# Remote Large Area Automated NDT Inspection

Aerospace MRO of the Future

*Pieter Troost, TiaT europe, 2016*

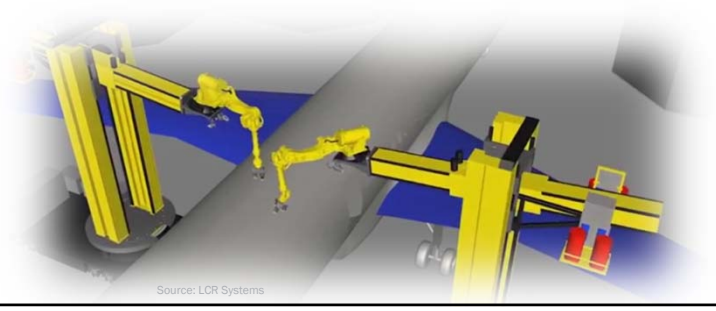

**TiaT europe**

- NDT Training
- NDT Inspection
- NDT Consultancy

- Based in Roosendaal, The Netherlands

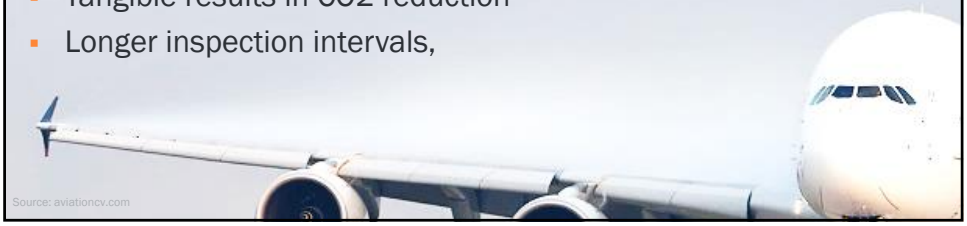
# Scope

- Why Automated Remote Large Scale NDT for MRO
- How can this be achieved
  - Methods and Techniques
  - Considerations and Developments




# MRO Market Trends

- Global growth in aviation demand of 4.7% per year until 2033
- Increased competition, Pressure on costs and turn-around time
- 50% of commercial aircraft fleet will be **Composite** by 2030
- Growth in lease market and changes in ownership.
- **Loss of skilled labor** and/or limitation in foreign labor employment
- Tangible results in CO2 reduction
- Longer inspection intervals,

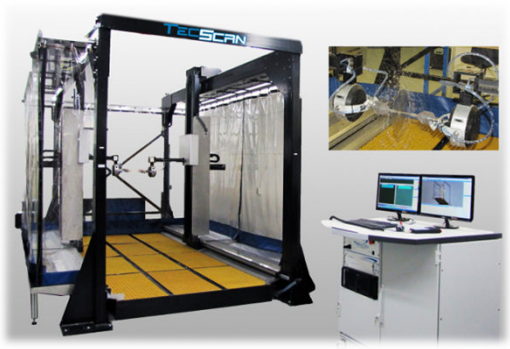


- Aerospace MRO NDT requires **innovation** to cope with trends
- **Innovation** must lead to:
  - Increased efficiency
  - Faster inspection (Shorter Time on the Ground)
  - Cost reduction
  - Effective information systems that allow for easy and timely data analysis
- Automated Remote Large Area NDT is potentially the key to achieve the above.

Source: aerospace testing international

# Automated NDT inspection

- Not new
- Widely used in **manufacturing,** utilizing various NDT methods and techniques
  - UT Scanners (PE, TT, etc.)
  - ET
  - RT
  - Etc.




Source: TecScan

- Current Automated **NDT** systems for Aerospace **MRO**:
  - Relative small area's (*localized inspections*)
  - Mostly semi-automated (manual operated)
  - Only specific data is considered
  - Evaluation of results immediately done on site
  - Various NDT Methods and Techniques utilized, both contact and non-contact

