

Eddy Current Array for Aircraft Engine Component Inspection

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Agenda

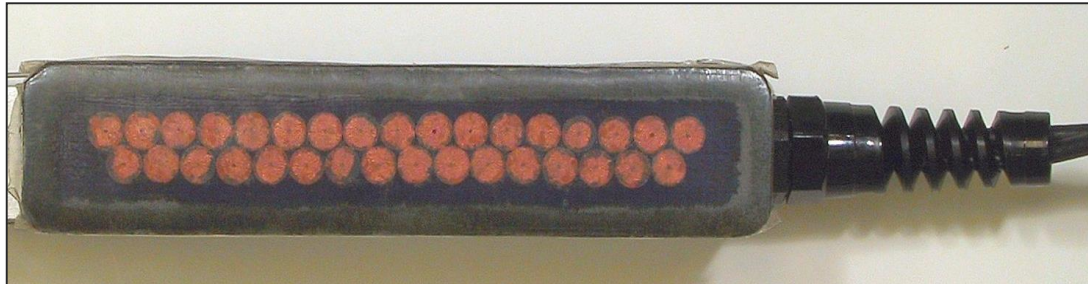
1. Eddy Current Array (ECA) Technology
2. ECA Equipment
3. Engine Applications
4. Conclusion



Eddy Current Array Technology

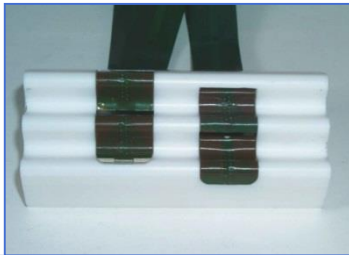
Eddy Current Array Principles

- ECA is a technology based on the ability to ***electronically drive several eddy current sensors*** placed side-by-side in the same probe assembly
- Data acquisition is performed by ***multiplexing the eddy current sensors***
- Most eddy current probes and techniques (absolute, reflection, etc.) for flaw detection can be used with eddy current array probes

