MISTRAS

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Spider SA-semi-automated ultrasonic system for C-Scan data acquisition on rotor blades

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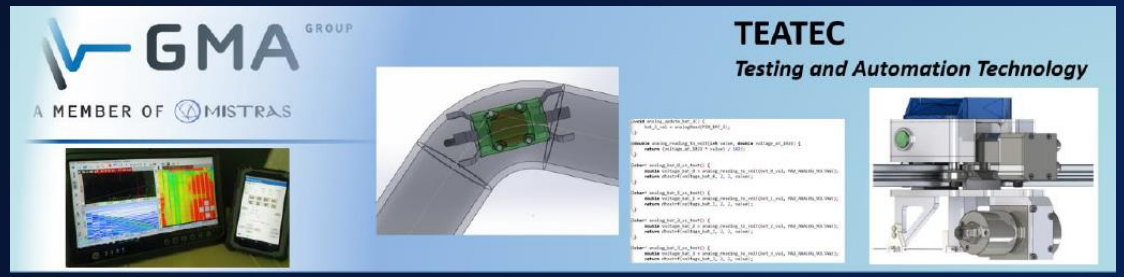
AirTuB Event, 22.09.2022

Background

- **NDT R&D departments** in Stade (GER) and Marsille (FR)



- **Blade inspection UT**

  several different scanners used and developed, different locations and access methods, projects globally

Timeline Spider System Development

Presentation for German Airforce

Kick-off meeting (Teatec GMA Team)
System boundary conditions

March 2019

November 2021

~October 2022
Spider FA Prototype

3,5 years

December 2019

~6 years

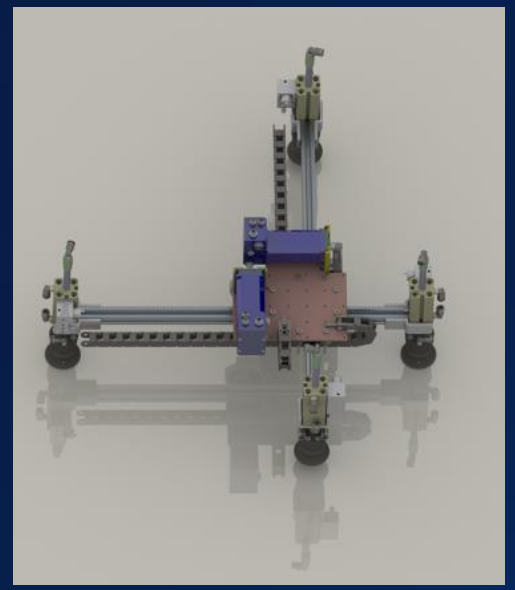
July 2022

July 2016

Redesigned OEM solution
Concept for Spider FA

First prototype, 160h in-house test
NDT tests on site (Europe, production facilities)

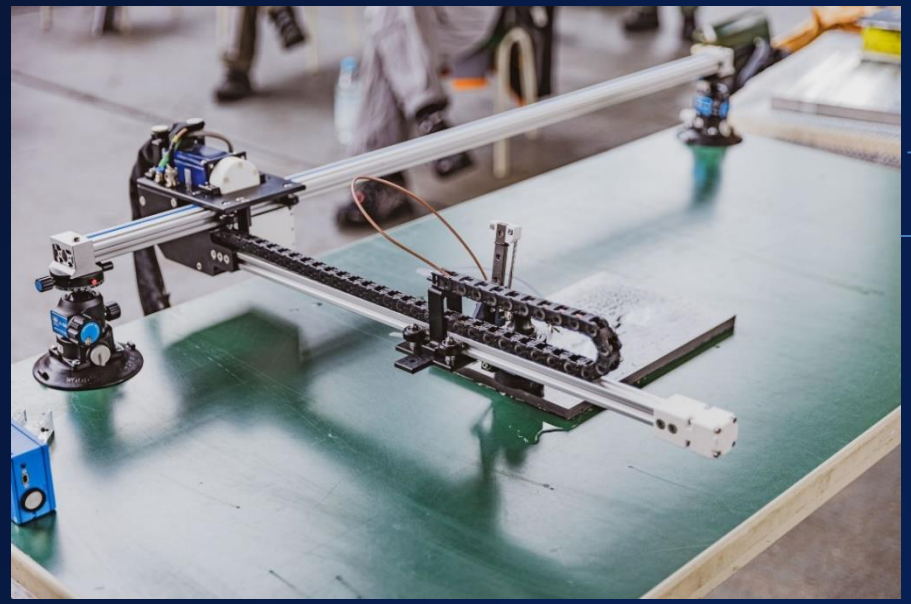
First Offshore deployment



Scanner frame and control device

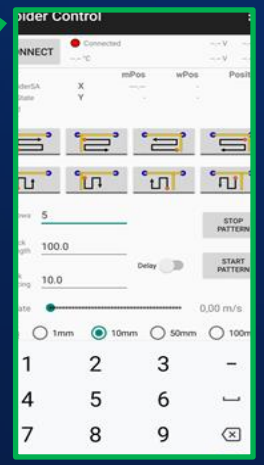
Main features:

- Automated inspection of one test area as a standard 2060mm x 650mm
- High speed up to 2,0m/sec probe movement
- Integrated encoders
- Control box, incl. tablet with wireless control
- Replaceable battery pack
- Customizable transducer housing incl. phased array technique
- Customizable suction cups



