EDDY CURRENT ARRAYS

A major leap for reliable measurements over conventional surface NDT methods used in aerospace industry.

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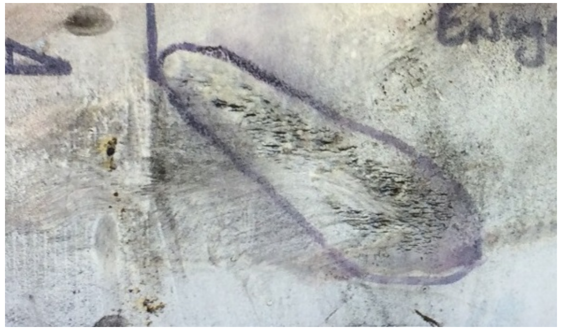
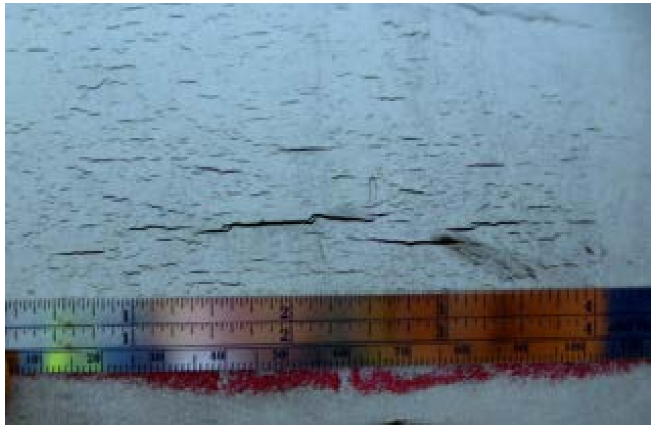
Summary

- Traditional Methods – Advantages and limitations
- ECT – Basics
- Single Element ECT – Advantages and limitations
- ECA VS ECT
  - How can ECA help the aerospace industry
    - Reliability, repeatability, automation, customization, data recording, etc.
  - Some examples of application where ECA brought inspection to the next level

Traditional Methods



- Penetrant Testing and Magnetic Testing
  - Surface breaking cracks
  - Cheap, easy to apply, quick to analyse, high sensitivity and resolution
  - No depth estimation, requires surface preparation and chemicals, limited reporting, operator dependent
- X-Ray
- Visual