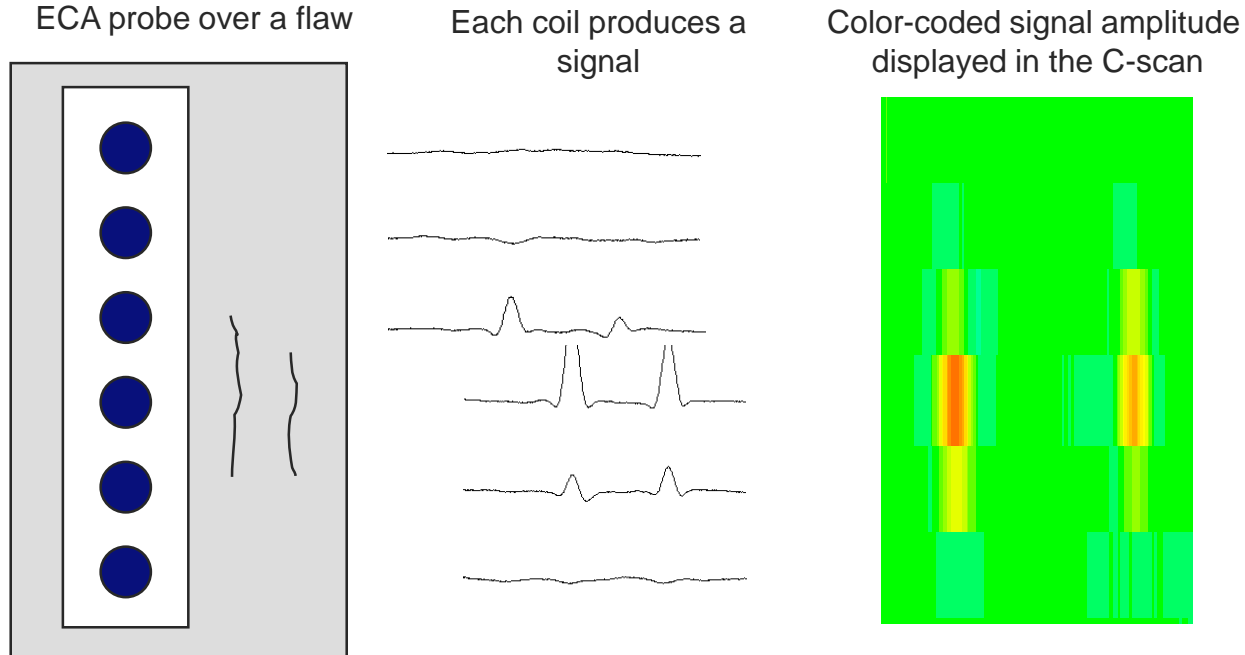


Eddy Current Array—Advantages

- Provides larger coverage in a single probe pass while maintaining high resolution
- Improves flaw detection and sizing with C-scan imaging
- Enables inspection of complex shapes with probes customized to the profile of parts

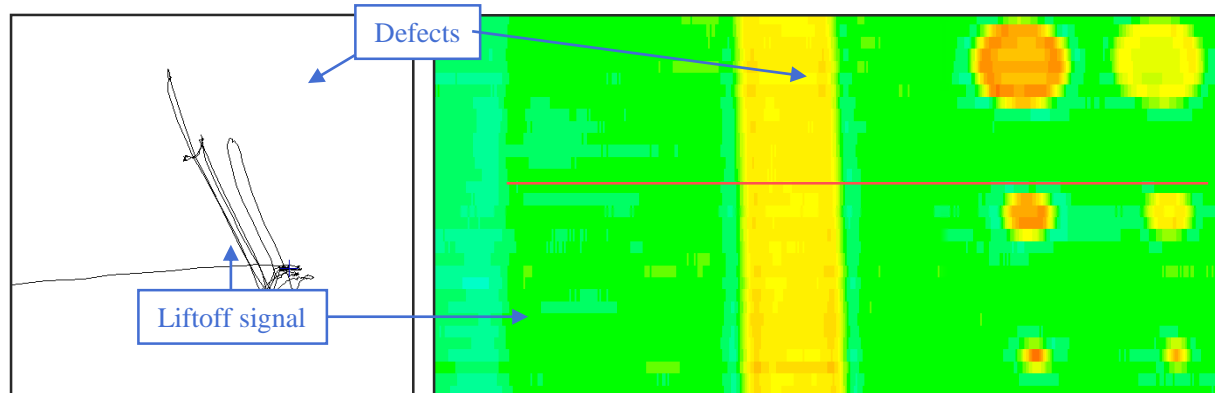


ECA – Signal Representation



ECA – Signal Representation

- The C-scan can display either the vertical or horizontal component of the signal in the impedance plane.
- In the example below, only the vertical component of the signal (Y axis) is displayed on the C-scan, ensuring that all defects are clearly shown. The phase of the signal was adjusted so the liftoff signal is in the horizontal plane (X axis).



Eddy Current Array Equipment

General Hardware Features

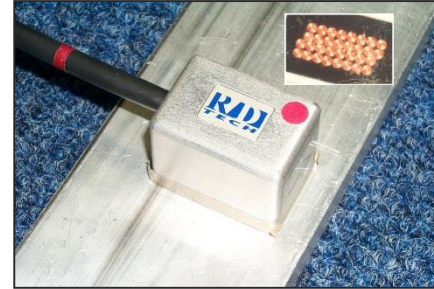
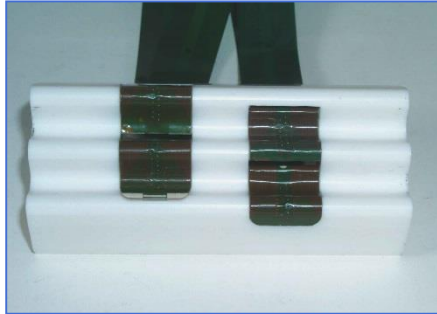
OMNI-P-ECT4