Control box incl. battery pack

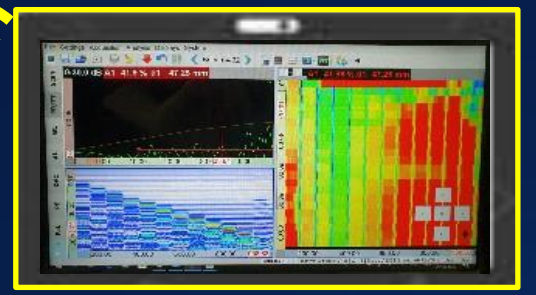
Water pump



Mistras Tablet (Android) with separate UT device

P/R ENC

UT Machine

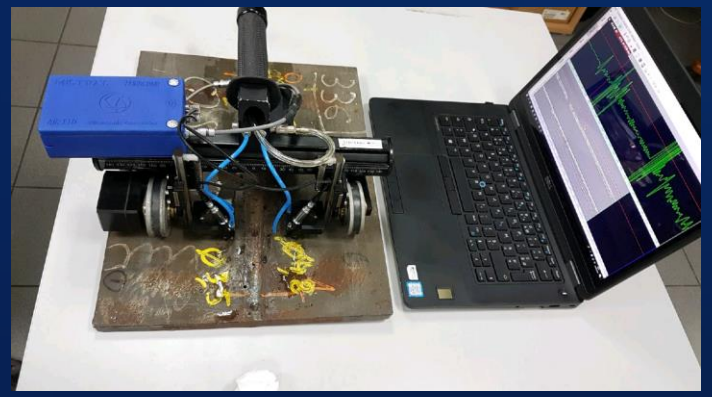


Mistras Tablet (Win) with integrated UT device AIR 110

System base parameters – UT machine

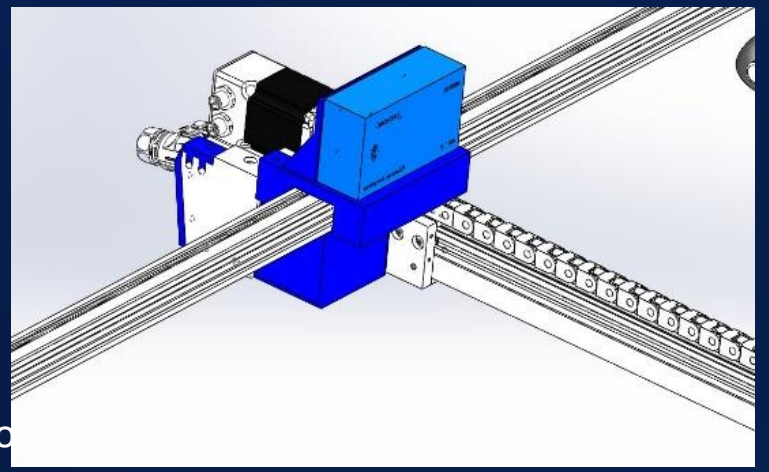
AIR 110 device:

- Compatibile with a whole Mistras software
- Configurable both with a EuroscanV and Utwin software
- Developed to lead A/B/Cscan ultrasonic aquisition



AIR 110 applications:

- Restircted space area
- TOFD inspection
- Flaws measurement
- Thickness measuring
- Rope and drone inspection (collaboration between a rope access tech and a more experienced NDT specialist)



Emitter:

The ultrasonic AIR 110 device is built with a negative square pulser.
This impulsion can be set both in width and amplitude to adapt every type of ultraso
50 ohms sensors from 1 to 25 MHz.

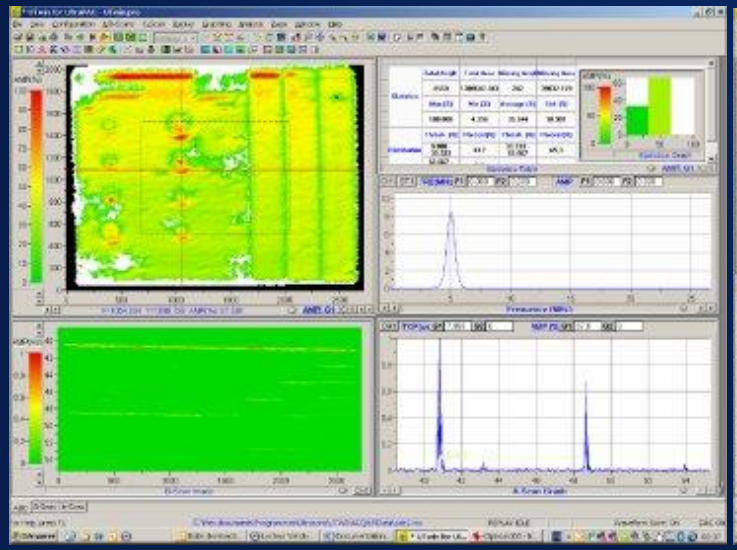
Receiver:

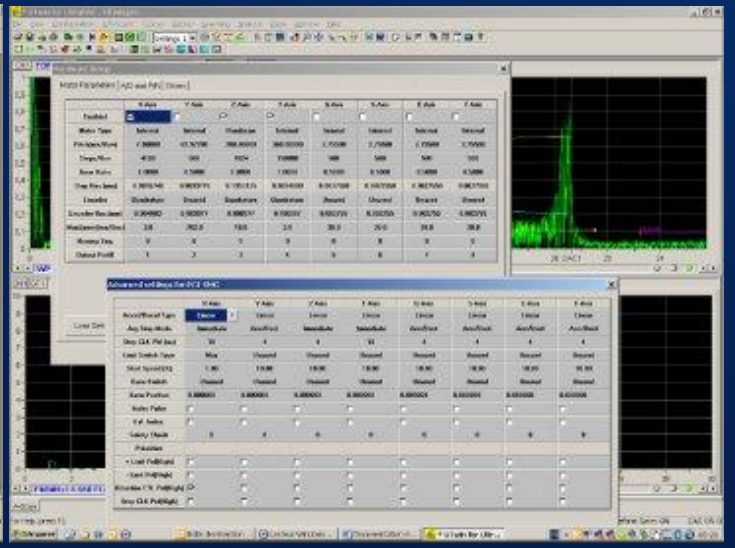
In charge of the amplification, filtering and digitization of the signal.

