ICNDT

The World Organisation for NDT

Education Gaps between Level 3 and Advanced Technology

- What is the Education of a Level 3 certificate
- How do Level 3 Trainers gain their knowledge in advanced NDT technology

20th WCNDT – Incheon Friday 31st May 2024

Presented by: Colin Bird, ICEC Secretary

31 May 2024

Who Trains the Trainer For New Technologies

- How do NDT technicians and trainers gain and maintain emerging and advancing technology.

- Who is teaching FMC, PCI, Array Electromagnetic techniques, Long Range UT, highly processed thermographic imaging techniques, digital radiography image processing, etc.

Training/Knowledge and Certification Gaps

Level 1 – A person who follows a written set of instructions with no deviation allowed. They calibrate and collect data.

Level 2 – A person who can write a written instruction from an approved procedure, perform an inspection and analyse the data,

Level 3 – A person who can interpret a standard and write a procedure analyse data and act as a supervisor.

NOTE Level 3 qualification does not mean that they can write standards, develop inspection methods, write technical justifications or design qualification strategies. They are examined almost at the same level as that of Level 2 technicians but in more subjects and a slightly wider range of questions.

Training/Knowledge and Certification Gaps

- Some level 3s have further education to degree level and have development experience but not the majority.
- Their physics and mathematic knowledge can be missing making it more difficult for them to self develop with new technologies.
- If Level 3s do not necessarily have the ability to do or understand statistical analysis how can they qualify or test the reliability of new and developing procedures and equipment.
- I have heard too many NDT Level 3s state “I can detect these defects” They mean they have made a test block with a slot or side drilled hole in a component and they found it already knowing the target was there.

Examples of Highly Processed Data

- FMC is one of a number of Array data capture methods
- TFM is one of a number of many data processing methods for FMC type data.
- Ultrasonic Phase correlation v colour displays are also offered by at least two instrument manufacturers.
- Eddy-current Array techniques and signal processing,
- Flux Leakage
- Long Range UT
- Visual with image processing
- Digital imaged radiography

Correct Use of New Electromagnetic Technologies

What are we taught.

How to use a single probe.

The shapes of the electromagnetic field for a single coil.

Depth of penetration for a single coil.

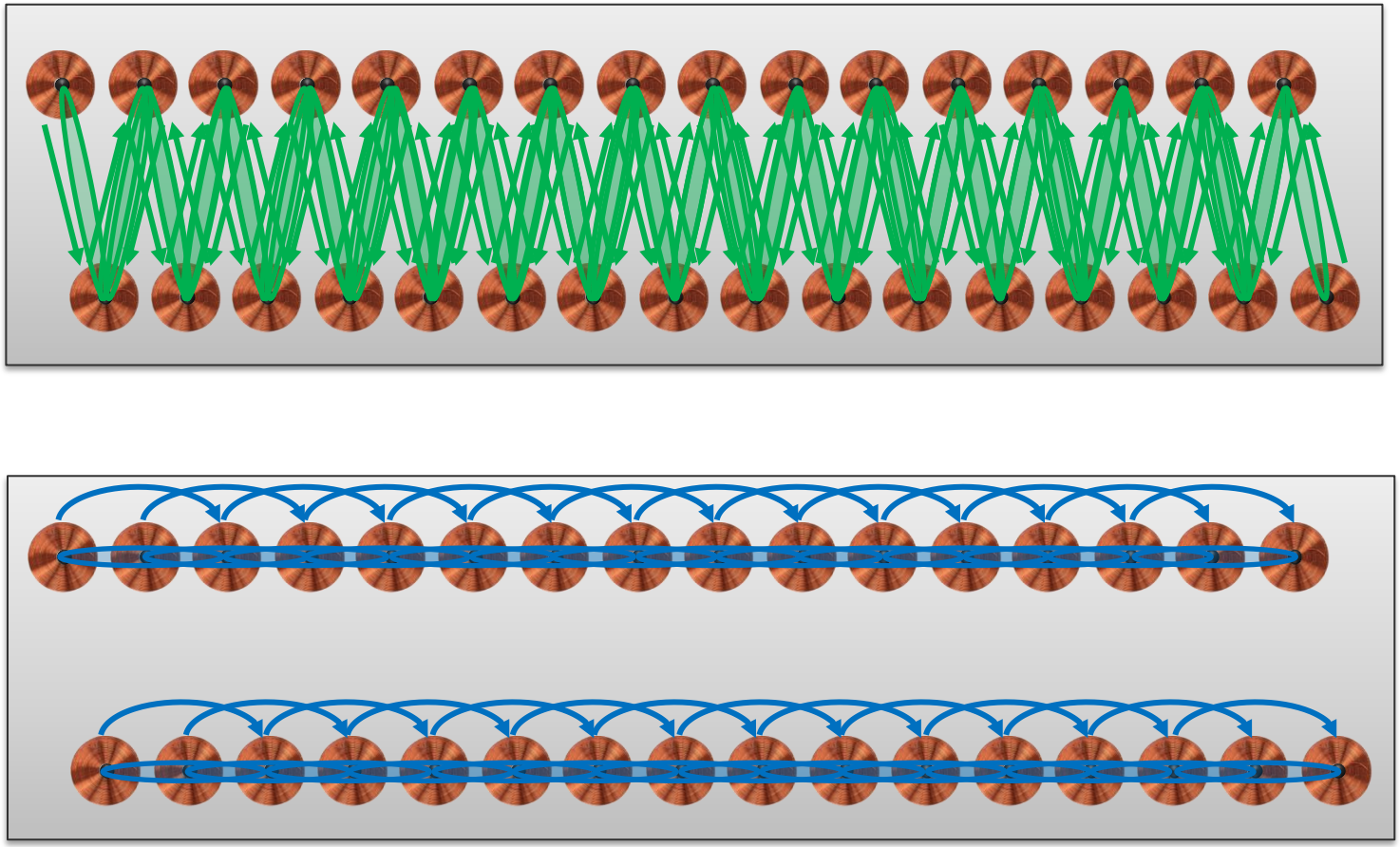
Lift-off for a single coil.

