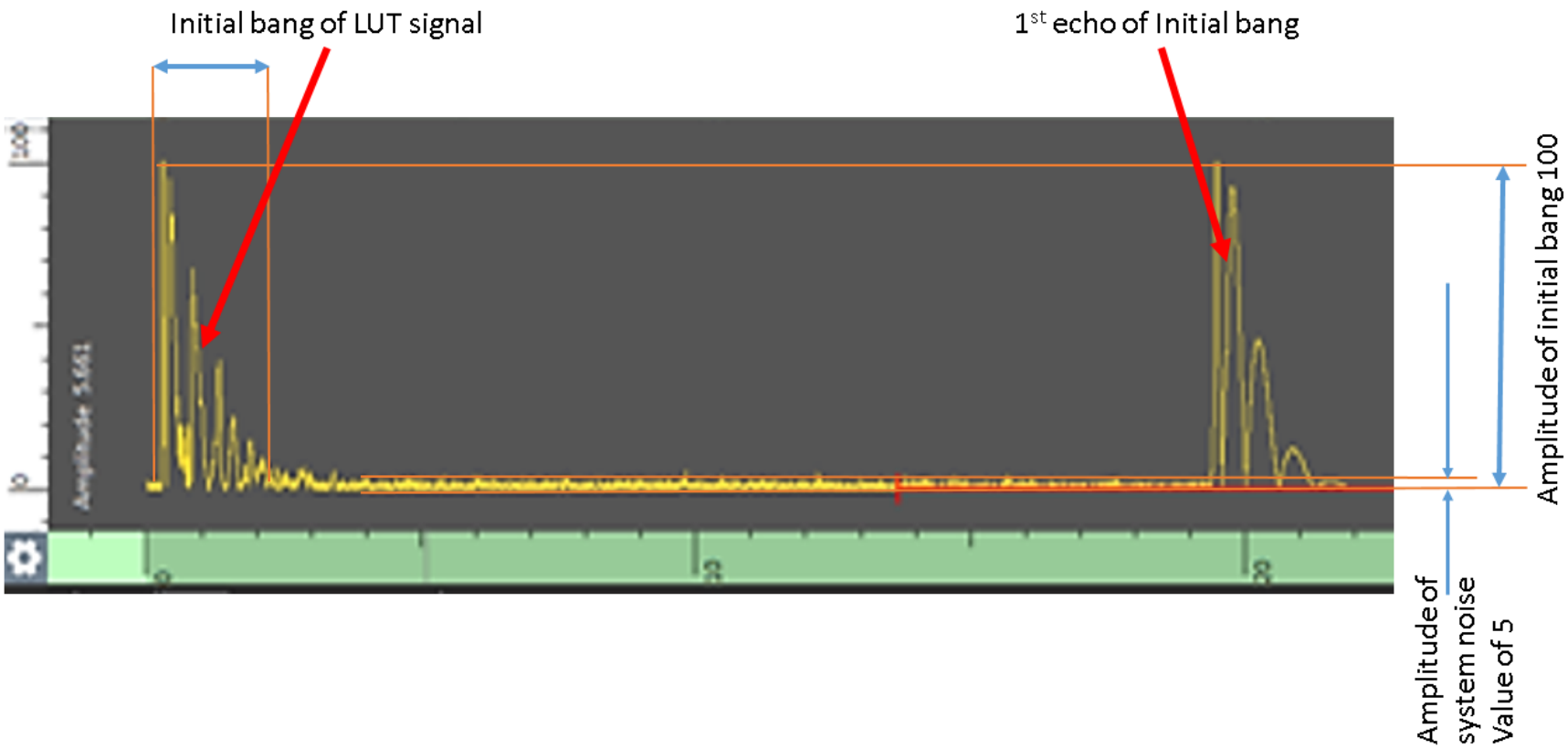
- Bespoke software for data acquisition, analysis and visualisation of inspection results
- Display and analyse data in A-scan, B-Scan and 3D view
- Offline data processing & visualisation
- Full interaction with the 3D model
- Indication logging and reporting