- Conventional ECT only
- 4 input channels
- Frequency ranges from 20 Hz to 6 MHz
- Dual frequency operation
- 2 encoder inputs
- 3 alarm outputs
- 1 analog output



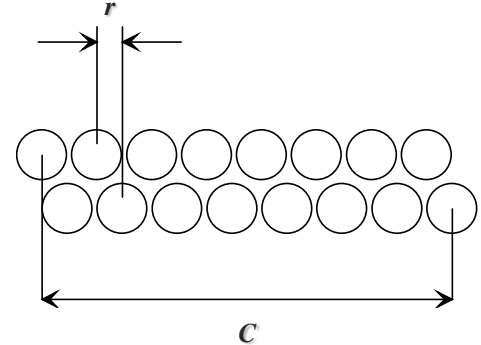
ECA Probes

- Can be optimized for different applications
- Can be shaped to the part to inspect



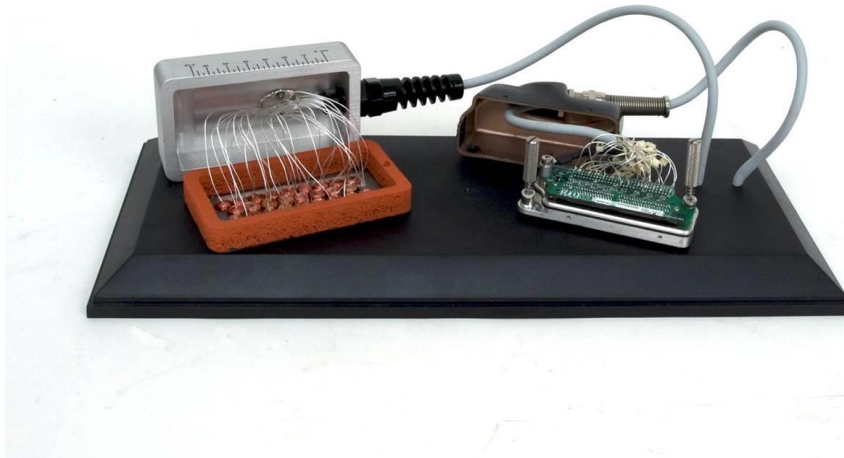
ECA — Probe Parameters

- Frequency (f)
- Number of elements (n)
- Resolution (r) (also depends on the coil configuration)
- Coverage (C)

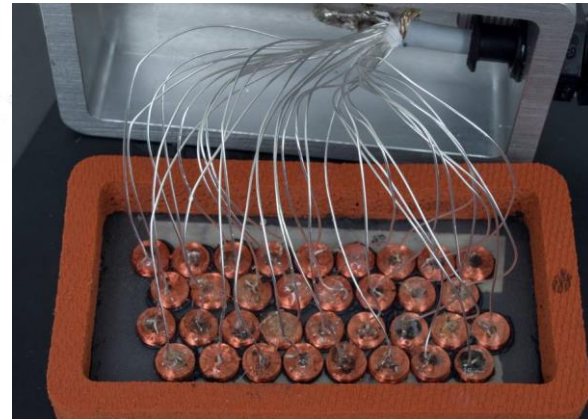


Example of an absolute bridge probe

Inside an ECA Probe



- Hard coils
- Many wires
- A lot of soldering
- Labor intensive



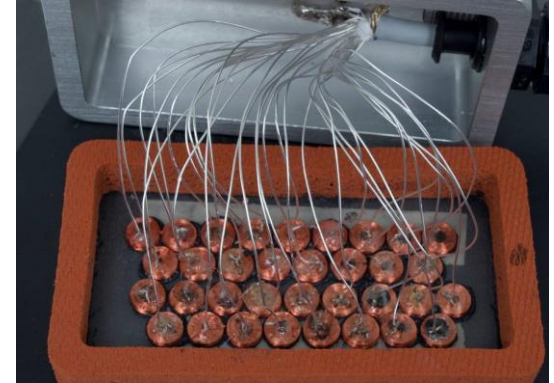
ECA Hard Coiled Array VS Printed Circuit Board (PCB) Array