Control and evaluation software

Hardware Setting

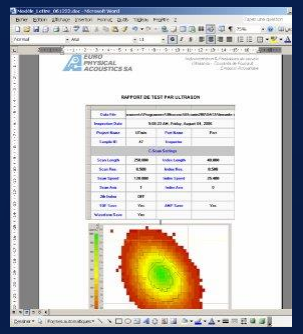
- Select Pulser/ Receiver / Digitizer UT and axis control boards.
- Setup parameters for up to 8 axis mechanics : Motors, belts, gear ratio…
- Easy adaptation to all kind of mechanic working with stepper motors and/or encoders, like immersion tank, gantry, robots...

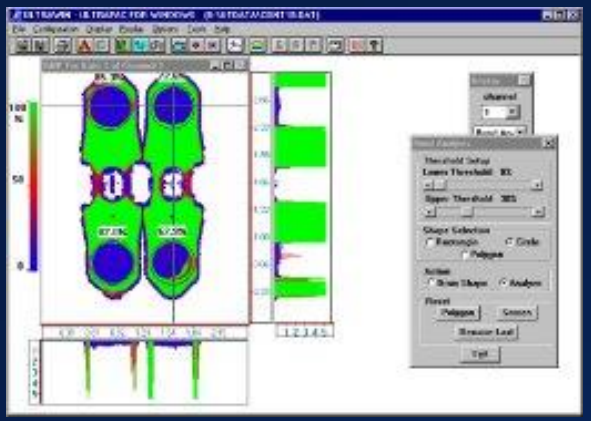




Data Storage

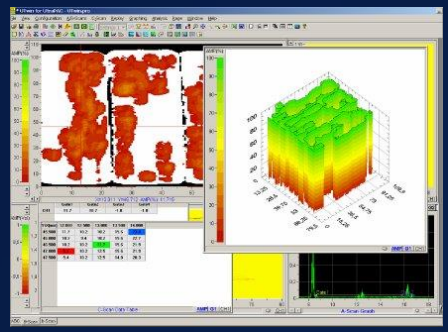
- Test Setup (Projects, desktop)
- Data C-scan, B-scan & A-scan binary or ASCII
- Multiple graphical formats JPG TIFF CSV…