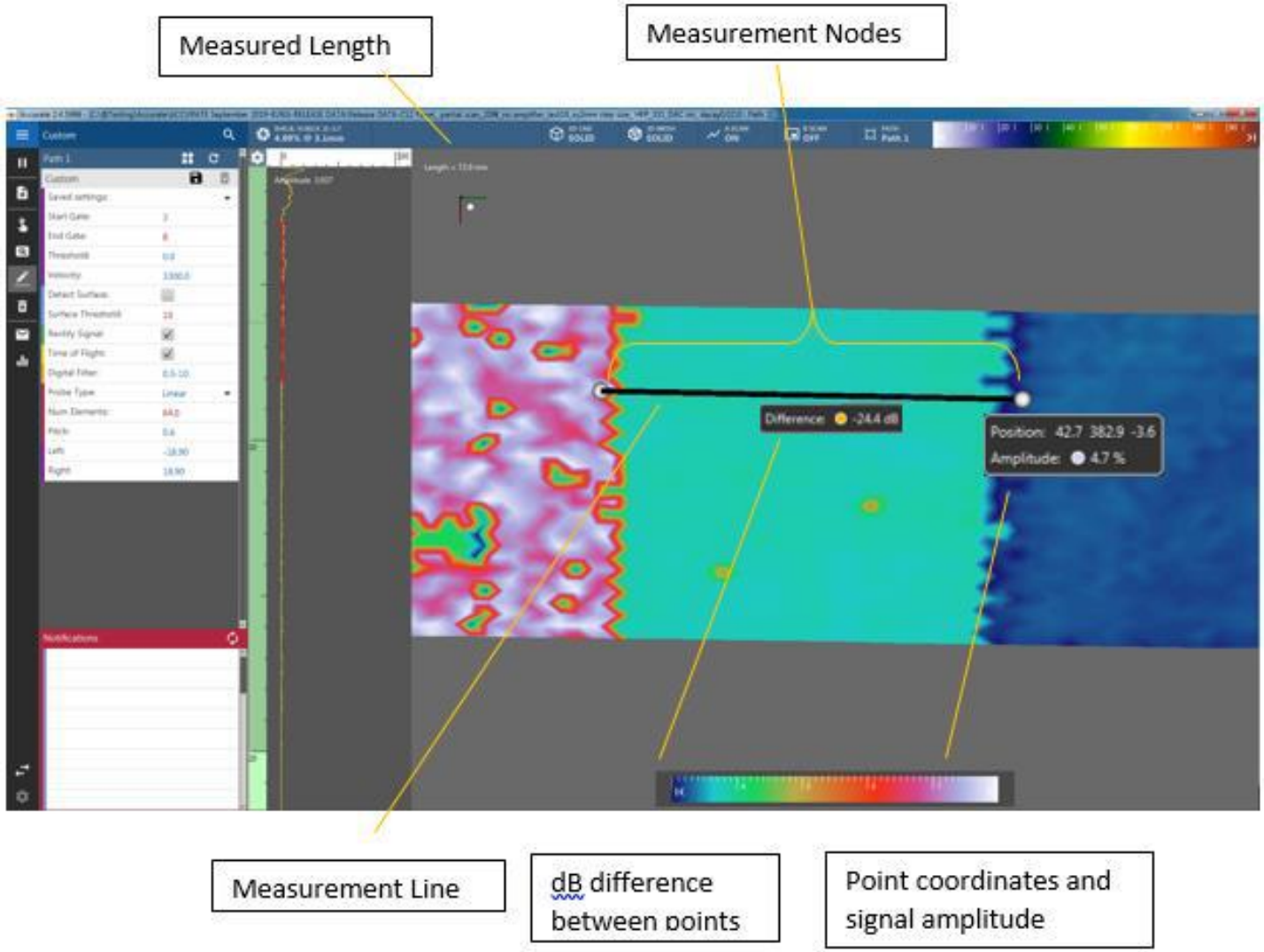
Software functions



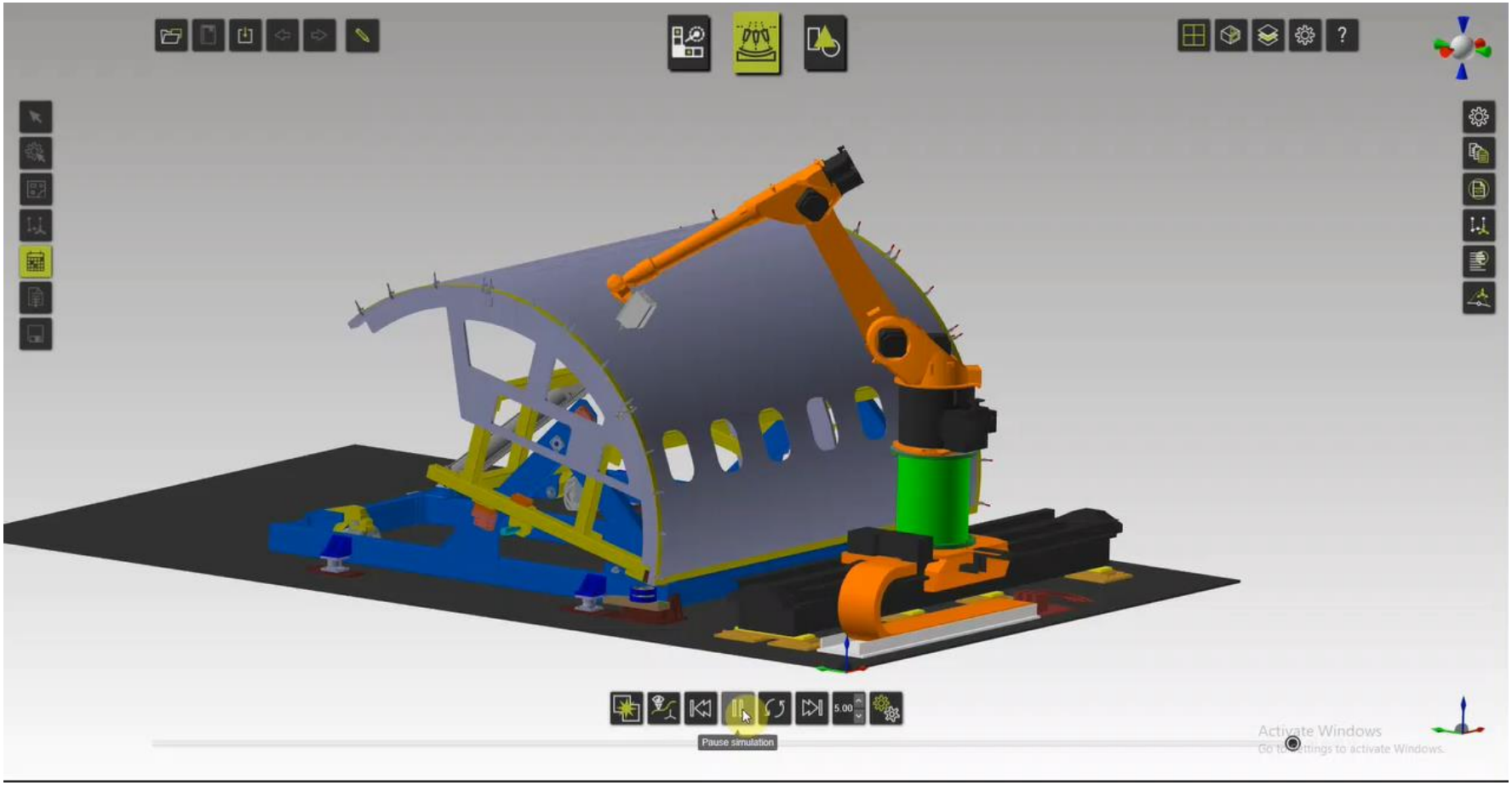
A scan features



