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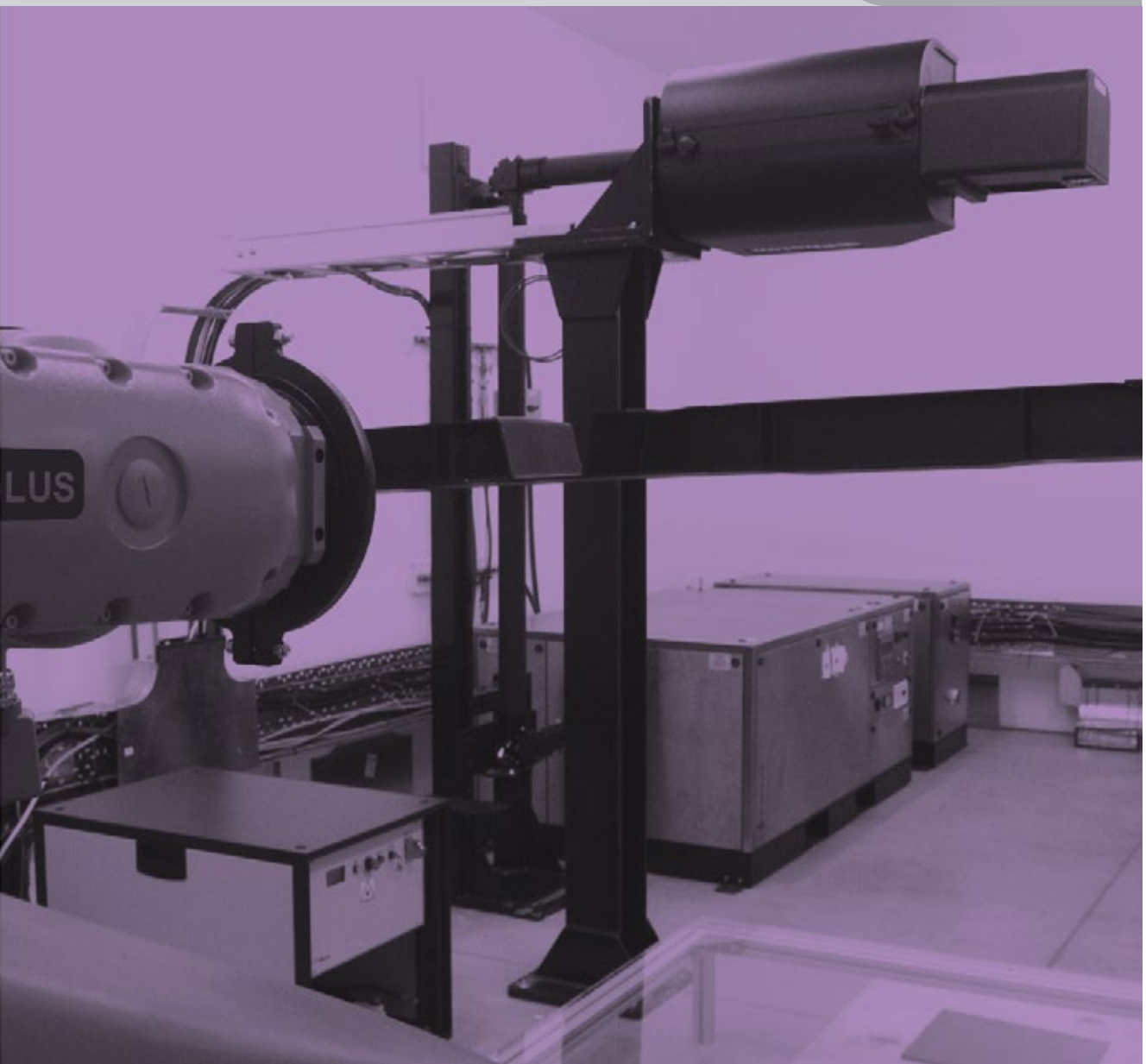

