Eddy Current Array for Rivet Hole Inspection

Pairing Speed, Efficiency and Reliability

Alain HADDAD, Jr. Eng.
aelhaddad@eddyfi.com
AGENDA

- Rivet hole inspection
- Our solution
- Performances
- Solution advantages
Rivet hole inspection
RIVET HOLE INSPECTION

Context

• Rivet assemblies represents the main fixation system for aeronautic and aerospace structures.
• Lifetime affected by stresses leads to small cracking initiated in the rivet holes

Objective

Provide a new inspection solution using eddy current array techniques while pairing speed, efficiency and reliability
INSPECTION REQUIREMENTS

Client requirements

• Multi-layer of aluminium plates with a hole length range from 0.12 to 0.7 inches
• 0.5 inches hole ID with 100 mils variation
• Detection of axial cracks with the smallest crack having 80 mils Height x 20 mils Depth

Challenges

• Rivet hole geometry and restricted access
• Flaws located mainly on the layer transition
Our complete solution
OUR SOLUTION

A complete acquisition chain (probe, instrument and software), that is rapid and simple to deploy and answers the industry’s need

Probe : Rivet hole ECA probe

EC instrument : Reddy

Acquisition and analysis software: Magnifi
CUSTOM ECA PROBE

Configuration – Differential mode

• Coils are physically placed side-by-side
• Coils are excited and sensed at the same time
• One coil connected to positive input and the other to negative input
CUSTOM ECA PROBE

Signal response and advantages

- Signal from the subtraction of two sensors
- Double loop for each defect detected (8 shape)
- Very sensitive to short defects and provides a high signal-to-noise ratio
- Unaffected by gradual variations similar to lift-off, layer transition
CUSTOM ECA PROBE

Mechanical solution

- Adapted spring-loaded shoe
- 360-degree probe rotation
- Custom holder for a stable scan
- Encoded scans
- Easy-to-repair probe head
- Optional ceramic shoe for better durability
CUSTOM ECA PROBE

Coil arrangement

- Total of 46 coils generating 23 channels as for client’s request
- Probe total coverage of 0.8 inches that can be increased if required
- Coil OD 60 mils centred at 1MHz with frequency range from 500 - 1500KHz
EC INSTRUMENT

Reddy ®

Proposed solution is compatible with the Reddy instrument
ACQUISITION AND ANALYSIS SOFTWARE

Magnifi overview

• Intuitive user interface
• Assisted analysis
• Automatic reporting
• Full data traceability
Performances
TEST SAMPLE

Sample composed by 3 layers having 8 rivet holes
TEST SAMPLE

Defect size
80 mils H x 40 mils D

Defect size
80 mils H x 40 mils D

Defect size
80 mils H x 20 mils D
QUICK DEMO
RESULTING DATA IN MAGNIFI

One defect identified in rivet hole #2

Indication boxes
Layer transition with C-scan grid
2D C-scan view
3D C-scan Front view

Hole length

80 mils H x 40 mils D

Alarm gates
Lissajous view
Mini-stripchart view
RESULTING DATA IN MAGNIFI

Two defects identified in rivet hole #4

80 mils H x 40 mils D
80 mils H x 20 mils D
Solution advantages
FAST INSPECTION & AUTOMATIC REPORTING

Scan performed

Dedicated ECA probe

High speed – Single pass

Analysis

Auto defect detection with alarm gates

Automatic reporting

One click report generation

Typical inspection workflow

Rivet Hole inspection
POWERFUL SOLUTION

- Human controlled factor
- Dynamic acquisition with integrated encoder for defect localization inside the hole
- Single-pass covering the full length of holes
- Unaffected by layer transition and very sensitive to small cracks initiating from this transition
- Very high signal-to-noise ratio (SNR)
- Can be adapted to a wide range of hole OD
Thank you