Measurement of flaws



Offline Path Planning & Simulation



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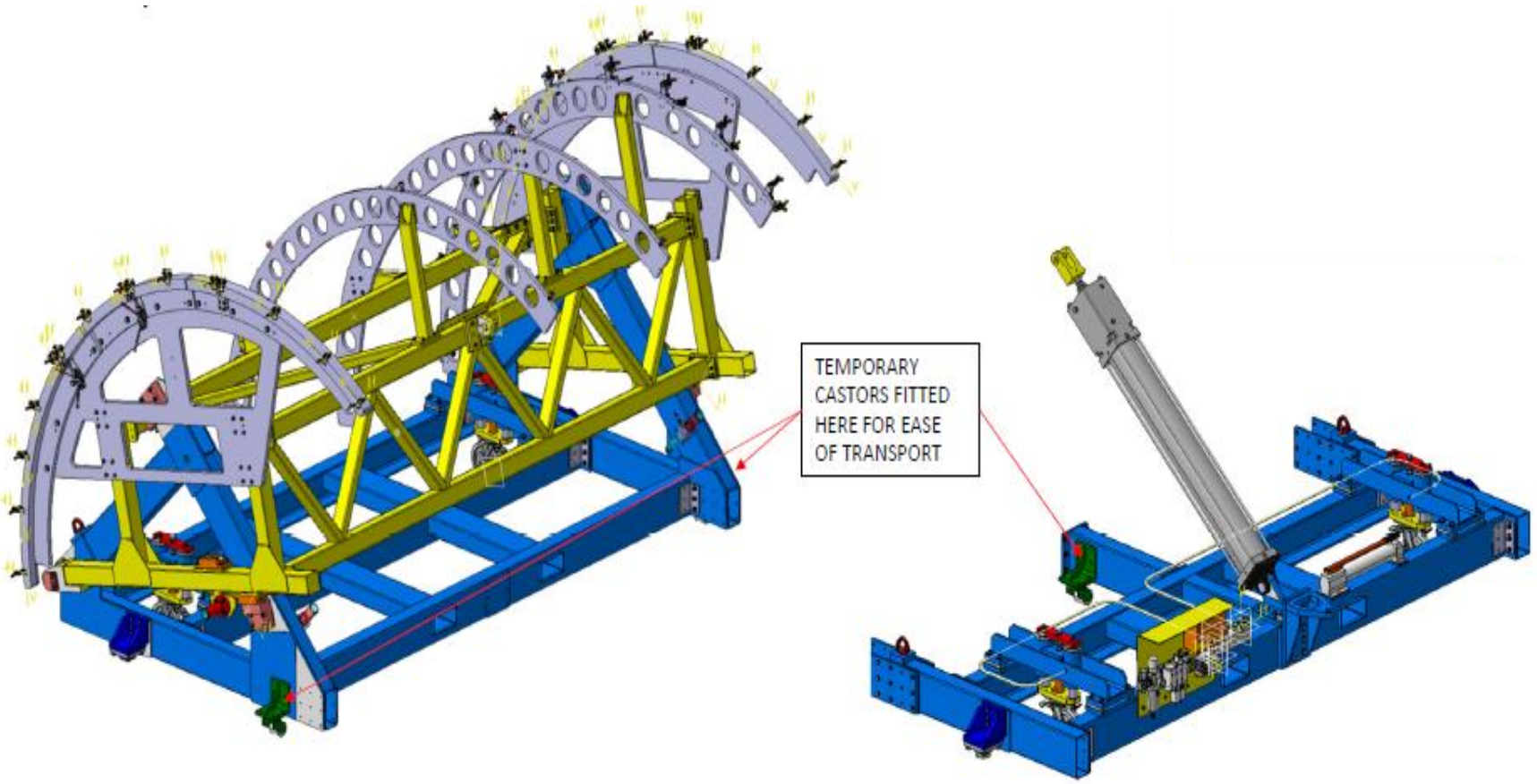