Data analysis. AI. It is already deployed in tube inspection.

How is the AI developed and what are its limitations. Level 3 ?

Arrays DO NOT behave like single coils the field patterns are more complex. The coils can be absolute pitch catch or pitch catch tangential (Shark). What direction is the magnetic field in. what is the effect of liftoff, what is the depth of penetration. Depth of penetration v coil separation and orientation. Minimal application standards for arrays – Level 3?

EC Array Patterns

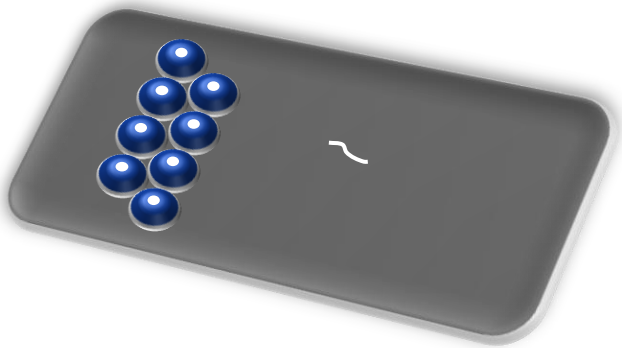


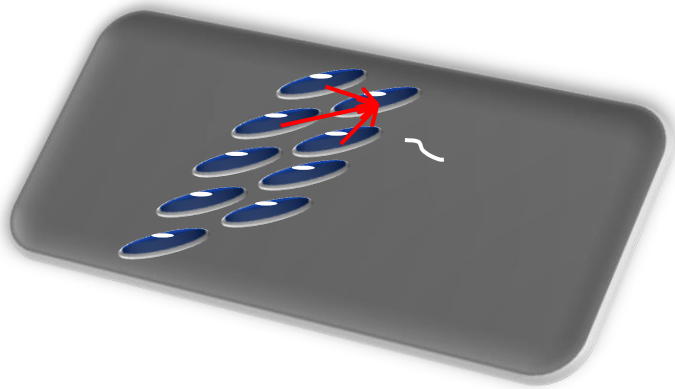
ICNDT
The World Organisation for NDT

Examples of Advanced NDT Technology

Eddy Current Coil Orientation.

When it is simple pancake coils we understand the field shape but some arrays the coils are orientated 90 º. To the plane



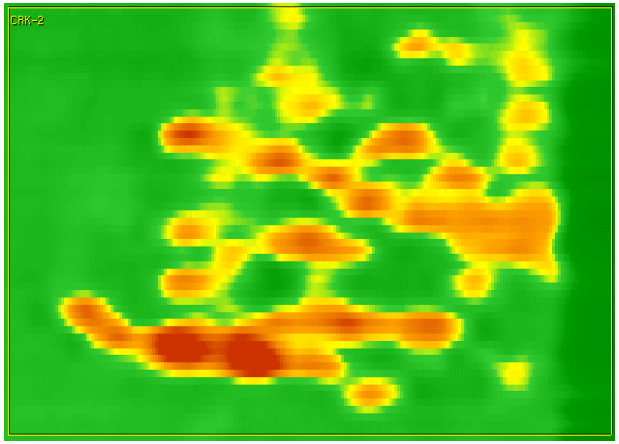


What are the field shape and what is the effect on depth of penetration.