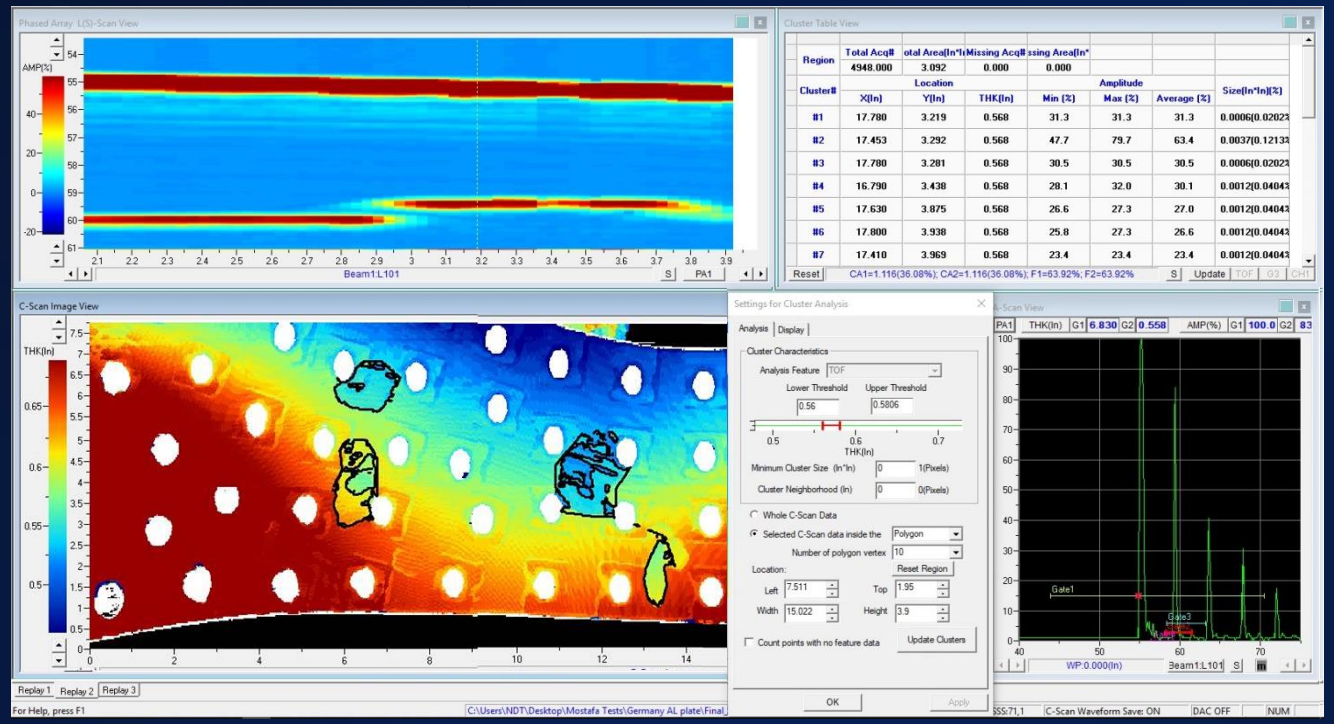
Post-Analysis

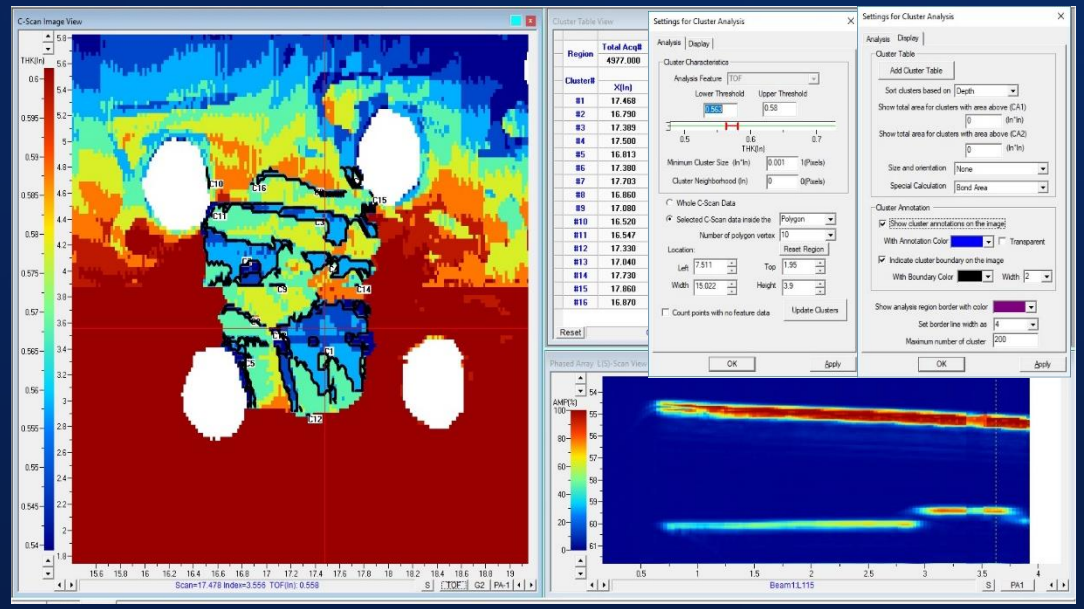
- Replay A-scan, B-scan, C-scan using data within all gates and features, FFT in gates.
- Single or double cursors.
- Image filter capabilities
- Custom color palette
- Statistic & Cluster Analysis in all image or selected area



Control and evaluation software

- Menu control with several registers for setting test parameters and adjustment
- Ability of the system to test irregular polygon surfaces
- Volume scan with ultrasonic A scan image storage
- B-scan display
- Area measurement with polygon selection
- Local wall thickness measurement

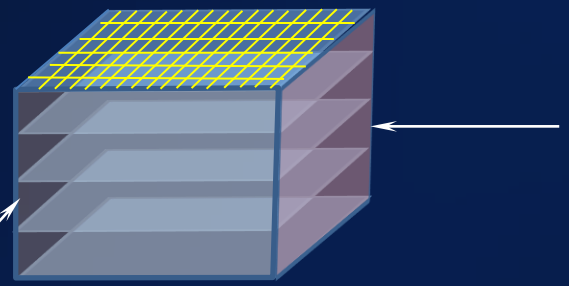




- Cluster Analysis criteria can be based on size (area), Depth (TOF), Amplitude (% FSH).

UT capabilities

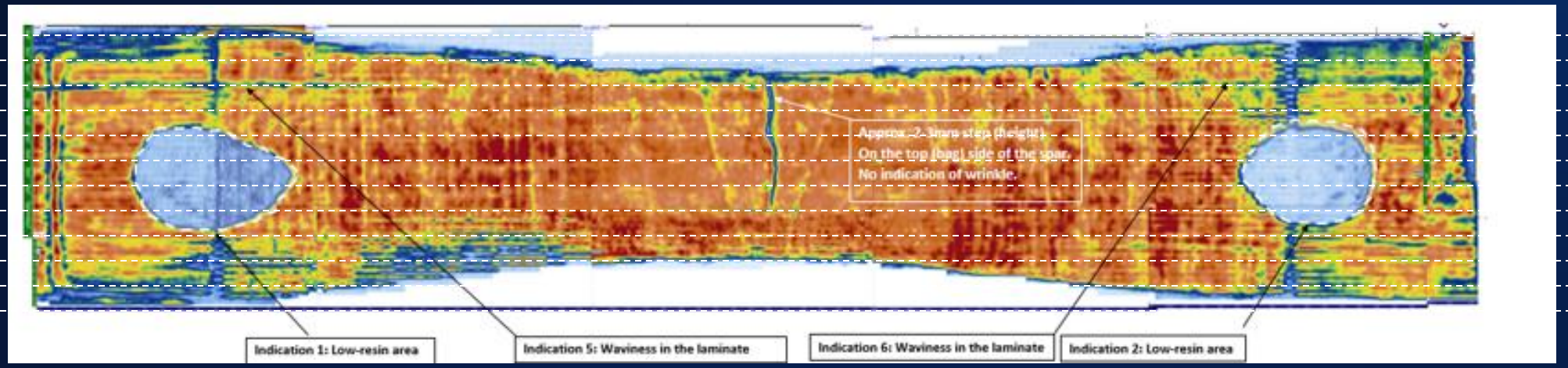
C-Scan, Top View , the blue surface shows the position of the GFRP/CFRP layers and the inspection surface