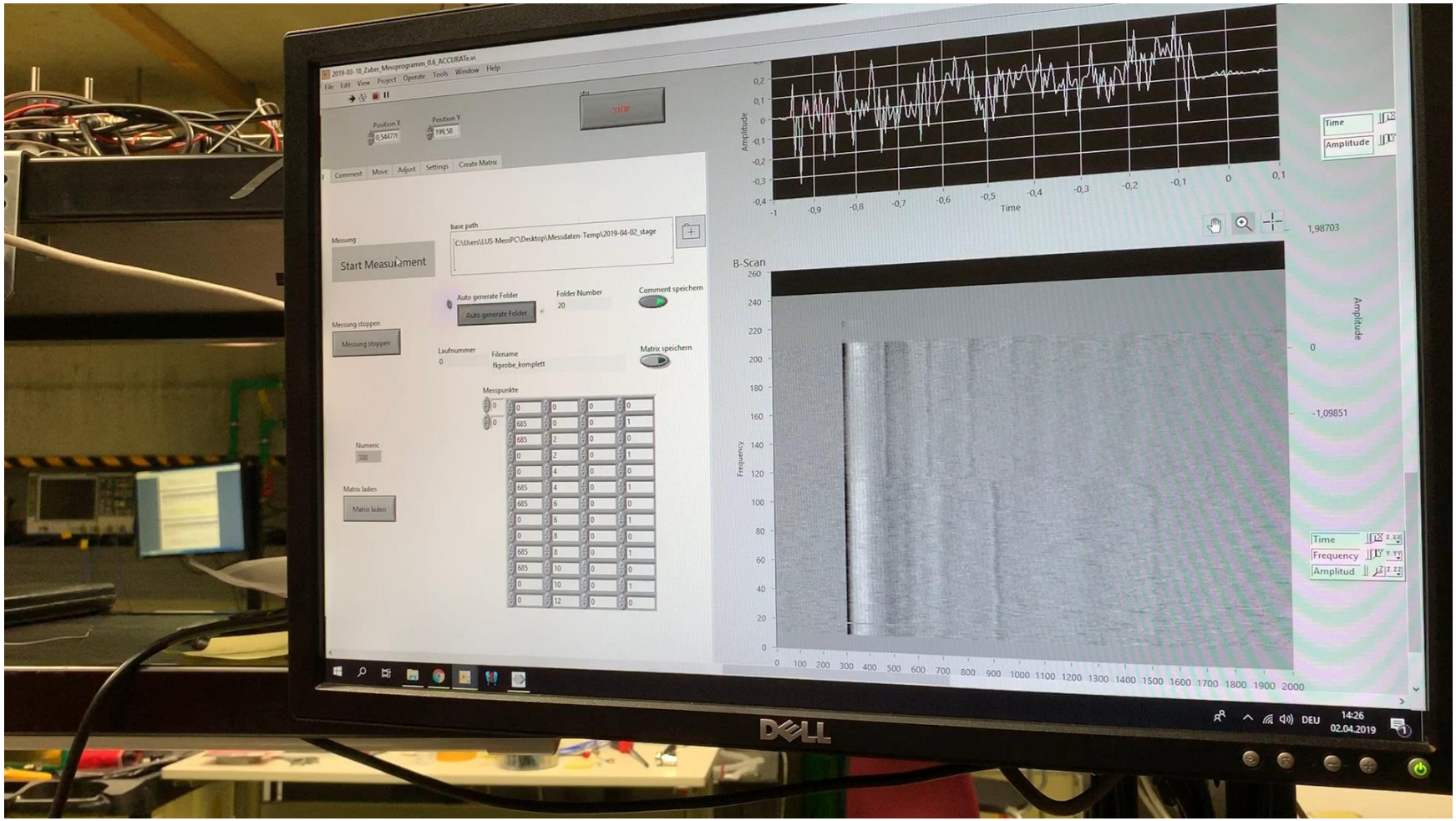
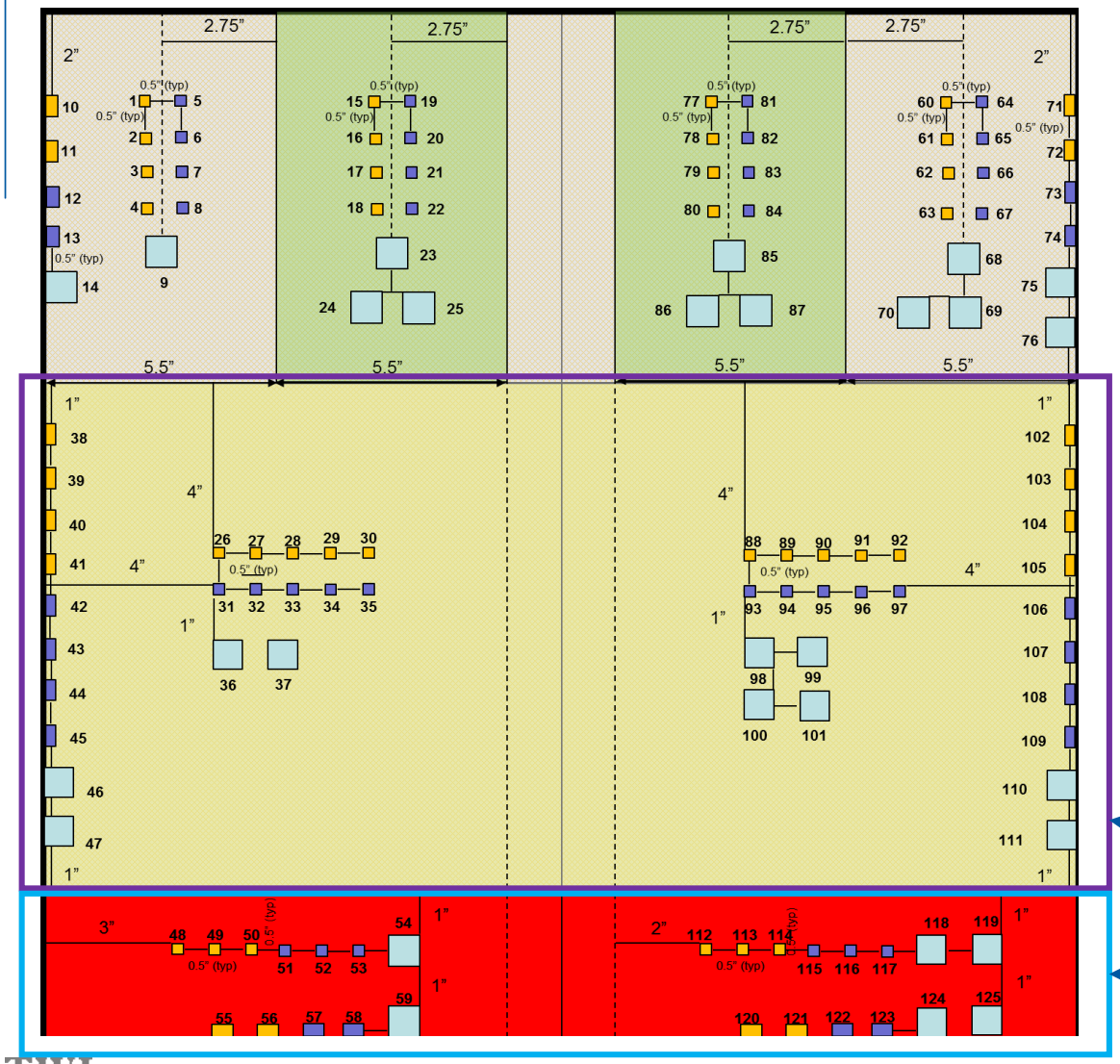
Superpanel Fixture design