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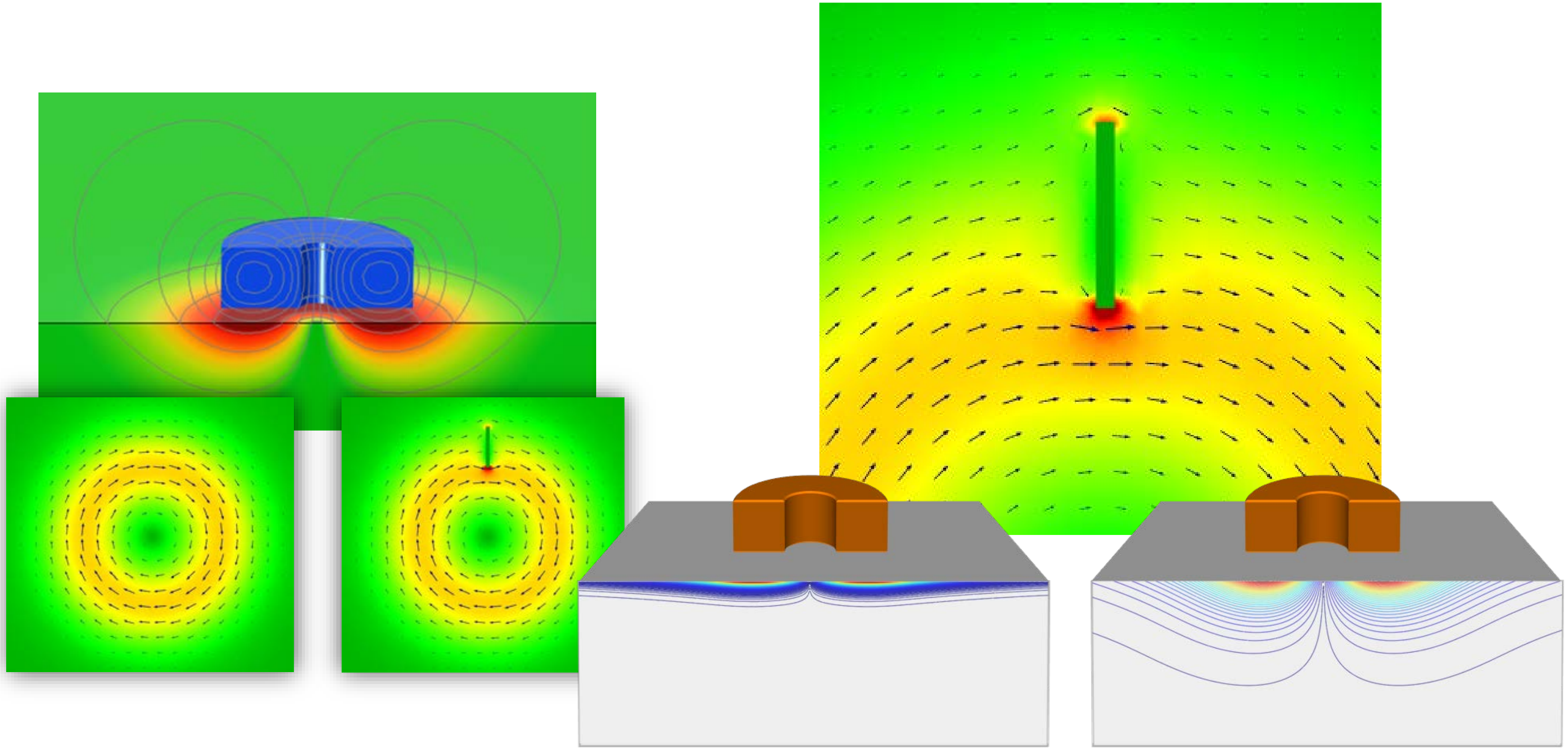
ECT - A FIRST STEP

ECT Basics: ECT Principles

- Disruptions of the induced current in a conductive metal



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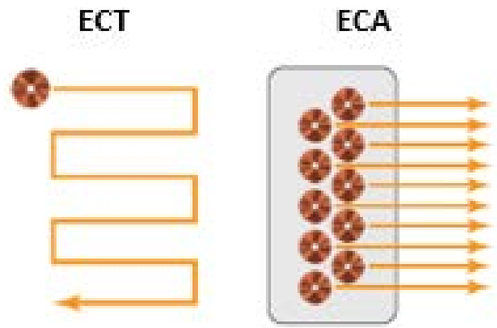
ECT – Single element probes

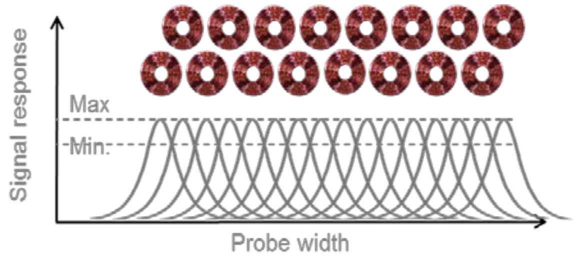
- ECT can be used for:
  - Part’s condition (corrosion, cracking, etc.)
  - Coating thickness monitoring
  - Material sorting
- Advantages over traditional methods:
  - Faster
  - Data recording
  - Less than traditional technique, but still highly operator dependant
  - No or few surface preparation