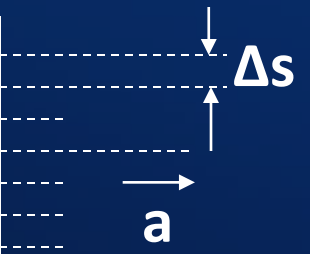


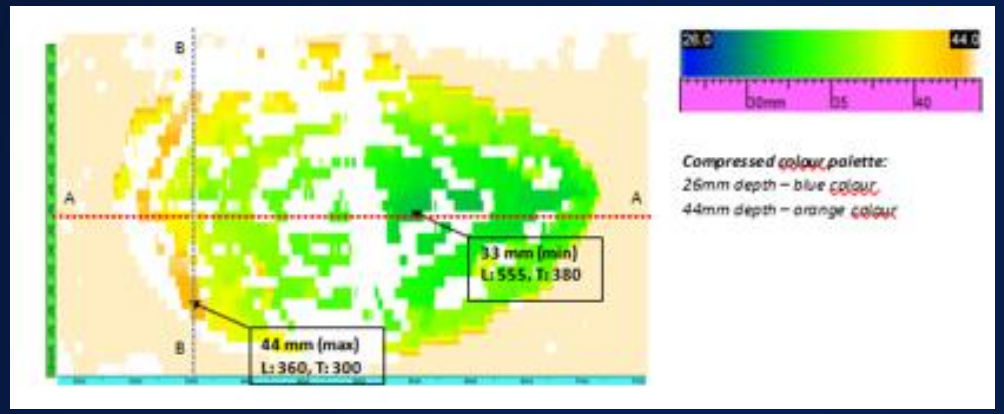
B-Scan, Side View (longitudinal direction), the cross-section, depends on the index resolution

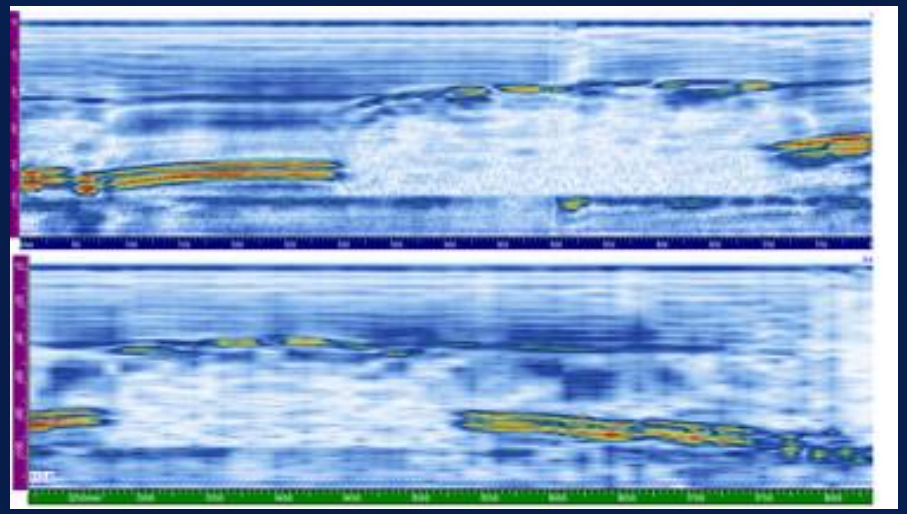
B-Scan, Side View (transversal direction) the cross-section, depends on the index resolution