Traditional hard coil sensors

- Pros:
 - Different type and size of coils
- Cons:
 - Time consuming
 - Repeatability and coil matching
 - Expensive

Flexible array on PCB film

- Pros:
 - Excellent repeatability and coil matching
 - Versatility, i.e., can be attached to holders of different shapes
 - Affordable price
- Cons:
 - Price/time for the initial film



Engine Applications

Dovetail Slot Inspection — Current Method

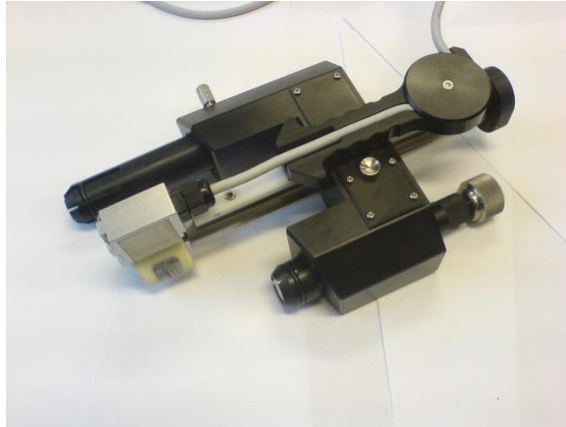
- Manual tooling
- Scanner with eddy current pencil probe
- The operator must perform 40 line scans
- Time consuming
- Operators complain of discomfort



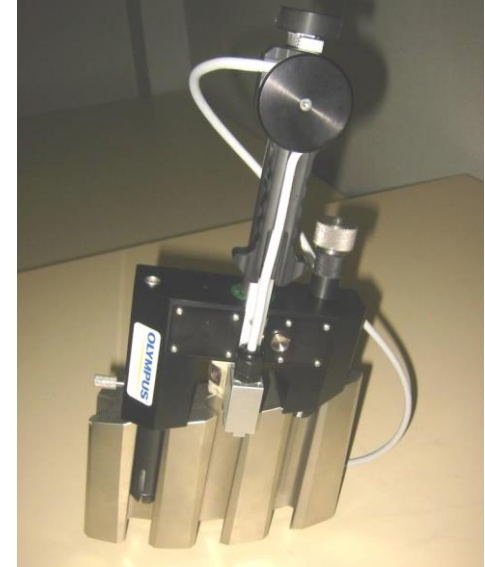
Engine Disk Dovetail Slot Semiautomated Inspection