Initial Testing of the LUT system



The CS2 reference panel



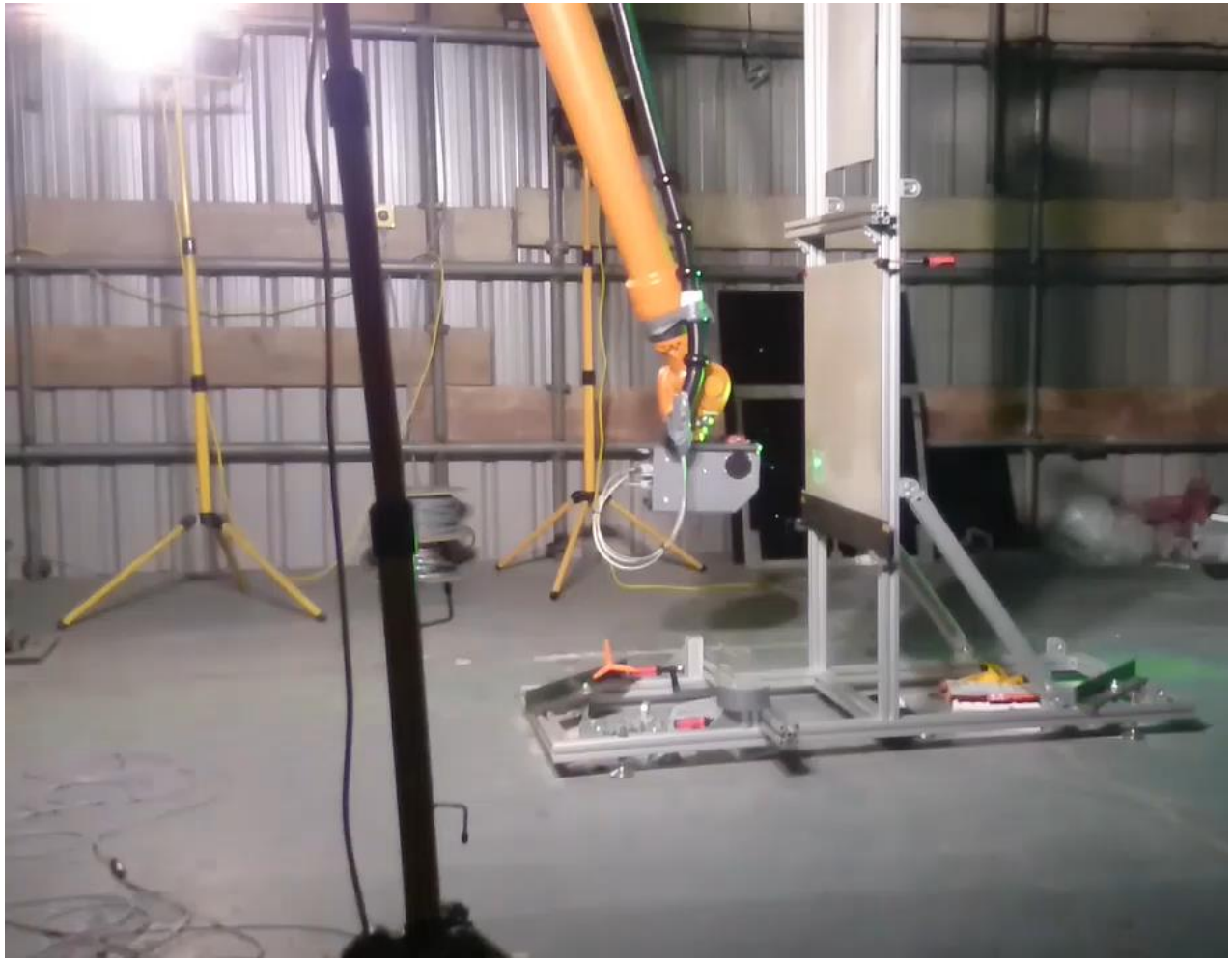
The CS2 reference panel contains

- Artificial flaws 6 x 6mm
- Artificial flaws 17 x 17mm
- Visco-elastic layers
- 8 ply and 30 ply sections
- Fiberglass sections
- Copper mesh sections