These are good developments but the technicians are not taught the effects of the change and therefor do not understand the effect on defect detection.

Examples of Advanced NDT Technology

Array Eddy Current for SCC Detection – Replacement for MPI.

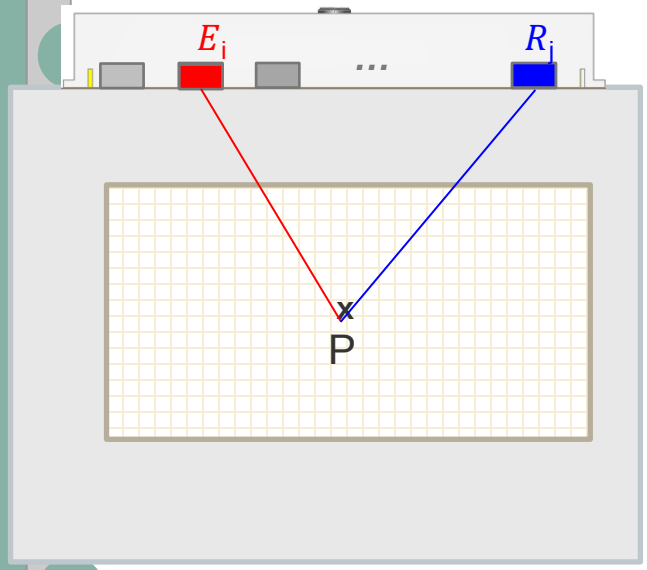


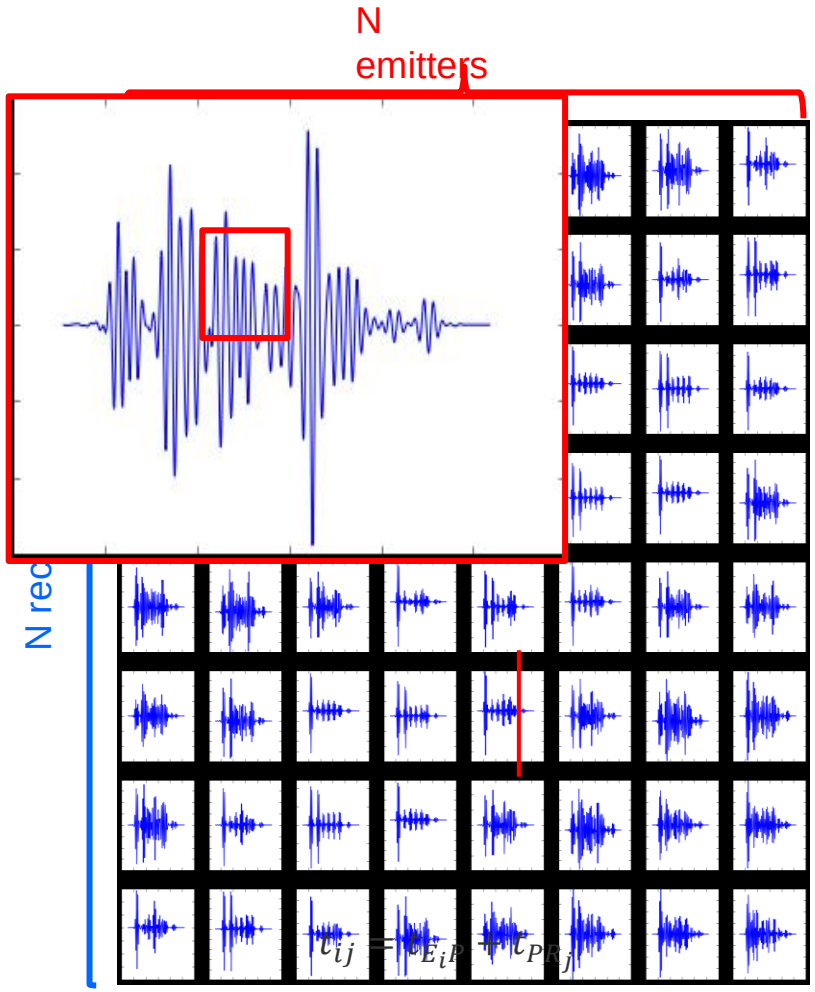
Ultrasonic Arrays FMC

- What are we taught.
- How to use a single probe.
- The shapes of a single beam of ultrasound.
- Beam spread.
- Near Zone.
- Ultrasonic FMC data DOES NOT necessarily have a near zone. Level 3 ?
- Ultrasonic FMC data DOES NOT necessarily have a beam spread, Level 3 ?
- It does NOT have a single direction.
- There are NO standards detailed enough to write a procedure from. Level 3 ?
- We are taught about normal incidence detection of defects. (Semi taught).
- What is the amplitude relationship of array ultrasound with range. **It is NOT 6dB double distance. You cannot do 6dB sizing.**
- Scattering matrix plots ?