Example: Laminate condition - porosity





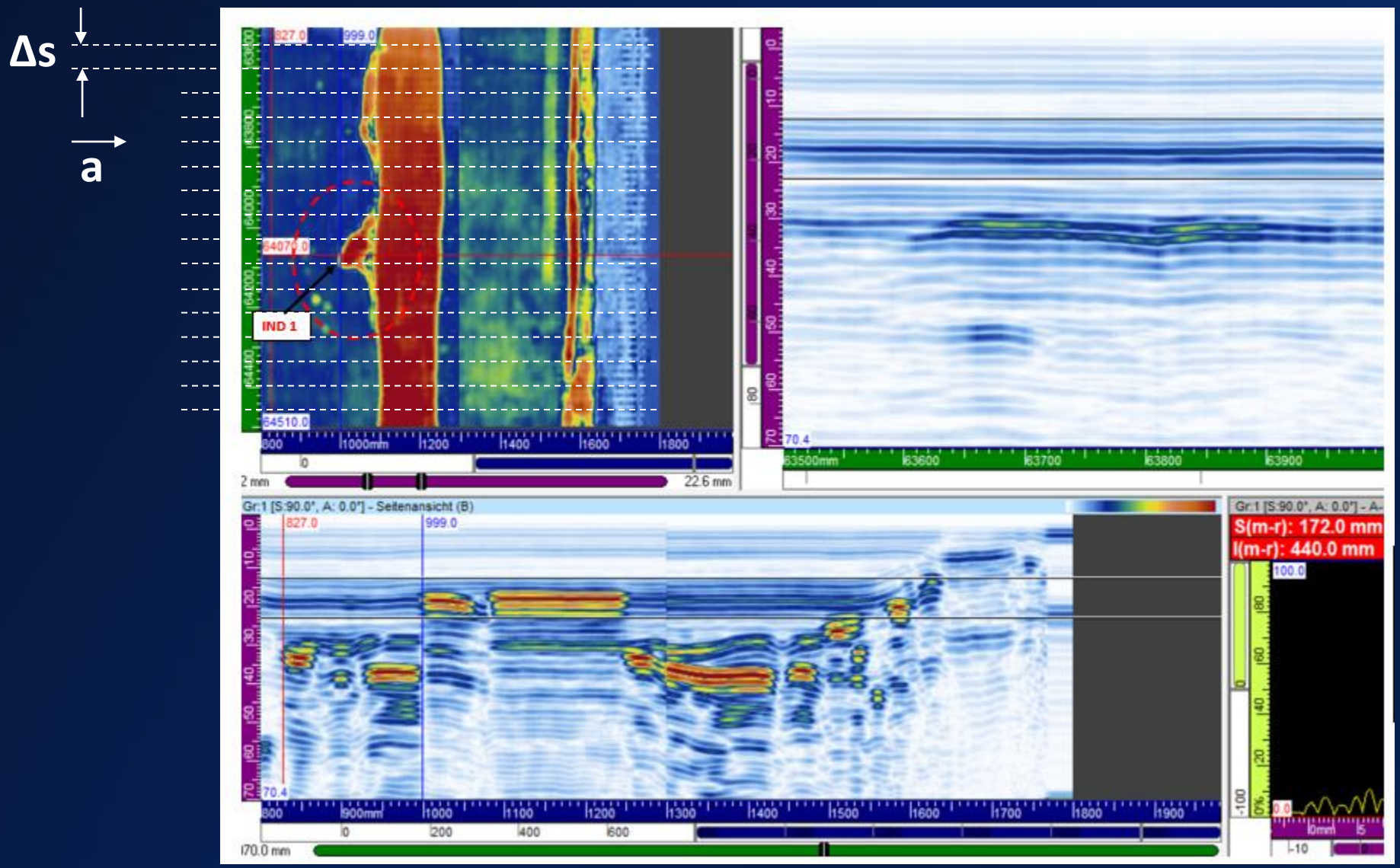




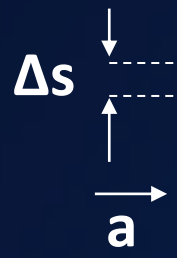
a and Δs can be set as desired:

Range 0,8 – 100mm

Example: Debonding



Example: Wrinkles



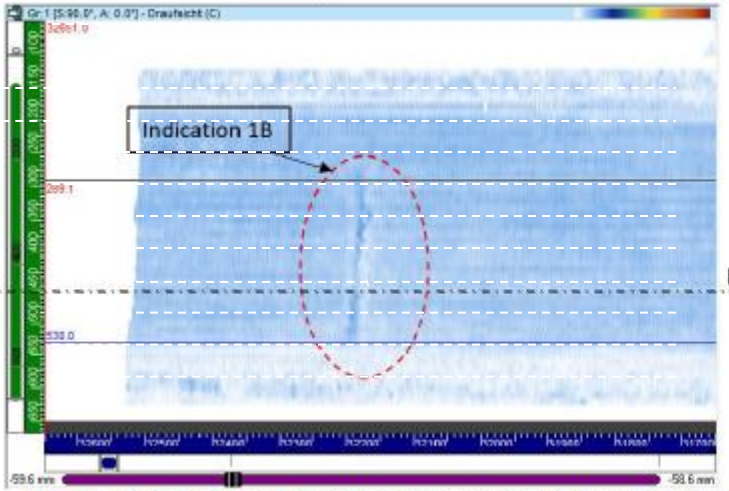
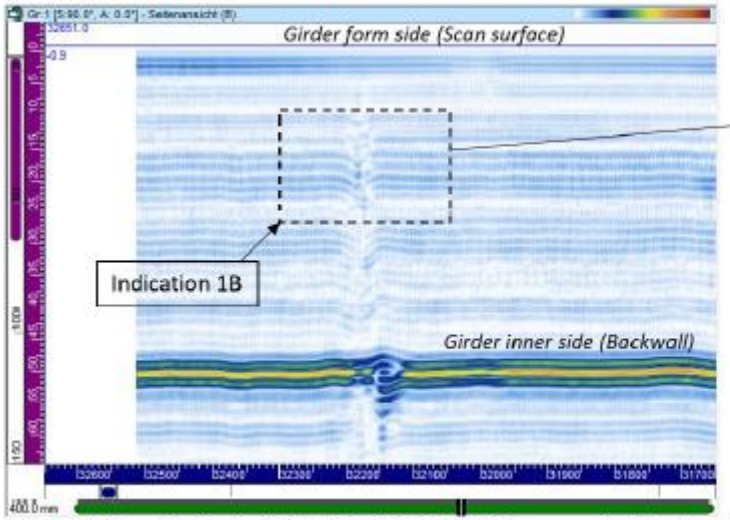


Abb. 6 C- Scan (Draufsicht), Amplitude: Zwischenanzeige, Blende: 16-17mm, Bildverhältnis 1:1

Indication 1B – Waviness (Inspection from main girder form side)

Position:	Z 32.170 (20mm tolerance due to position of the UT scanner)
Length (girder longitudinal):	54mm
Height:	1,9mm
Slope:	3,5 % (measured 210mm from girder leading edge side)
Width (girder transversal):	ca. 240mm (120-360mm from girder leading edge side)
Depth:	up to 45mm (waviness starts approx. 6,5mm from girder form side up to backwall)
Laminate affected:	approx. 85%



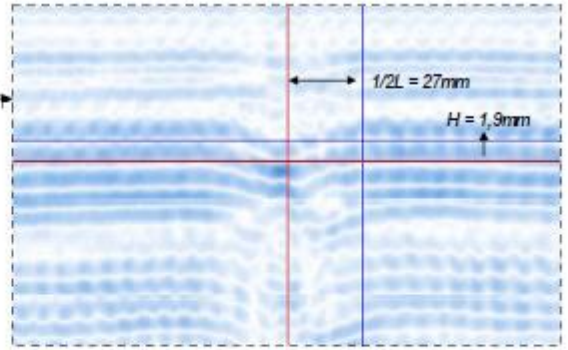
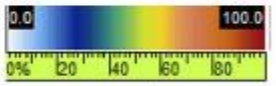