Laser Ultrasonic Products

tecnaLUS & tecnaPLUS

An advanced
Ultrasonic Technology

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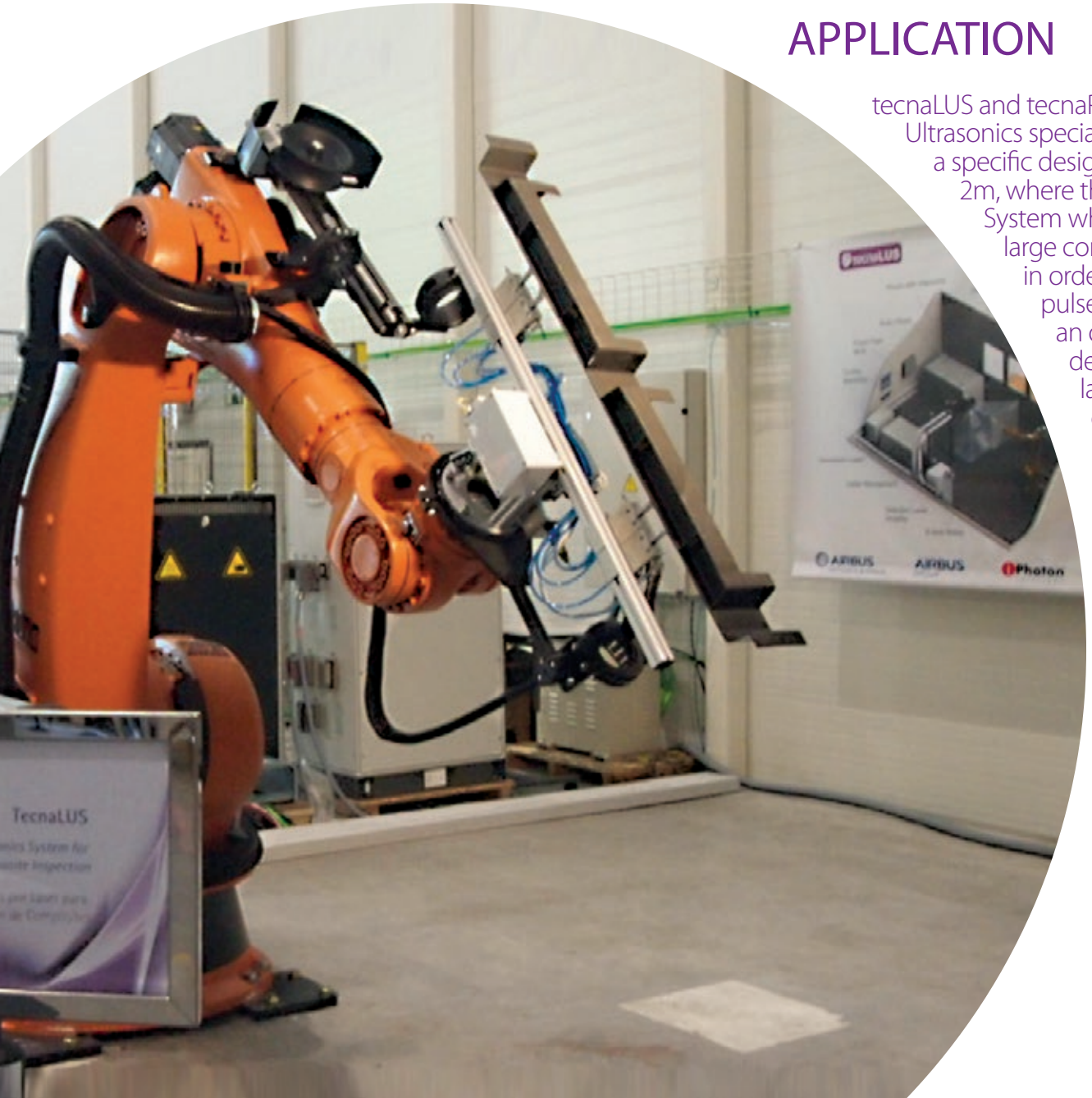


APPLICATION

tecnaLUS and tecnaPLUS are two automatic inspection systems based of Laser Ultrasonics specially designed for the inspection of composites. tecnaLUS has a specific design for the inspection of small components, less than 2m by 2m, where the part is hold by the robot. tecnaPLUS is the Laser Ultrasonic System where the robot moves the scanning head, and is specific for large components. Laser ultrasonic technology combines two lasers in order to perform the inspection of the part: a high peak power pulsed laser for generation (CO^2 laser), a detection laser (Nd YAG), an optical interferometer (double cavity of Fabry Perot), a photo detector, a digitizer and a module control to synchronize laser shots and measurement acquisition. Ultrasounds are generated directly in the surface of the component, so no couplant medium is needed.