ECA – A MAJOR LEAP

ECA – How it works

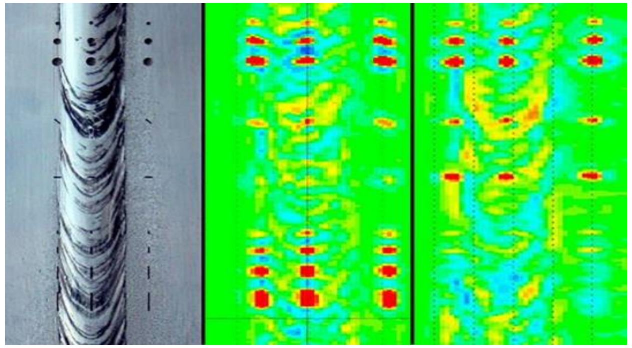
- ECA uses same technical principles than ECT
  - Measures the disruption of the induced current into the conductive material
- Only, it is done with an array of elements, which are activated according to a specific sequence
  - Provide multiple measurement per second
  - Sequence is designed according to material under test, flaws to be detected, etc. → optimized
  - The capacity to detect submillimeter cracks and flaws up to 10 thou/250µm in size
  - Up to 256 channels, in fully optimized configurations (# of coils/channels will depend on the topology used – Imp. Absolute, transmit/receive, etc.)
  - A scan speed of up to 24 in/sec (up to 600 mm/s)



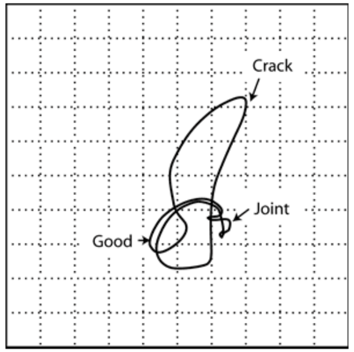


ECA – Advantages

- Larger coverage – shorter inspection time
- Improvement and simplification of the analysis process using the C-scan imaging and ongoing development of new software tool to ease the analysis
- Capability to design dedicated sensors for complex geometry
- Easier integration in automated systems



VS



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ECA – High level of customization available

- Advances in electronics enabled tailoring probes to specific applications
  - Tailored coil designs and multiplexing patterns
  - Optimization of the acquisition chain
  - Advanced data processing
  - State of the art imaging
  - Data archiving
- Dedicated mechanical designs
  - Complex geometry
  - Hard to reach area

ECA in the aerospace industry

- Which inspection could be optimized?
  - Wings
  - Wheels
  - Rivets
  - Fuselage
  - Engine blades and blade’s roots
  - Dovetails
  - Landing gear shaft
  - Etc.

Example of applications

- Automated inspection - The robot select and connect the right probe to:
  - Measure conductivity changes in casted wings

  or
  - Detect flaws in aluminum casted wings with ribs
    - Inspection of the area between the ribs (variable geometry) and static measurements on the ribs themselves.