Abb. 8 Detail mit Welligkeitsparametern (Indikation 1B)



Colour palette / Amplitude [%]

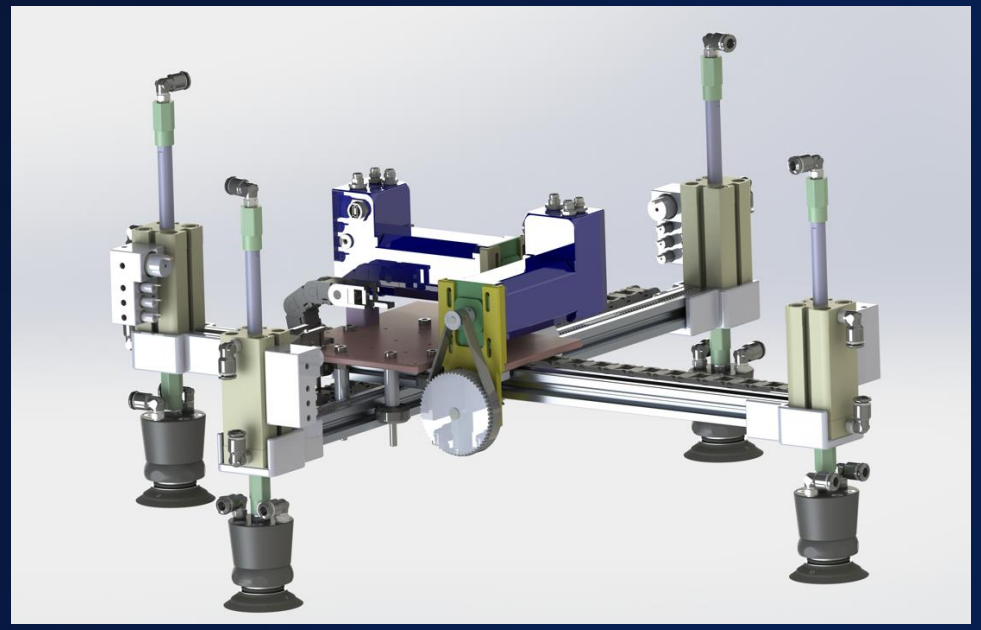
Abb. 7 B- Scan (Seiten Ansicht), Schnitt A-A' (ca. 210mm von der Hauptgurt Vorderkante), angenommene Schallgeschwindigkeit: 2800 m/s

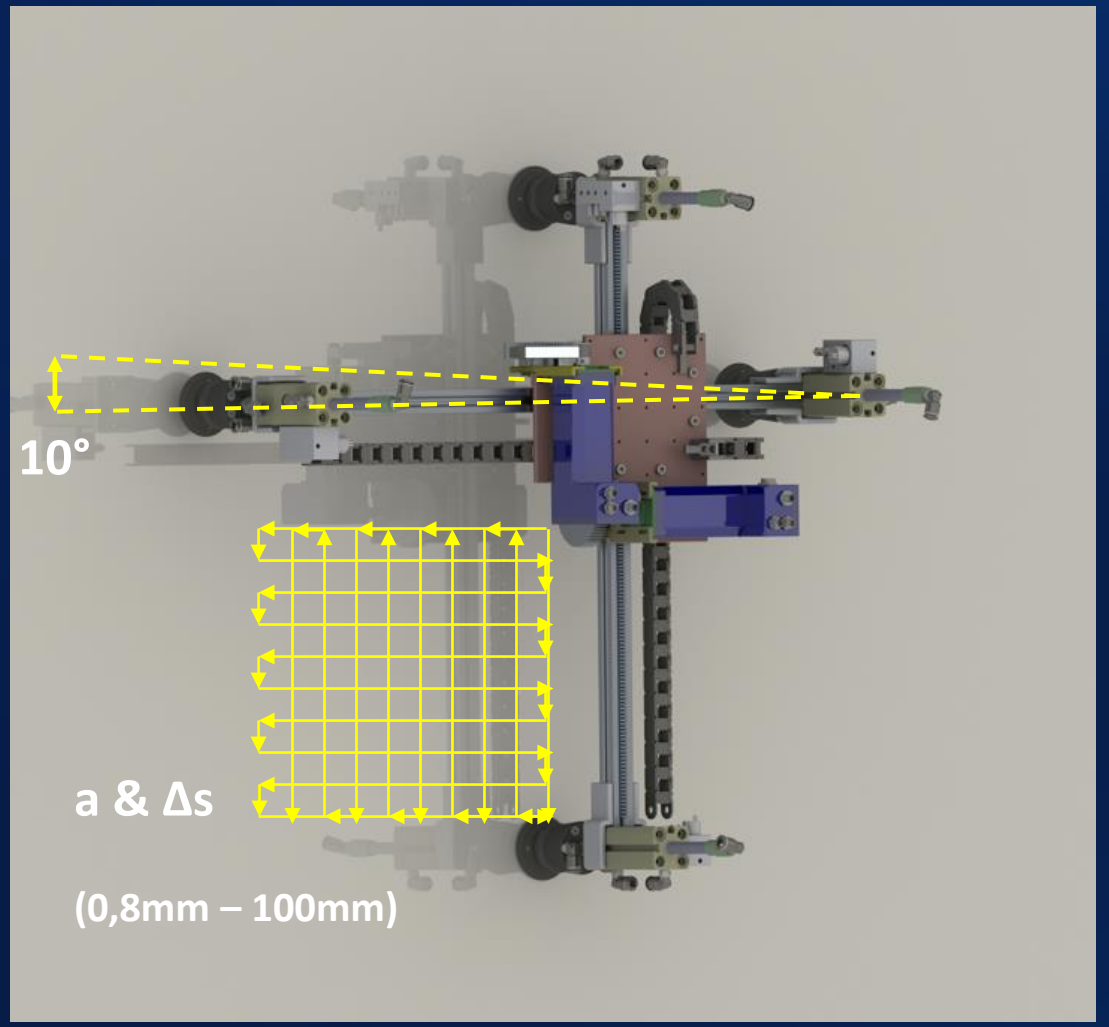
System tests for aviation (not only wind power AOI)