- 32 coils cover critical zones



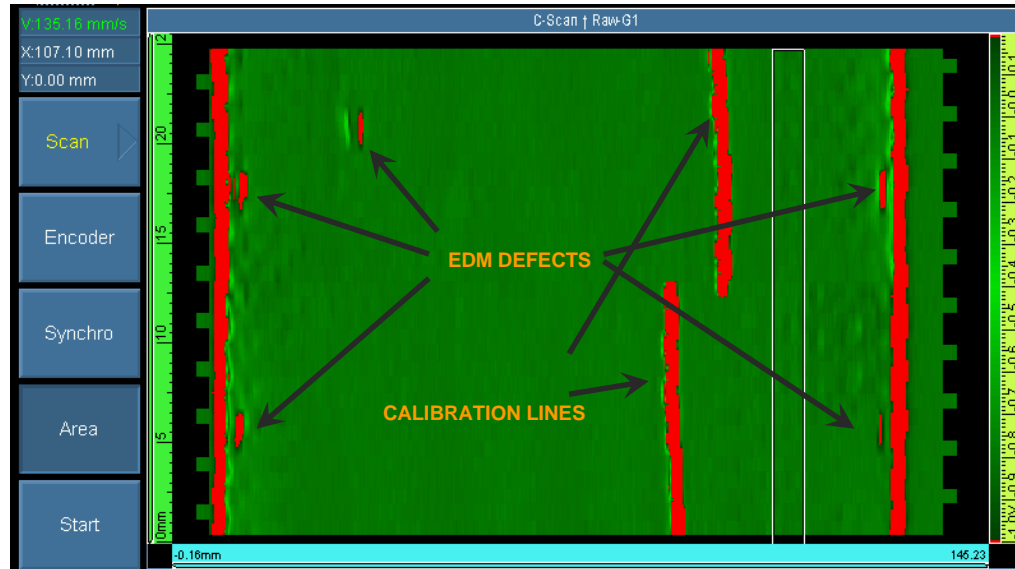
- Probe mounted on portable scanner



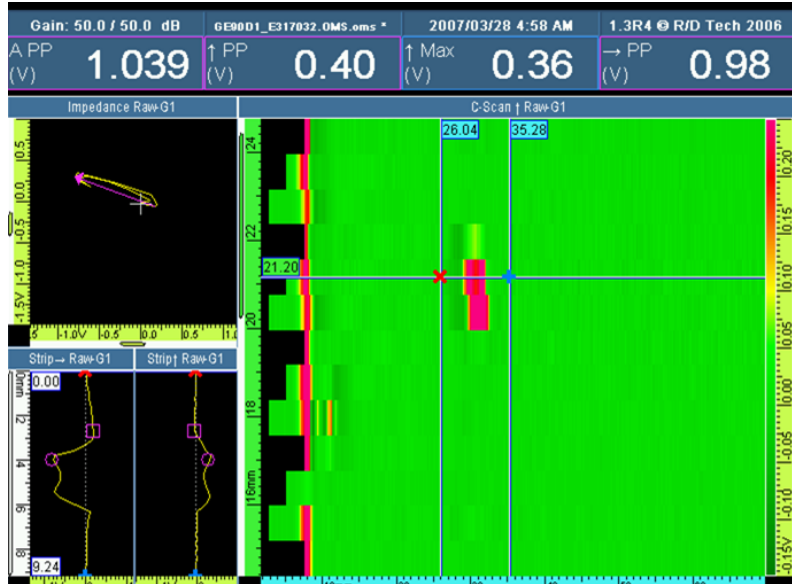
- Scanner in position

ECA Engine Disk Dovetail Results

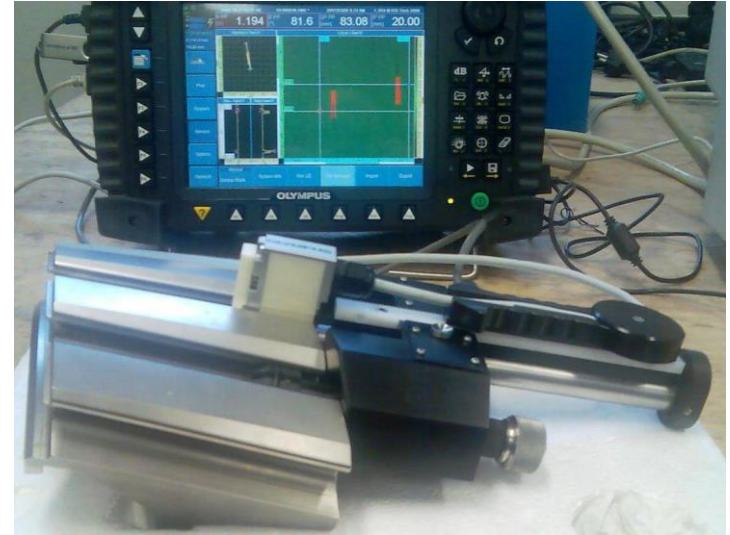
- C-scan displaying EDM and calibration notches in the calibration standard