Proven Advantages

- Optimization of the Laser System for Composites applications: CO^2 (generation laser) and Nd YAG (Detection Laser).
- **No need of couplant**.
- **High tolerance** relative to the incidence angle of the laser beam with the part (± 35º) and to the distance from the scanning optical on head.
- Ability to detect defects up to 40 mm depth.
- **Productivity**: Reducing inspection times and more for complex shape components.
- **Flexibility**: incorporating different solutions to increase its performances: Robot over track, Robot holding the parts.
- **Powerful HW-SW technology** that enables the integration of the complete inspection process.

SCOPE OF SUPPLY

Ultrasonic generation laser & Detector Laser

Two lasers are used for generation and detection of Ultrasonic beams in the part. Both of these lasers generate a very concentrated beam of light but they react differently depending on the material. The laser selected shall not damage of the component, taking advantage of the most recent developments of this technology state of the art. In particular, no additional surface treatment is envisaged for parts.

Interferometer

The interferometer shall extract the information contained in the detection laser which is reflected from the part. That information is coded in phase modulation. The interferometer translates this phase modulation into an intensity modulation that can be measured. Dual cavity differential CFP is used like interferometer with a 94% mirror reflectivity.

The photo detector

As part of the detection chain, is associated to the interferometer. The most of the time, a dark surface like the composites one doesn't reflect so much light into the collecting system. This phenomenon is also amplified when we work with high incidence angles. For that reason it is necessary to have an electronic circuit able to reduce the noise and adjust the gain, obtaining an with very low light level back from the part. The photo detector sensitivity must be large enough to overcome that constraint.

Acquisition chain

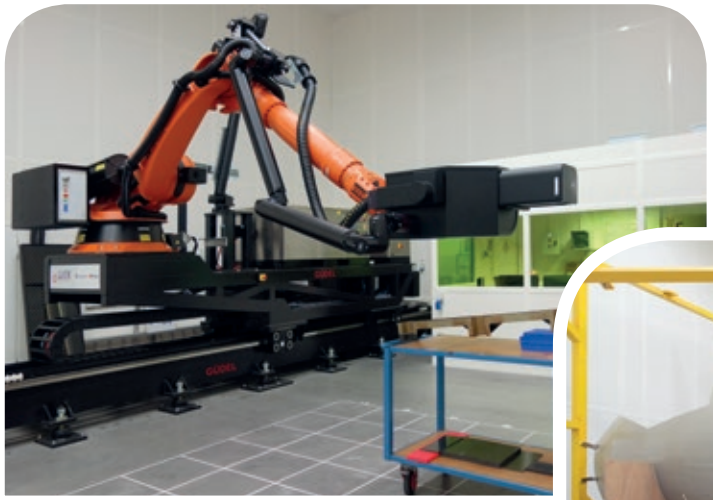
In order to recover data, the analog signal must be converted into an exploitable digital signal. The system architecture enssure the traceability between the different parameters of the A/D converter and the other elements of the system.

Mechanical system

Architecture can be adapted depending on the Customer inspection requirements.

Auxiliary Elements

Video, Audio, Protection, safety elemens such the cell with suitable crystals or the operator area and Control Station.