Ultrasonic Array – Alternate Signal Processing

Full Matrix capture and Associated Signal Processing Methods

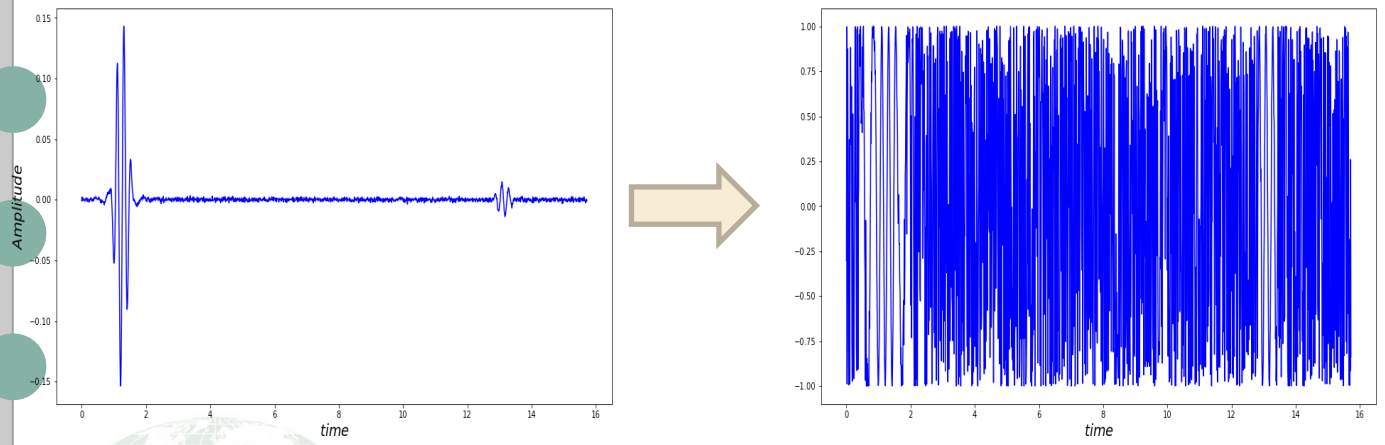




Ultrasonic Array – Alternate Signal Processing

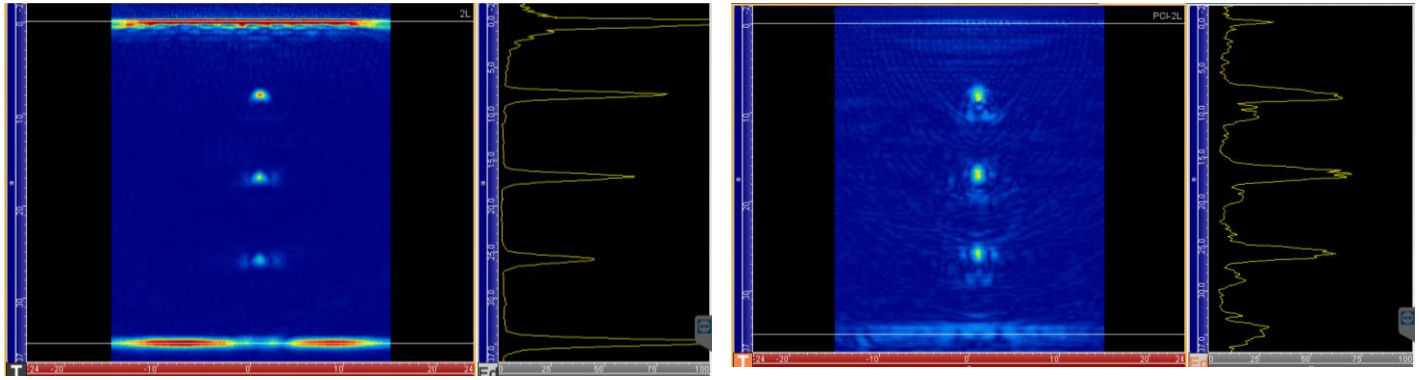
Ultrasonic Array – Alternate Signal Processing Phase Coherence Imaging.

- The PCI image is transformed from a amplitude vs time signals of the FMC into phase vs time
- The phase is obtained by dividing the signals by the modulus of their Hilbert transform (analytical signal).