ECA Engine Disk Dovetail Results



C-scan of an EDM notch: 1.5 × 0.7 × 0.1 mm



New Engine Disk Slot Inspection System



Scanner improved with OmniScan®
flaw detector remote control

Engine Fan Blade Inspection



Engine Fan Blade Inspection Solution — Development Process

Stage 1: Manual inspection



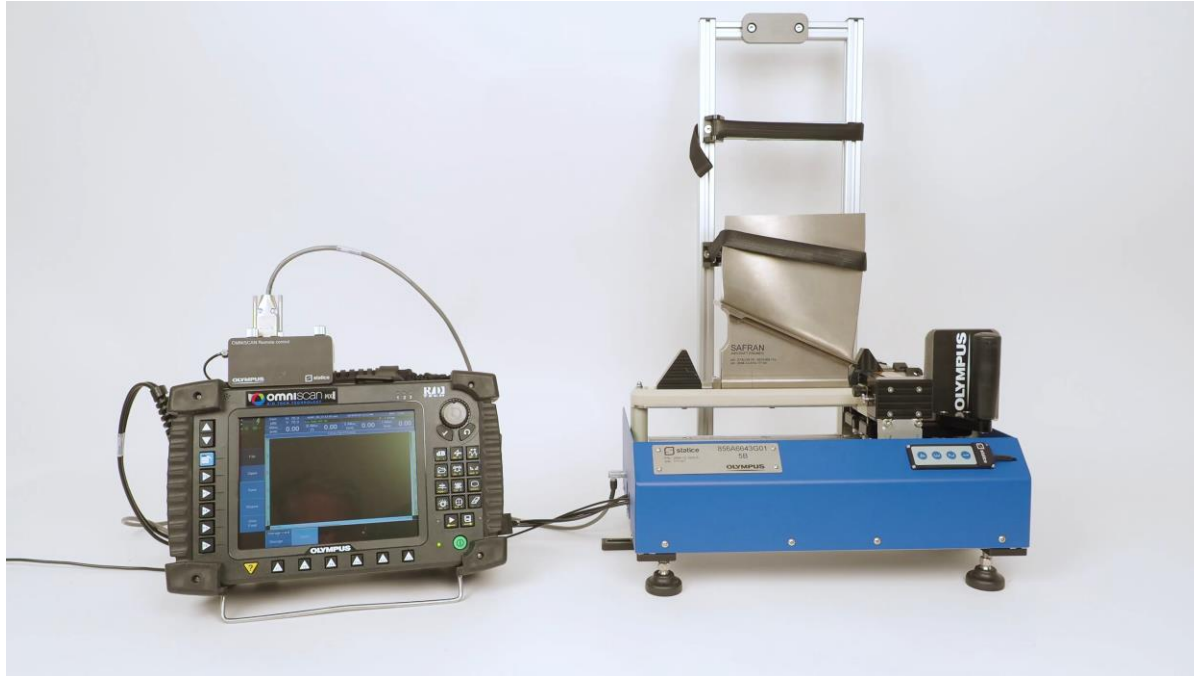
- 2 passes:
 - 1 convex side
 - 1 concave side
- Wire encoder

Stage 2: Semiautomated inspection



- Single pass, convex and concave sides
- Encoded scanner

Semiautomated Fan Blade Inspection Solution



Conclusion

ECA Advantages for Aircraft Engine Inspection

- ECA probes cover large areas in a single pass
 - Improved Probability of Detection due to full coverage and C-scan imaging
 - Probes can be adapted to the complex shapes of components
 - Flexible ECA can be used interchangeably with probe holders of different shapes
 - Can be used on-site for aircraft engine component inspection during maintenance
 - Referenced in procedures for aircraft and engine maintenance
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OLYMPUS[®]

The logo features the word "OLYMPUS" in a bold, dark blue, sans-serif typeface. A small registered trademark symbol (®) is positioned at the top right of the letter "S". Directly beneath the text is a horizontal orange line that tapers at both ends, creating a stylized, elongated shape.