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AVAILABLE OPTIONS

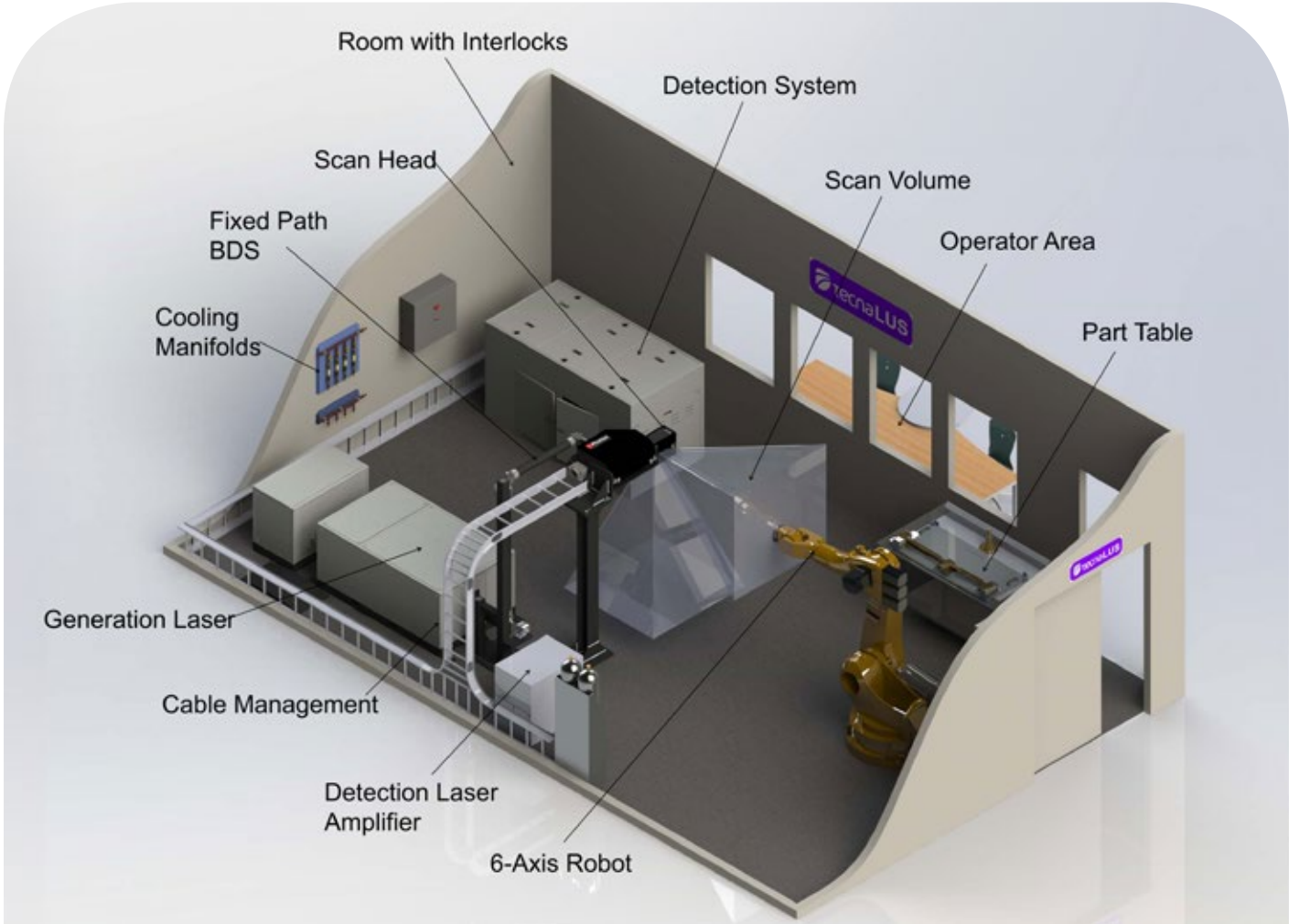
The flexibility of the control system allows adapting different solutions with diverse configurations: with or without track, robot holding the part or scanning head... There are different possibilities depending on the dimensions and geometries of aeronautical parts to be inspected.

tecnaLUS	tecnaPLUS
Robot holds the part	Robot holding Scanning Laser Head over track
Smaller Samples	Large components
Repetition Rate: 600Hz	Repetition Rate: 400Hz - 1000Hz

OPTION:

tecnaLUS

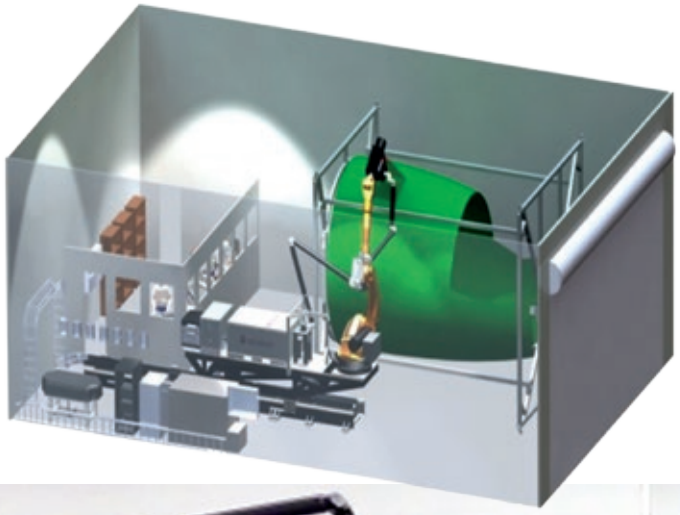
Robot Holds The Part



OPTION:

