CIVA N·D·E | 11

Simulation Software for Non-Destructive Testing

Application Example N°4

Assessing the deterioration factors

Background

When evaluating the effectiveness of an inspection procedure and performance in the field, **deterioration factors** that affect the inspection results must be identified and assessed.

Not all factors that introduce variability can be controlled, and in this case it is essential to quantify their **effect on detection sensitivity** and sizing capability.

This knowledge is essential to determine safety margins and **acceptance thresholds**, and to specify the **performance limitations** of the method.

Benefits

CIVA simulations are used in this context to:

- Identify and assess the sources of variability and determine the parameters that **have the greatest impact** on performance.
- Study parameters that are difficult to control in laboratory experiments.
- **Quantify** the effects of variability.
- Use the results of variability assessment and sensitivity studies to **optimize the inspection procedure to improve reliability.**

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Assessing the deterioration factors

Case study

Defect response as a function of liftoff and the orientation of the probe

THE PROBLEM

Eddy-current signals are very sensitive to:

- liftoff
- orientation (tilt) of the probe

Moreover, measurements tend to fluctuate around a nominal value, particularly with "pencil" probes operated manually.

Accounting for the variability that occurs under realistic operating conditions is also necessary to **compare and evaluate** different sensors that nominally have comparable performance.

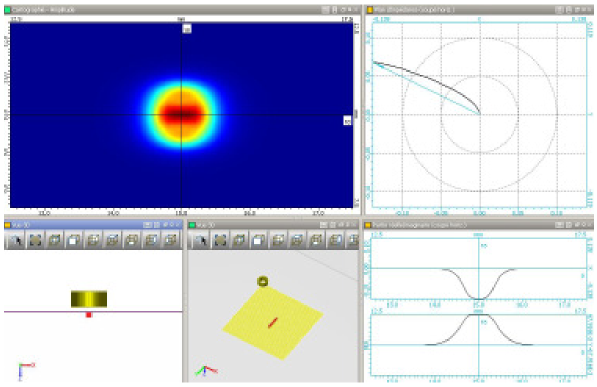
CIVA'S CONTRIBUTION

CIVA makes it possible to **easily and quickly** perform sensitivity studies to assess the **effect of variables** including liftoff and the probe orientation.

Several different configurations can be simulated in **one set of calculations**, and the data from different simulations can be extracted automatically and plotted on the same graph.

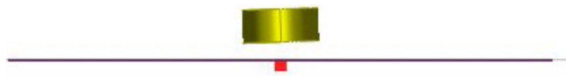
These results help you to optimize the procedure by **evaluating performance limits** and determining the best **threshold for detection.**

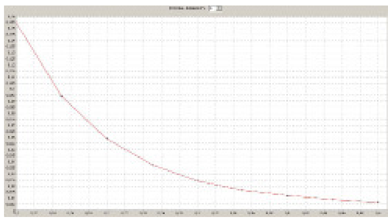
EC inspection of a surface-breaking crack in a plate with a cylindrical coil



Result for a gap of 0.1mm and the sensor oriented perfectly parallel to the plate. C-scan image, impedance plane, channel X (real) and channel Y (imaginary).

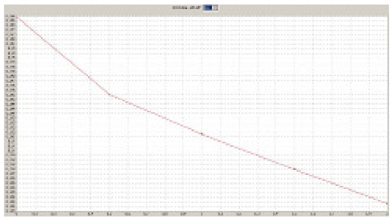
EC inspection of a surface-breaking crack in a plate for varying air gap and coil orientation





Amplitude variation curves calculated in CIVA:

Effect of air gap (abscissa) on signal amplitude (ordinate) for the sensor parallel to the surface (orientation of 0 °).



Effect of sensor orientation (abscissa) on signal amplitude (ordinate) for an air gap of 0.1 mm.

The curves above show that signal amplitude drops sharply as the air gap increases, decreasing by 40% when the gap increases from 0.1 to 0.15mm. The loss in amplitude that results from misalignment of the probe is less severe, but still significant (about 15% for a 2-degree offset from parallel).

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