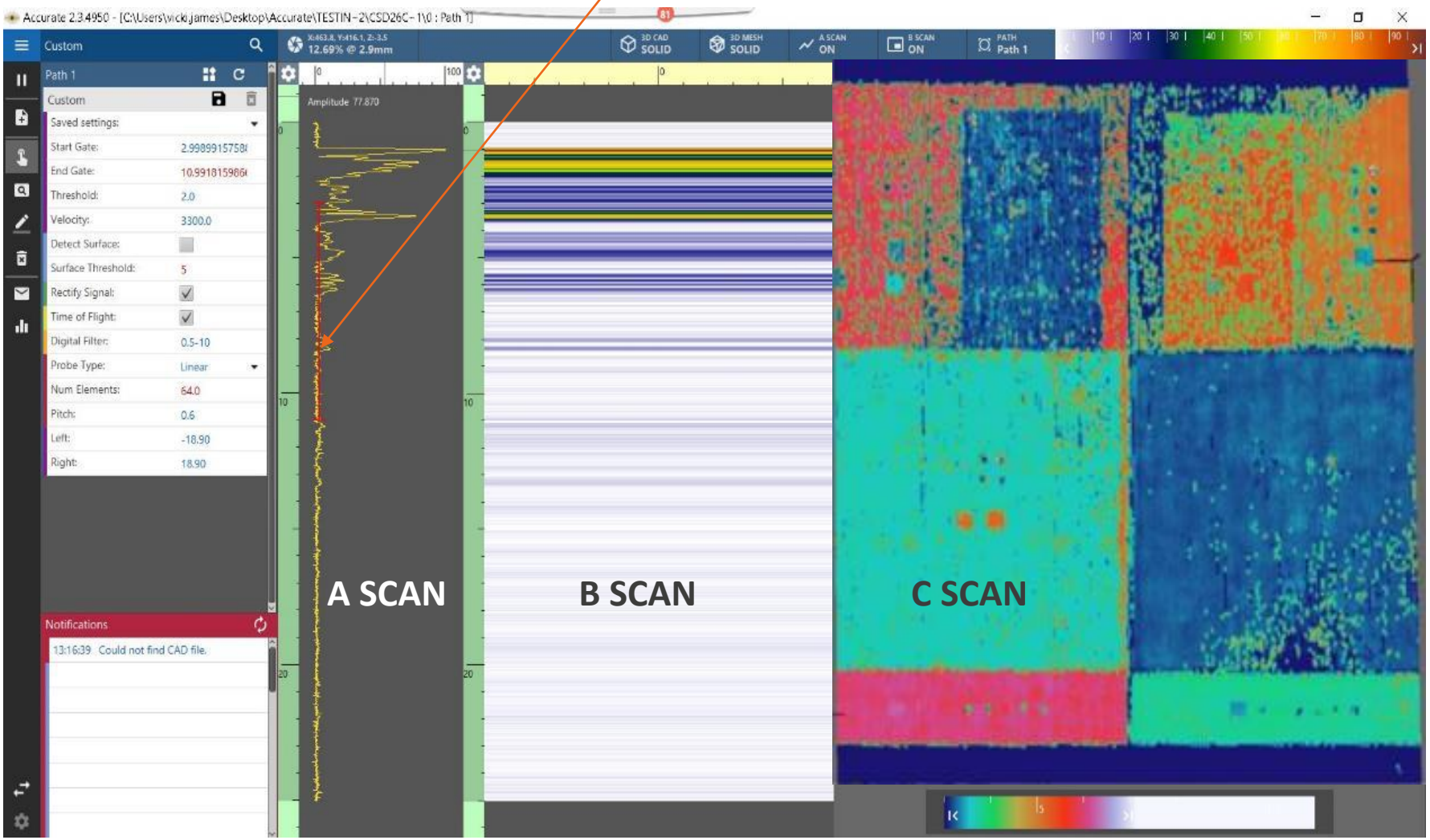
Viscoelastic region

Black paint region

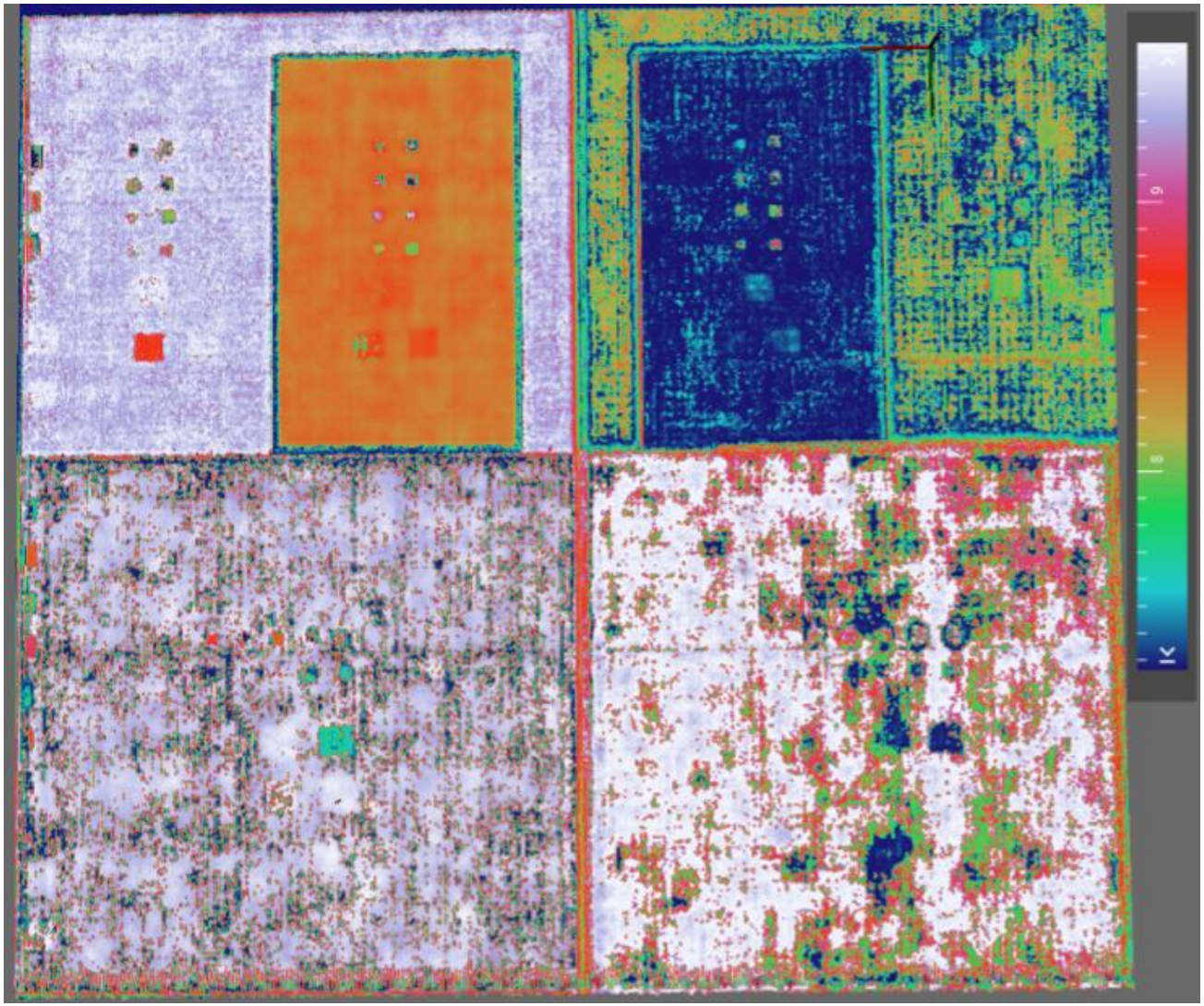
System Testing



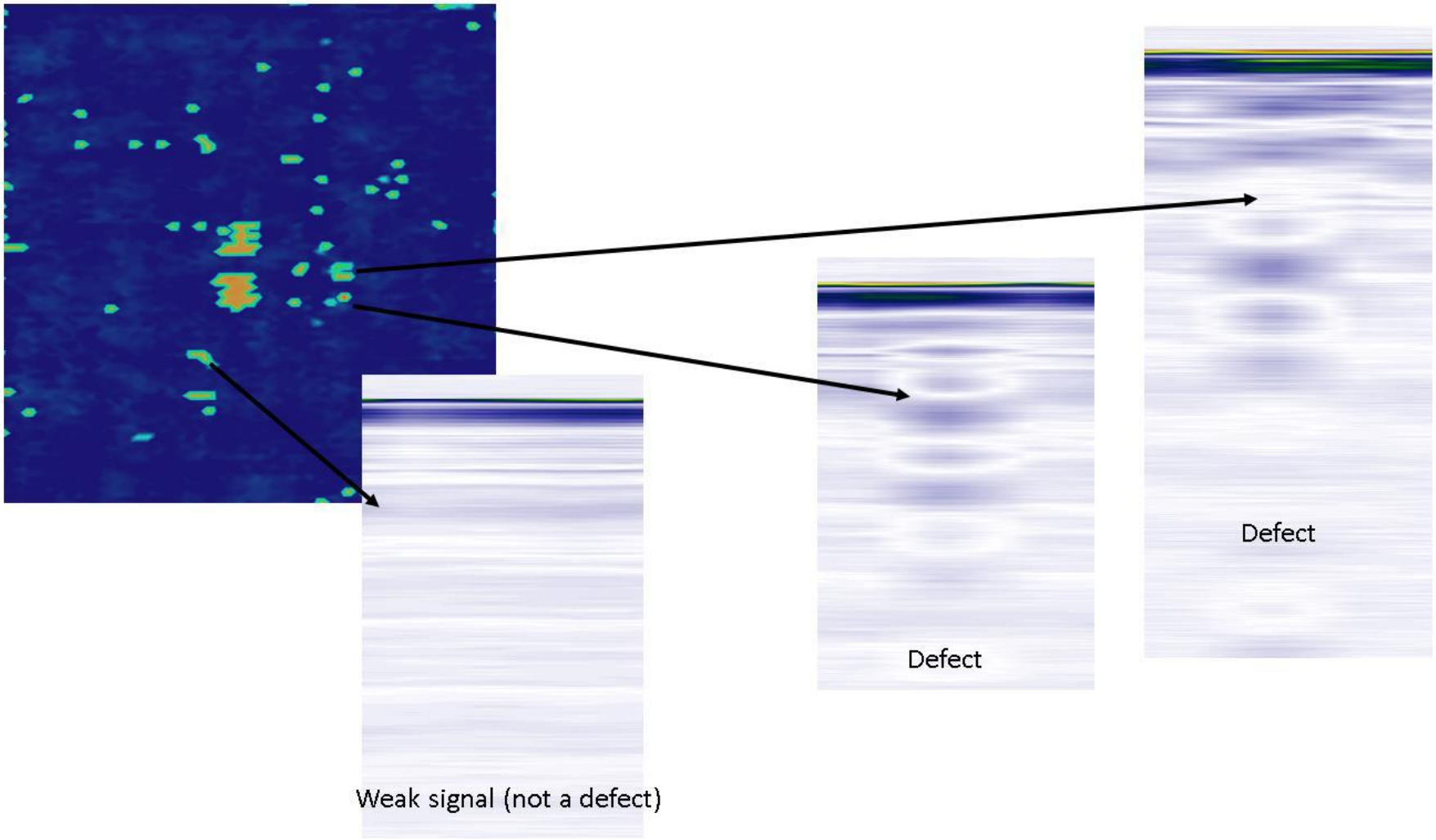
LUT results



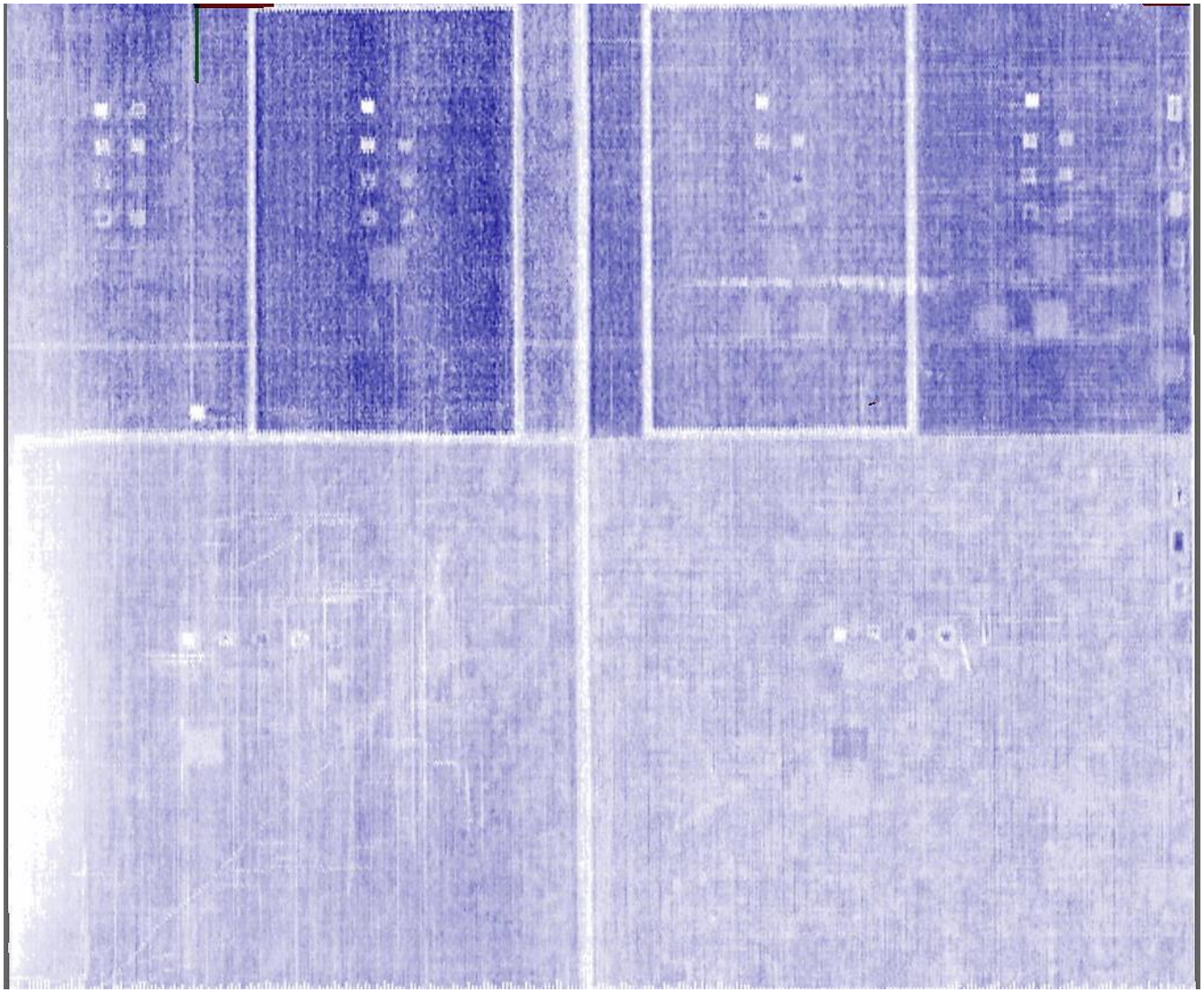
Colour coding of artificial flaws



Flaw detection by viewing B scan-cross section



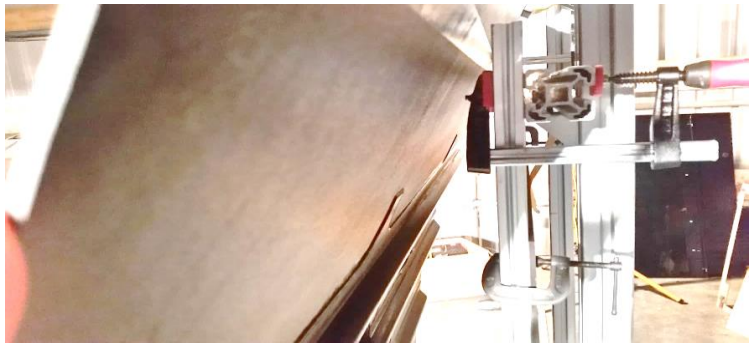
Histogram function