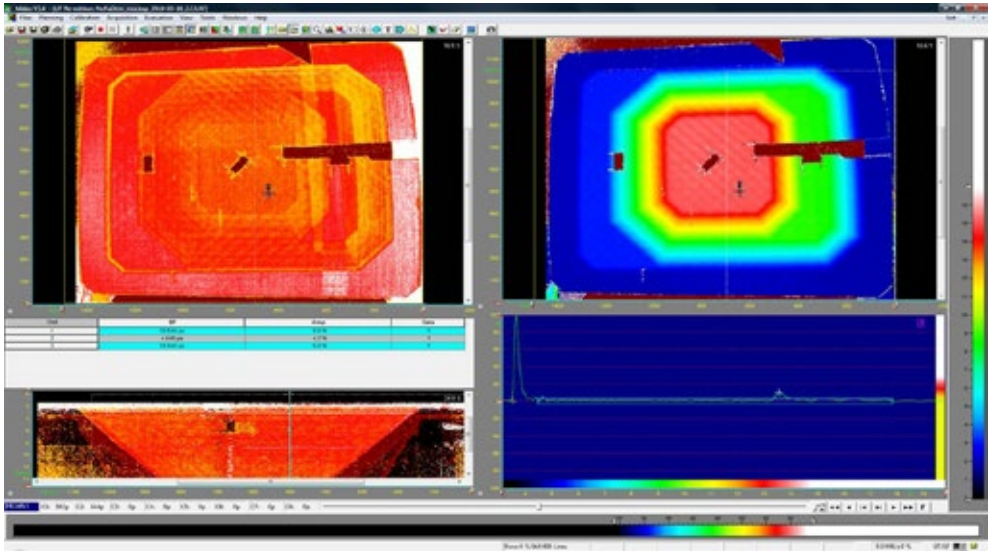
tecnaPLUS

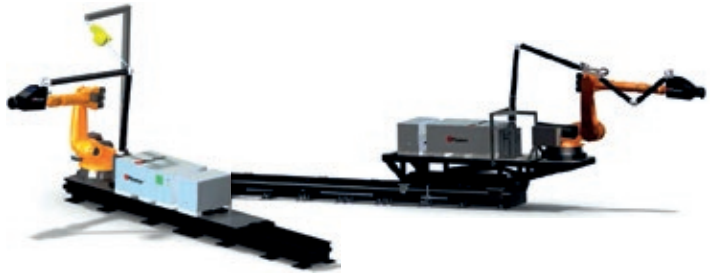
Robot Holds the Scanning Laser Head



Laser Ultrasonic
Composite Inspection

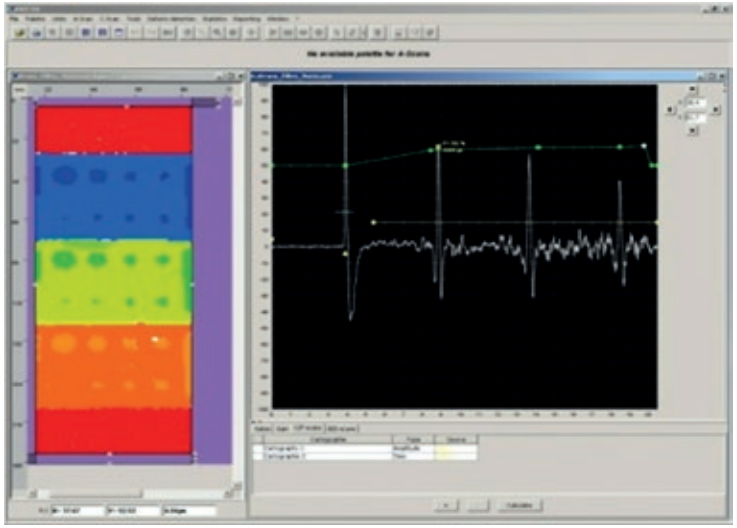
INSPECTION RESULTS

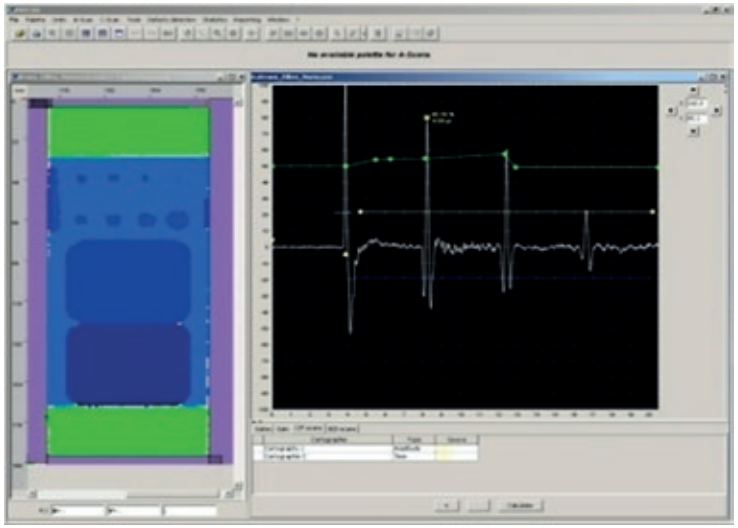




CONCLUSIONS

- It is fundamentally a pulse-echo ultrasonic Technique.
- It is sensitive to both surface and subsurface discontinuities.
- Only single-side access is needed when UT laser technique is used.
- It is highly accurate in determining reflector position and estimating size.
- Minimal part preparation is required.
- It has other uses, such as thickness measurement, in addition to flaw detection.





SPECIFICATIONS

Ultrasonics

Target application	Ultrasonic inspection of polymer-based composite materials
Ultrasonic configuration	Pulse-echo
Signal bandwidth	0.5 MHz to 20 MHz
Number of digitizer channels	2
Maximum digitizer sampling rate	100 MHz
Digitizer resolution	14 bit
Pulse repetition frequency	600 Hz (user adjustable down to single shot)
Inspection spot size	~5 mm [0.2 in] (optional variable spot size)
Inspection step size	User selectable
Area inspection rate	8.6 m^2/hr [96 ft^2/hr] with 2-mm [0.08 in] steps (geometry invariant)
Amplification dynamic range	80 dB

Scanning System

Scanner	2D galvanometer with digital driver
Scanner positioning	7th axis with 360° rotation, mounted in-line with robot 6th-axis
Nominal scanner-to-part distance	1800 mm [6 ft]
Depth of field	±300 mm [± 1 ft] from nominal distance