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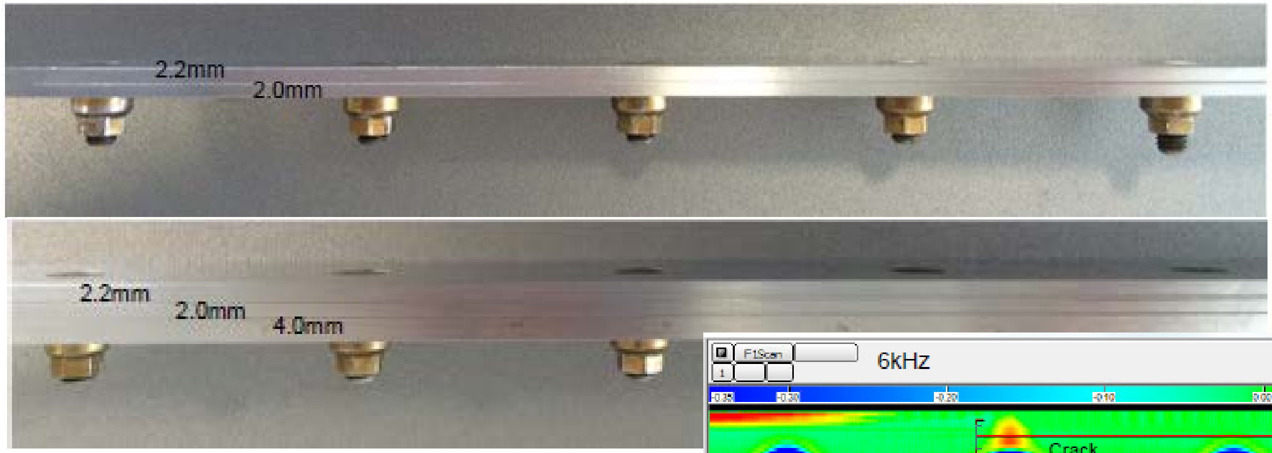
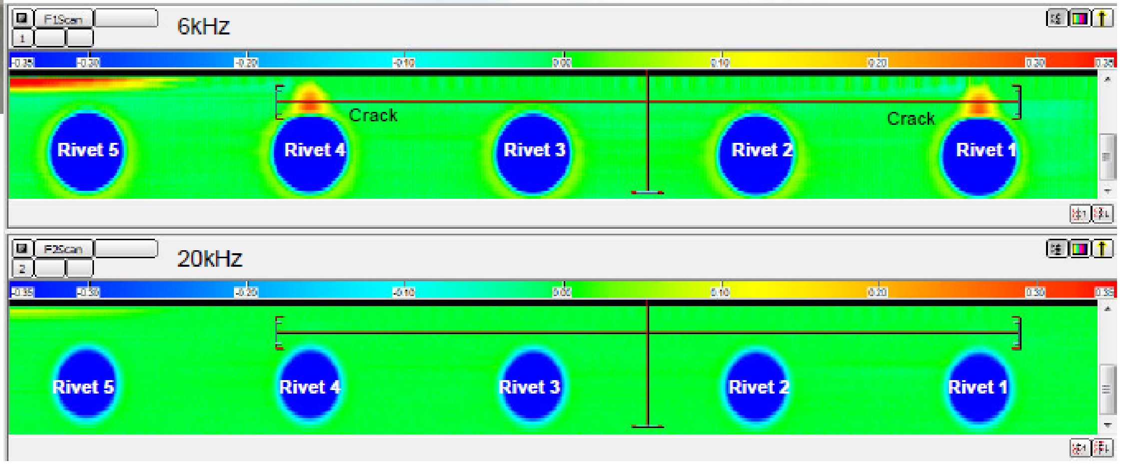
Example of applications

- Detection of cracks in riveted 2 or 3 layer aluminum stacking
  - Inspection from the top face of the 2.2mm layer
  - Cracks located in the 2.0mm layer, in rivet #1 and 4)





Example of applications

- **Detecting incomplete penetration** along the axis of FSW and other defects.
  - IP in this application are 1.5–2mm (0.06–0.08 in) long, while the FSWs are 9.1m (30 ft) long.
  - FSWs are also prone to: • Short axial and transverse cracking • Axial and transverse cracking in concavities from overgrinding
  - The Solution? A high-resolution probe with enough ECA channels to reliably detect very small incomplete penetration
  - The Benefits Significantly faster and more reliable detection than with previous inspection methods, without surface preparation in a single pass.
  - This solution takes the four-and-half-day PT inspection down to a fully documented six-hour inspection replacing both PT and PA UT.