Further tests and applications

Main features:

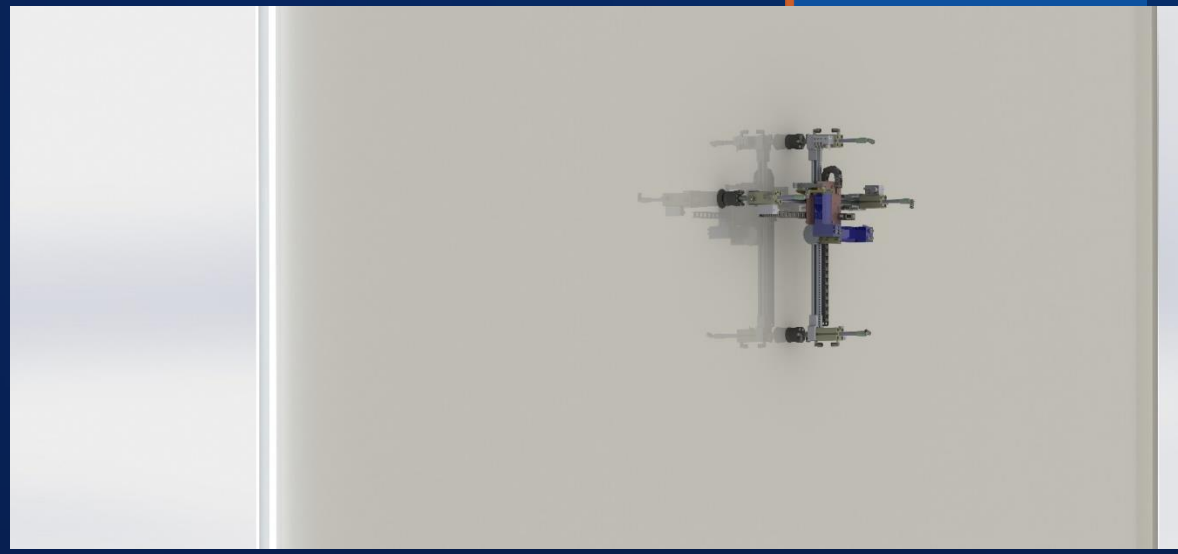
- Automated inspection of one test area max. 600mm x 600mm
- Automatic movement
- High speed up to 0,8m/sec
- Two integrated encoders
- Control box, incl. tablet with wireless control
- Setting the axis in the desired angle ($\pm 10^0$) loop with UT system
- Lightweight: 6,5kg incl. UT system

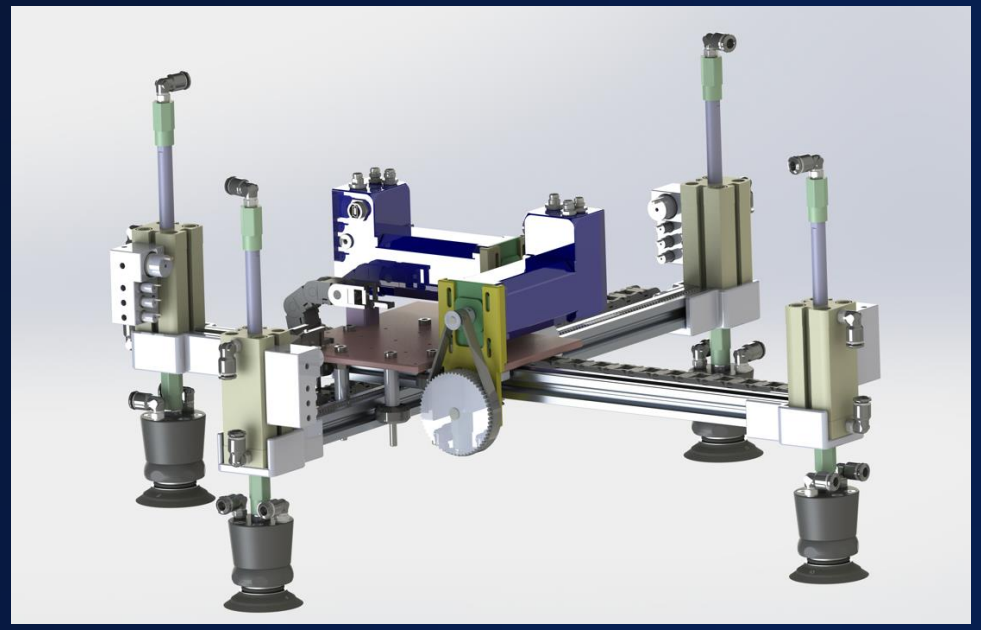




Future deployment method:

- Rope access, optionally with a drone support (positioning scanner on the blade surface)
- Wireless system control from the tower
- Utilising AIR110 device





Benefits comparing to semi-automated solution:

- Less rope access assistance and therefore less human factor during inspection and less effort on site in difficult working conditions (offshore or low season)
- Increased reproducibility of scans
- Improved efficiency:

Spider SA: up to 6m² inspection areas (volumetric) / day
Spider FA: up to 20m² inspection areas (volumetric) / day

Thank you for your attention!