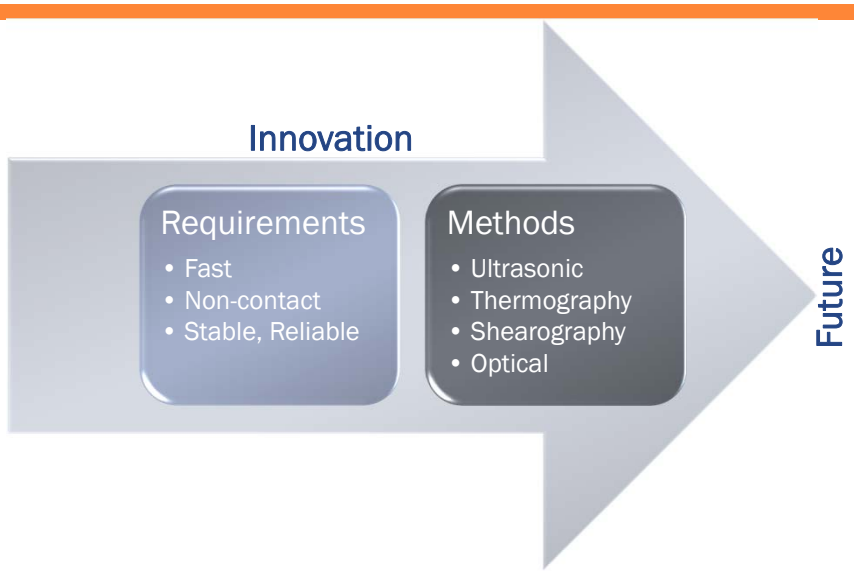
Source: Automation Technology

Source: Phoenix Inspection Systems Limited

# Future Aerospace MRO

- Challenges:
  - Automated Large (Larger) Area Inspection
  - Fast Inspection Methods and Techniques
  - Usable on **composite materials**
  - Data Handling (Recording, Analysis and Evaluation, Accessibility)

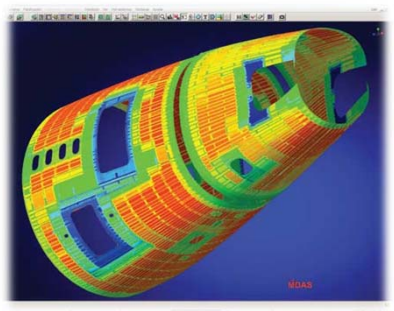
# NDT Methods and Techniques




# UT

- Ultrasonic Testing
  - Phased Array, Roller Probes
  - Laser-Induced Ultrasonic, non-contact technique
  - Surface Wave Techniques (Pitch-Catch)

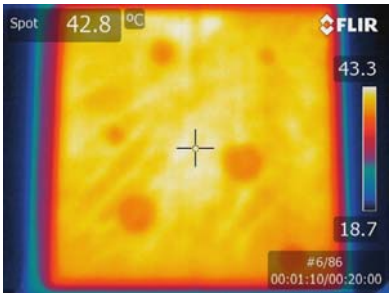
Source: Sonatest



Source: Tecnatom

# IRT

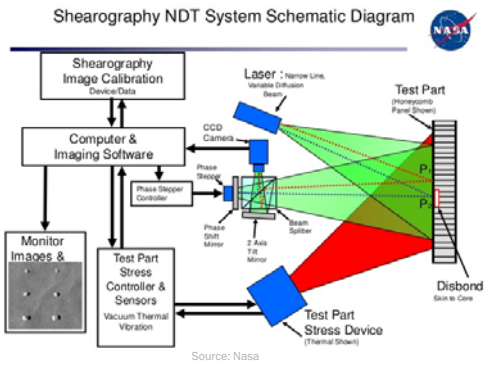
- Thermography
  - Pulse
  - Lock-In
  - Vibro




Source: Lufthansa Technik

# ST

- Shearography
  - Laser Shearography




Source: Nasa

Source: Dantec

- Optical
  - Surface Contour Scanning (Dent & Buckle List)
  - 3d Scanning Techniques


Source: Faro

# Automation

2d Scanner → 3-Axis Scanner → 6-Axis Scanner → 9-Axis Scanner → And on

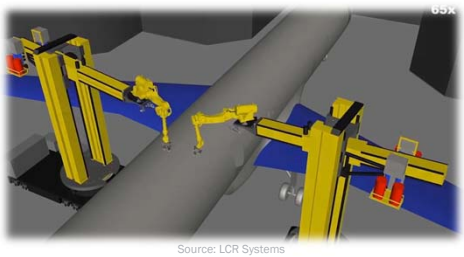
Source: Olympus


Source: Azorobotics

Source: LCR Systems

- Automation Challenges for MRO NDT:
  - Position and Orientation Sensor/Inspection System relative to inspection surface
  - Accurate location information of the data (results)
  - Covering complex curved surfaces
  - Smart movement