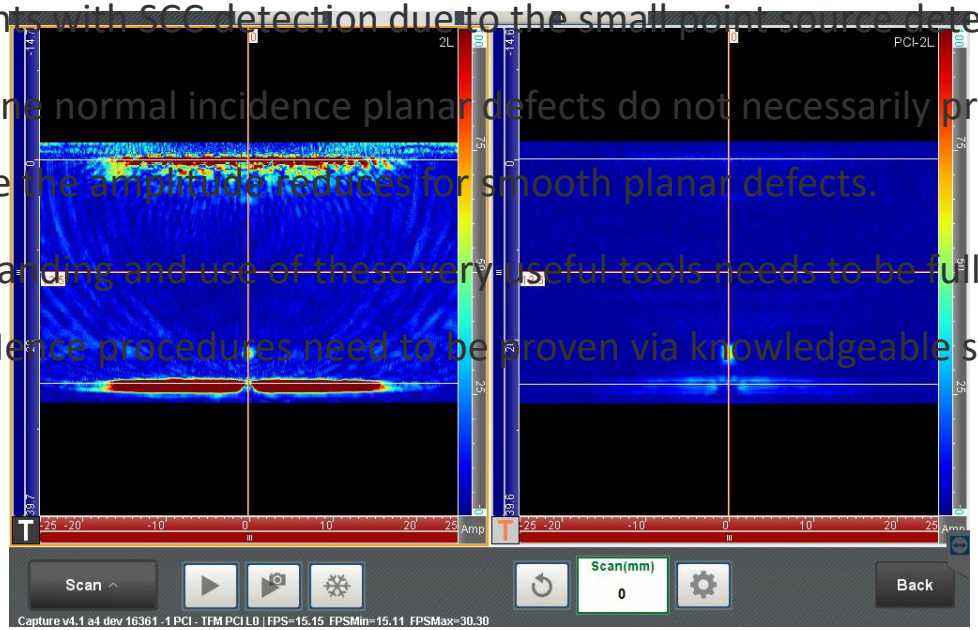
Phase Coherence Imaging

- We can see that PCI removes the front and backwall echoes pretty much entirely



Phase Coherence Imaging

- By removing the front and backwall echoes near surface defect detection is improved.
- Improvements with SCC detection due to the small point source detection capability.
- However none normal incidence planar defects do not necessarily provide phase coherence hence the amplitude reduces for smooth planar defects.
- The understanding and use of these very useful tools needs to be fully understood and used correctly. Hence procedures need to be proven via knowledgeable statistical trials.



How do we control and Qualify New NDT Technics/Technologies

You require NDT engineers to design NDT trials and test pieces.

- If the person designing the trial does not fully understand the technology they cannot design a trial.
- e.g. I saw a UT level 3 teacher demonstrate PCI for detection of SCC. Asked a few questions and it was clear he did not understand either what PCI is or how it apparently was effective on his particular sample.
- I have confirmed that PCI is not always effective with SCC and it depends upon the morphology of the SCC. It has specific capabilities.
- But to test the reliability you need to create appropriate trials.

How do we Qualify New NDT Technics

- Engineers who qualify Techniques need to be able to apply statistical analysis of trial results.

- Correctly design trials to test whether the detection is reliable for unknown defects not just machined artifacts.

- Current reporting amplitudes are irrelevant to PCI plots. The colour is a correlation function not an amplitude.

Who Can Supply the Education

Not NDT Schools –

Education starts with who teaches the teachers. So first to be educated should be the potential trainers. The training schools and teachers are not in a position to self teach. Their job is not development work. For this reason they cannot know the technology limitations.

Equipment Manufacturers –

Yes Up to a Point

The job of equipment manufacturers is to sell equipment – Not train.

Clearly their advantage to train and sell more equipment but this is not their speciality.

They do know the software and tools within their own equipment and will have performed trials with their own equipment.

Conclusions 1

- Level 3 is not an advanced NDT engineer
- We need advanced NDT engineers to correctly and fully apply advanced techniques.
- We need advanced NDT courses
- Who can supply them?
  - Universities with the assistance of Instrument manufacturers.
  - Coordinated by National NDT societies with ICNDT encouragement and guidance – Work via the ICNDT WG1 1 and 3

Conclusions – Discussion Points

- Maybe we should require NDT trainers and Level 3s in general to attend courses at Universities in advanced NDT technologies/statistics/physics in order to maintain their Level 3.
- Professional Mechanical Engineers or Medical Practitioners have to maintain/update their knowledge – so should Trainers.
- Do we create an NDT Engineer status for development of new procedures.