SHEAROGRAPHY – A FAST AND FLEXIBLE NDI TECHNIQUE FOR COMPOSITE MATERIALS NEW APPLICATIONS IN VARIOUS INDUSTRIES

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Abstract

Modern hi-tech products today widely are made of composite materials, which are specifically designed for the purpose of their application. Other than a precise knowledge of the characteristics of these materials, which often are anisotropic, quality control is of the essence. As said components, e.g. in aerospace, aircraft, or also boat industry and other thriving industries such as wind power industry are safety relevant, and also of great economic value, rapid defect recognition has to be carried out in production as well as in maintenance.

Shearography is a full field inspection technique, which is specifically suited to do fast defect detection. It is widely accepted as a reliable and fast inspection method especially designed for modern composite material.

Latest generation of Shearography technique and software are presented and the potential is outlined.

Different challenges are presented in production control and in maintenance, specifically in Aircraft and Wind Energy.

Keywords: Shearography; Optical Measurement Techniques; NDI; NDT; Composite Materials; Wind Power Rotor Blades
Non-Destructive Inspection With Shearography

- Technique to identify defects in almost any material
- Slightest surface excitation leads to surface deformations from the internal flaws
- The shearography system can detect these very small deformations
- Full-field, non-contact technique
Which materials can be tested?

- CRFP
- Glare
- Honeycomb
- Laminates
- Foam
- etc.

Boeing: Q-810
EADS: Q-810

Honey Comb Carbon Fibre Fabric
On the field:

Different Curvatures Available for non flat surfaces

Applications: Mobile Inspection

- Quality control in aircraft assembly
- Service inspection on aircraft wings
- NDT Expert Quality control in marine racing manufacturing
Shearography on Yacht

Verification of plug sample repair

Large Area scanning on Curved surfaces

Application Example of Portable Inspection Hood

Shearography inspection on AWACS
Royal Airforce UK, Inspection of Radome

SR Technics

Inlet fitted to engine Prior to test
SR Technics

Creates an enclosed out-of-plane inspection system to detect weaknesses in the composite sandwich construction.

Q-800 Portable Shearography System
Applications

• In-field use of large area NDT inspections

• Delaminations, Disbonds, Kissing bonds, Wrinkles, Impact Damages, Crushed Core

• Defect detection in Composite Materials CFRP, GRP, Laminates, Honeycomb, etc.

• Inspect structural integrity, Separation of Structural Components and Bond Lines.

Features

• Rapid full-field inspection rate

• 300 mm x 200 mm every 10 seconds.

• Adaptive seals for usage on highly curved surfaces.

• Operates independent of the local environmental conditions and can be used for production or in-field inspections
Jet Engine Abradable Seal Inspection

Pratt & Whitney

• PW 4000 jet engine
Aerospace- Phenom 100

- Composite Elevator
- Decrease inspection time
- Avoid soaking part with water (UT)

Rivet pattern around hinge
Embedded defect

Aerospace- Heavy Lift Helicopters

- Wooden blades
  - Very hard to inspect
- Rubber coating
- Cracks
Aerospace- Predator program

- Approved by USAF Predator program
- Heavy landing and impact damage

Calibration Standards

- Most Calibration Standards can be used
  - Some simply unsuitable for shearography
  - e.g. Bonded in UT reflectors ☘
- Must be representative of real part
  - Active loading vs thin panels ☘
- Must be ‘real’ weaknesses
Aerospace - Defect Examples

- Delaminations on bonded cork
- Contamination in production

Production Inspection: ARIANE 5

- Shearography inspection of composite materials
Robotic Inspection System

- Inspection of heat protection parts of booster support structure
- Industry robot for flexible application
- Combined vacuum and heat loading for different material combinations

Repair of composite material
Time Average Acquisition

Eurocopter
Eurocopter

Shearographic Measurement
Duration: 1 minute

Benchmark Performance

Helicopter Structural Element Panel (80x80 cm²)

Mechanical Impedance Test
Duration: 2 hours

80 cm
Robot Shearography NDT

- Manual NDT inspections are no better than the daily shape of the operator
- today’s aerospace composite subassemblies becoming more complex, the NDT systems used need to be more sophisticated.
- This also forces the NDT inspection methods to become contactless to be able to achieve a high inspection quality and speed.
- With Dantecs ISTROB Systems
- Speeds of 1m²/ minute is possible

Automatic Robot System for Aerospace Delivered Fall 2008
Automatic Robot System for Aerospace

Robotic Inspection system

- Robot installation, control room and new measuring head
- Combination of thermal and vacuum loading
Results

Part with defects

Part with no defects
Standard Q-800 System

Q-800 Shearography Sensor for various applications in production or in-Field

• Variable field-of-view
• Lightweight
• Compact design
• Any excitation method

For most materials no surface preparation required

Q-810 Vacuum Hood System

Q-810 portable Shearography System for applications in production or in-Field Service

• Large area coverage (15sqm/hr)
• Hood mounted touch-screen monitor
• Thermal and vacuum loading
• Lightweight
• Long cable connection >20m
New Up-tower Sensor mounting system

- Mil-Connector for Q-800 sensor with up to 8 LDs and Digital interface for Heat Control
- Lightweight mounting frame for sensor and heat lamp
- Vacuum cups with ball-joints
- Shrouded for wind and sunlight

New System for up-tower inspection with ropes

- Pelicase with Mil Connectors, Water and Dust proofed (IP 65)
- Ruggedized Magnesium Laptop IP65 and MIL-STD 810G
- 14" Sunlight Readable screen
- Shock and Vibration damped electronics
- Size: 52.4 x 42.9 x 20.6 cm³
- Weight: 16 kg incl. Notebook (35lbs)
- One button: Pre-defined recording routines
Our Shearography Customers

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Thank you for your attention!

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