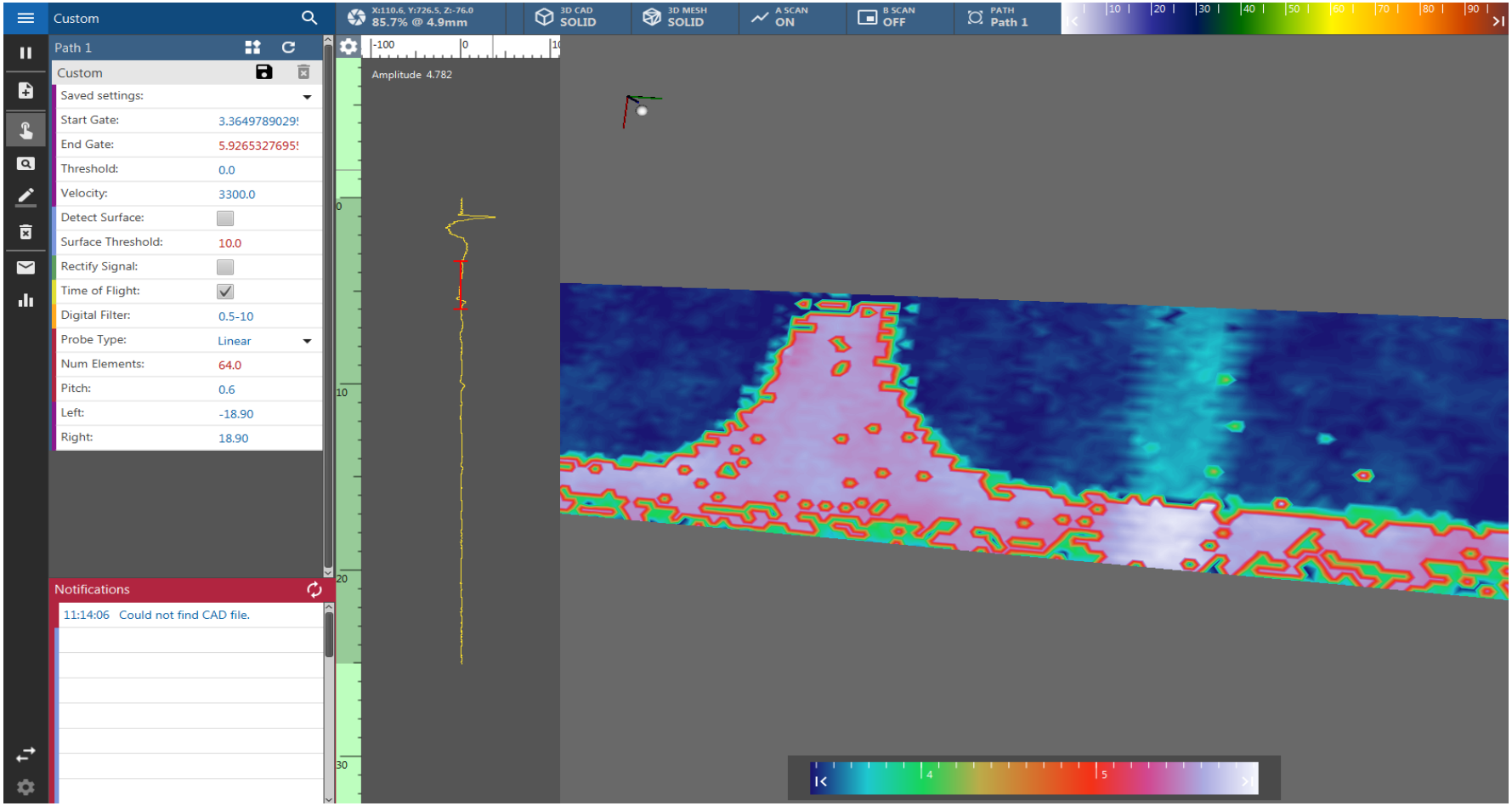
System Testing-Scrap fuselage panel

System Testing

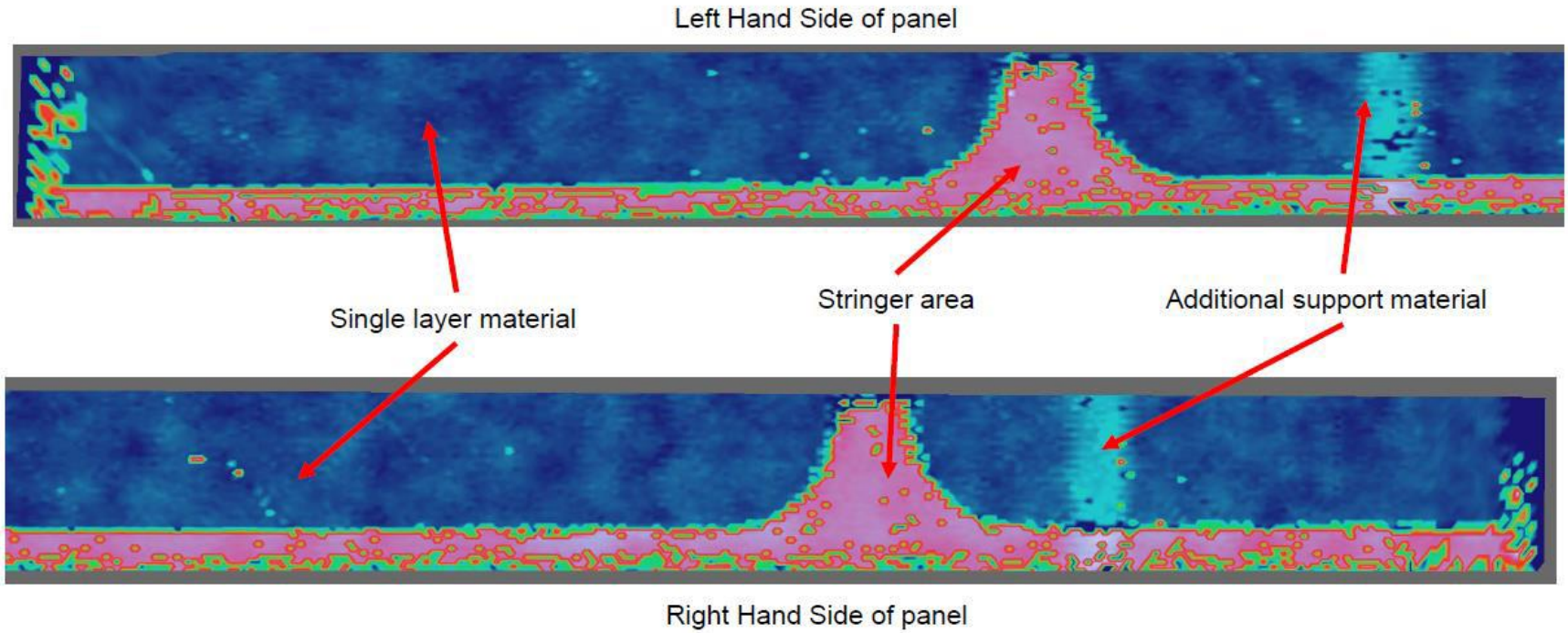
Rear views of the panel showing stringers and ribs



LUT results



Scrap fuselage panel detailedresults



Programme & Progress

Current status:

- Prototype LUT system commissioned
- LUT data acquisition and analysis software passed initial testing
- Proof of concept
- Completed integrated system tests

Next steps:

- Improvement of Signal to Noise ratio via electronic amplification
- Installation at Topic Manager site
- System validation trials & performance tests
- CE Marking
- Completion – Q1 2021

Questions ?

www.accurate-project.eu

Thank you for listening

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