CIVA N·D·E 11

Simulation Software for Non-Destructive Testing

Application Example N°9

Increase the reliability of your POD curves

Background

Generating **Probability of Detection (POD)** curves is **complex** and **costly**.

The process requires fabrication of a large number of **test specimens** with calibrated defects and several different operators to perform measurements. This in turn requires:

- Specification of **defects**: how many, what size, how introduced?
- Identification of the **key parameters** and assessment of their impact on performance.
- **Performance of tests** under conditions close to those that will be encountered on site.

All of these tasks have corresponding financial risks that can make a reliable POD study cost prohibitive.

Benefits

Owing to the **POD module** integrated into CIVA 10, you can significantly **reduce** these financial risks and **overall costs** by reducing the number of test specimens and laboratory experiments required.

Developed in collaboration with **EADS** (European Aeronautical Defense and Space Co.) and based on handbook MIL-HDBK-1823, this module allows you to:

- Replace some experiments with simulation.
- Quantify the influence of specific parameters.
- Contribute to the experimental design.
- Examine the influence of parameters that are impractical to study via experiments.
- Reduce confidence intervals by combining simulated and experimental data.
- Strengthen/improve procedures to maximize the POD without repeating all of the tests.

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Increase the reliability of your POD curves

Case study

Reduce costs while increasing the reliability of your POD curves

THE PROBLEM

The case presented here is for an **eddy-current inspection.** The question to be answered: What is the POD of a crack as a function of its length?

Additionally, what is the effect of variation in lift-off on crack detection, and what is the effect on the POD curve?

Defining an NDT procedure requires specifications for the sensor, operating conditions and other key variables. In practice, however, there is unavoidable variation in some paramers including lift-off, material conductivity and crack properties. Variation is qualitatively considered in designing the inspection, but the variation can be quantified in POD curves.

The problem is that generating **POD curves** requires experiments that are costly to perform because of the large number of calibrated defects that must be tested.

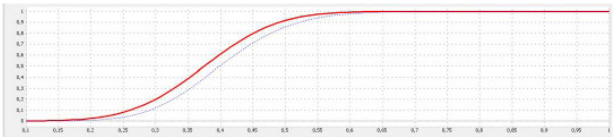
CIVA'S CONTRIBUTION

CIVA now provides a methodology for accounting for multiple sources of variation and quantifying the variability in POD curves.

CIVA makes it possible to:

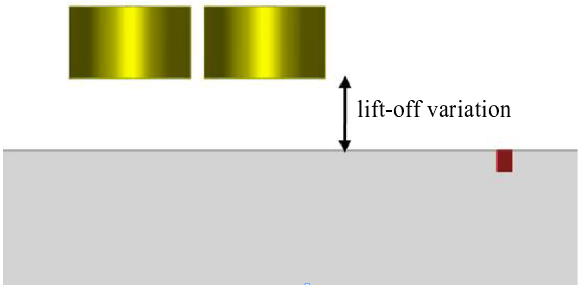
- Select the «uncertain parameters» such as liftoff, conductivity, crack length, and sensor orientation that will be used in the simulation study.
- Specify the statistical distribution functions for each variable.
- Launch the POD computation as a single simulation.

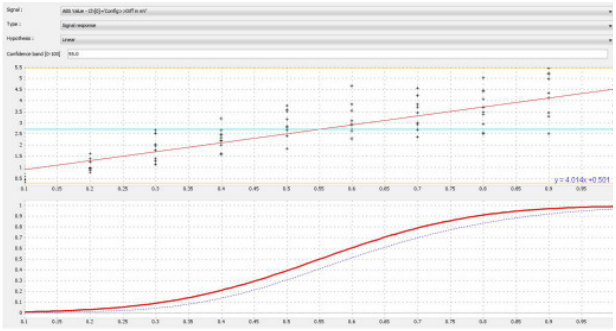
The plots in the following figures are examples showing the effect of lift-off variability on the POD. study.



POD curve when there is very little variation in lift-off: crack length (x) versus POD (y)

POD study for a surface-breaking semi-elliptical crack based on the maximum amplitude of the eddy-current signal. The «uncertain parameter»is lift-off, and the POD is plotted as a function of crack height.





POD curve when there is substantially greater variation in lift-off than in the first case: crack length (x) versus POD (y).

The POD module of CIVA includes estimation codes for POD's developed by EADS Innovation Works. Thus, CIVA takes benefits of 20 years of experience and R&D work on the reliability of control methods at EADS.

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