Scan area maximum dimensions	1500 mm x 1500 mm [5 ft X 5 ft]
Inspection step index	User selectable
Maximum angle of incidence	45° from normal of part surface
Laser alignment	Automatic

Generation Laser

Laser type	Industrial pulsed TEA CO^2 laser
Laser wavelength	10.6 µm
Pulse duration	< 100 ns (FWHM)
Pulse energy	> 180 mJ at part surface, adjustable
Maximum pulse repetition rate	600 Hz
Maintenance cycle	1 Billion shots or 1 year

Detection System

Interferometer type	Confocal dual-cavity Fabry-Perot (US patent # 8,134,715).
Interferometer bandwidth	0.5 MHz to 20 MHz (optional absolute response calibration)
Stabilization	Automatic. Optical stabilization circuit independent from sample light, ensuring 100% stabilization.

Detection Laser

Laser type	Industrial fiber laser amplifier seeded by a non-planar ring oscillator
Laser wavelength	1.064 µm
Pulse duration	250 µs
Maximum pulse peak power	500 W (optional 800 W version)
Maximum pulse repetition rate	> 1 kHz
Laser power control	Automatic, <1% to 100% on a shot-by-shot basis
Maintenance cycle	None

Safety Systems and Facility Requirements

Inspection area requirement	Laser safe as per local regulations
Power requirement	380 V, 50Hz, 100 A or 460 V, 60Hz, 100 A
Water	None
Compressed air	7 bar [100 psi]

Maintenance and Diagnostics

Maintenance cycle	Biannual system check (1/2 day) and yearly CO2 laser refurbishment (2 days)
Laser power monitoring	Automatic
Laser alignment monitoring	Automatic
System performance data logging	Automatic

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