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Example of applications

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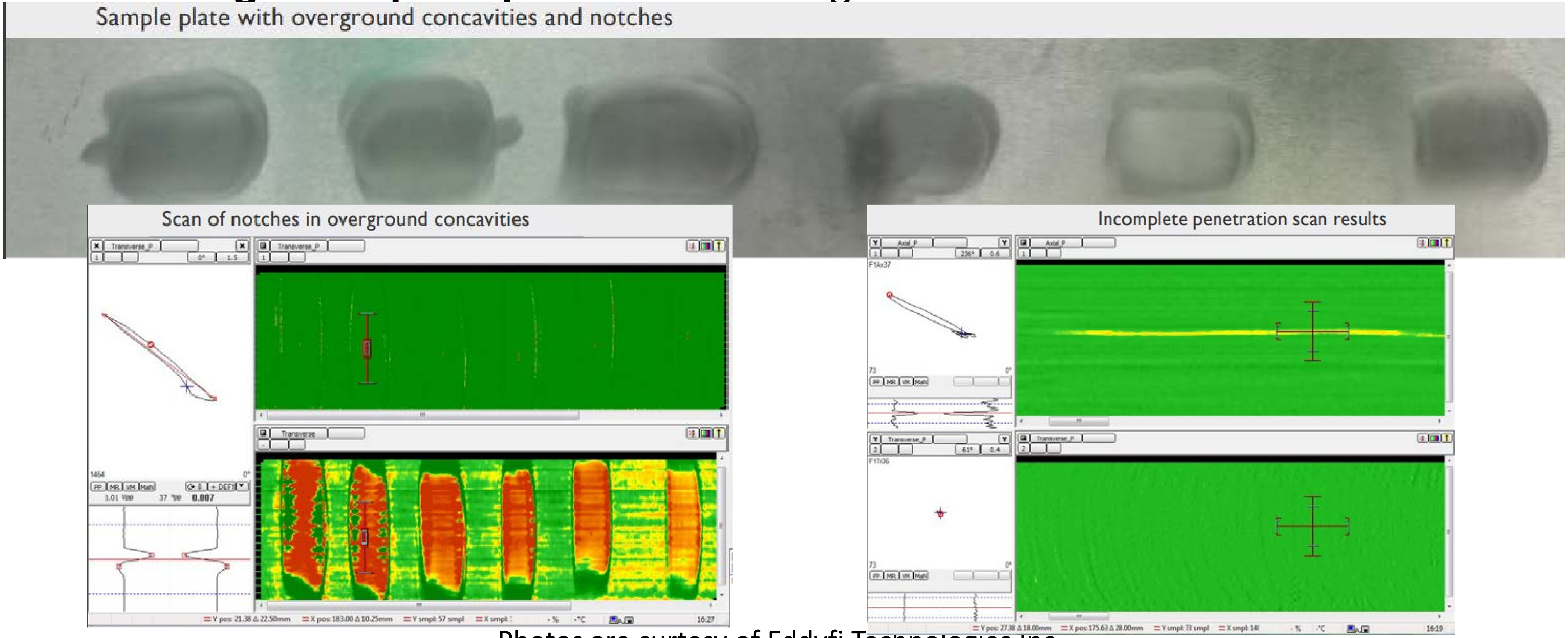