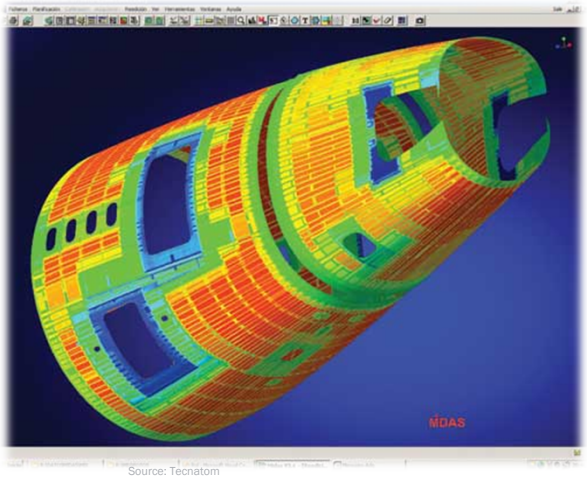
Source: aerospace testing international



Source: LCR Systems

# Data Handling

- NDT Inspection of Large Areas results in a lot of Data
  - Per location/position point at least:
    - Inspection Data (Settings, Response, etc.)
    - Location Information (relative to coordinate system)
    - Object Information
  - Data recording to a platform that enables, efficient, smart analysis and evaluation of the data (combined with CAD information)
  - The results of the evaluation need conversion to a report
  - (Big Data approach to some extend) *(Volume, Velocity, Varity and Veracity))*

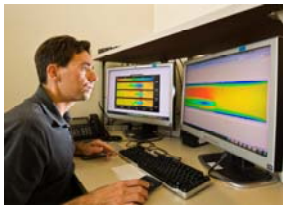



Source: Tecnatom

- Report Example
  - Laser Ultrasonic Test CFRP Full Scale Fuselage Part by Tecnatom for Airbus

# Remote

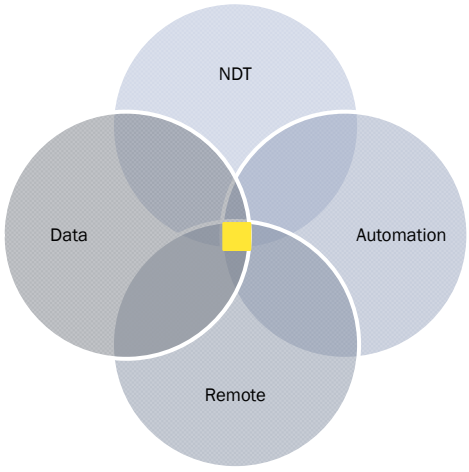
- The legacy NDT systems rely mostly on evaluation on site by well qualified personnel.
- When using the Automated Systems with more recent NDT Techniques, the inspection data is digitally available and can be send to specialists throughout the world using internet, This increases speed of inspection and can contribute to the consistency of the inspections.



Source: Sandia National Laboratories

- Challenges:
  - Availability of the data
  - Configuration (arrangement) of all data
  - Personnel responsibilities

# Developments



# Examples

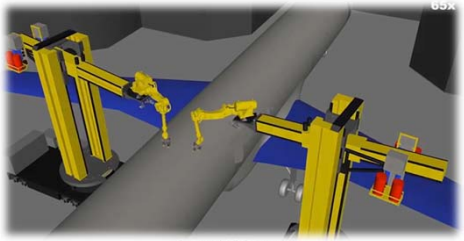
- Demonstrator: Automated Large Area NDT Inspection, Composite Material
  - Int'l, MRO-related
- Demonstrator of Automated System, in which several techniques are combined and simultaneously utilized
- Integrated Damage Assessment and Repair of CRFP
  - NL. In this project
- Several projects on automation of NDT Inspections
  - Combinations of Inspection Equipment manufacturers and Robots

Source: NDTherm

- Projects (Nationally, Internationally)
  - Participants:
    - OEM's (Airbus, Boeing)
    - MRO organizations (KLM, Lufthansa Technik, Singapore Airlines, Klu)
    - Manufacturers of systems and equipment (Olympus, GE, Sonatest, Dantec, KuKa, Genesis)
    - Research Institutes (TNO, NLR, TU Delft)
    - Supporting Companies (TiaT)
  - Funding:
    - Government
    - And above-mentioned parties (partially)

# Ultimate Goal

- Automated check for damage of the complete fuselage and wings of a modern type of Aircraft (Airbus A350, Boeing 787) in a time and cost effective way.




# Consideration

- Above-mentioned projects are important.
  By further development and innovation of our Aerospace NDT for MRO we assure our position on the global market for the longer term.
- Future Aerospace MRO requires a more global approach through international cooperation
- Robotic Inspection Systems can also be used for other tasks (paint stripping, painting, etc.) and visa versa.

Thank you for your attention.

Questions?