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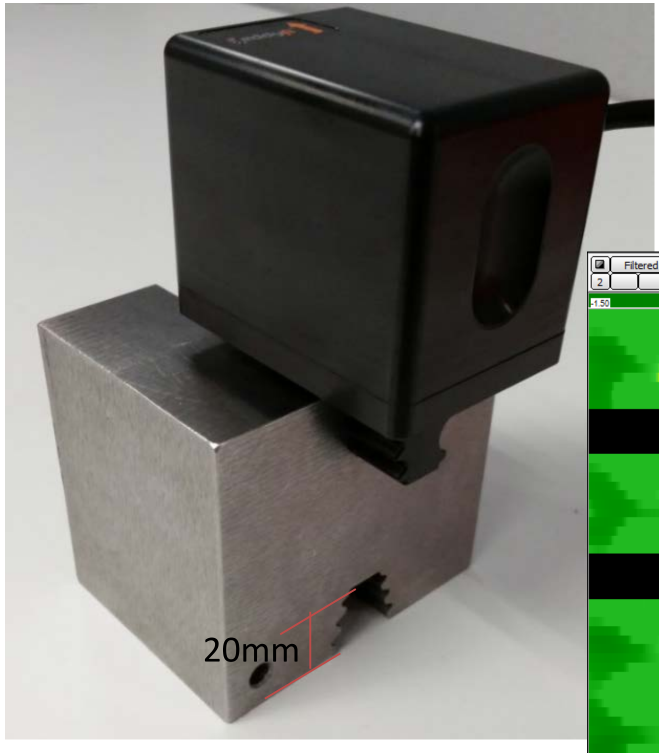
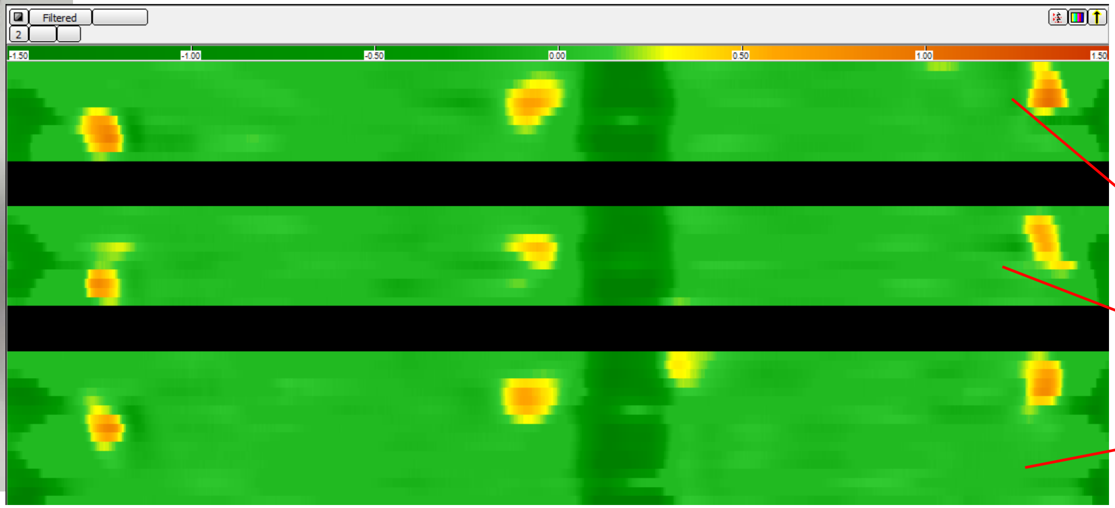
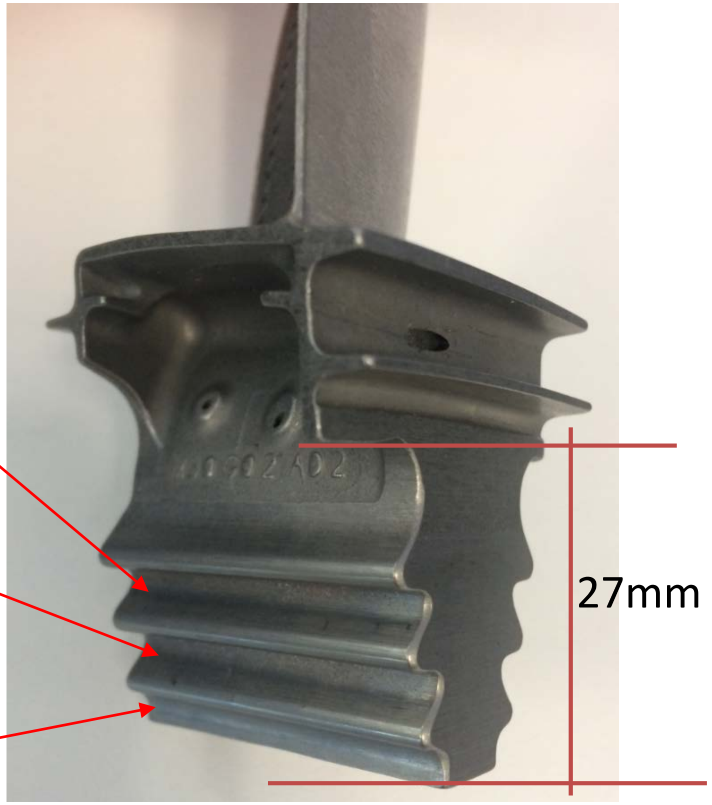
Example of application

- Dovetails and turbine blade's roots







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