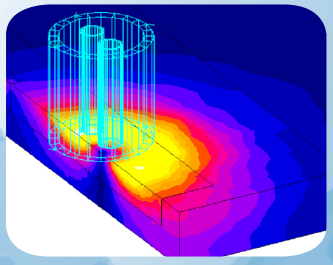
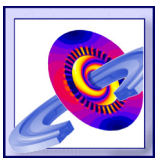


Eddy Current Non Destructive Evaluation

In order to enhance the different techniques used for Non Destructive Evaluation (NDE), simulation has played an increasing role. When it comes to qualify and improve the methods, design the sensors or train the operators, simulation solutions are a fast and efficient help and an excellent way to improve the understanding of the considered phenomena.

Flux and CIVA^{nde}: complementary tools for NDE

CEDRAT offers complementary solutions to model virtually any Eddy Current NDE device or process: CIVA^{nde}® is a unique software solution dedicated to NDE. This platform includes both ultrasonic and Eddy Current tools.
The Finite Element package Flux® includes all the capabilities allowing to simulate any Eddy Current NDE device.



WEB LINKS

Nuclear plants' tubes inspection

Sensor design

Aerospace

Automotive

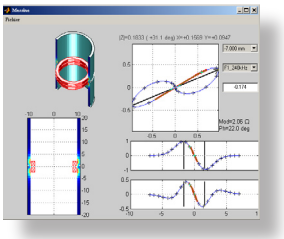
Corrosion inspection

Welding

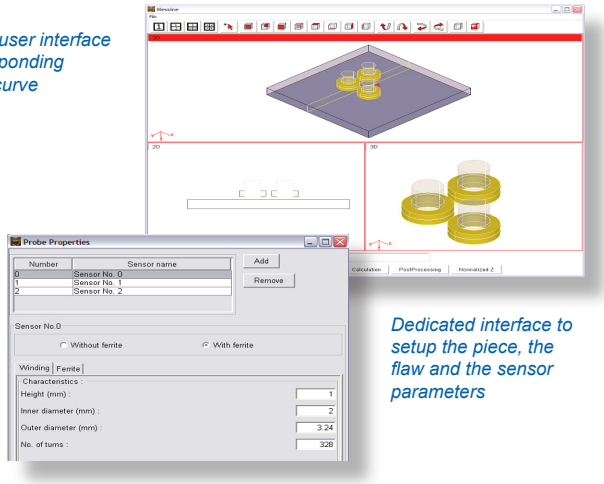
Method qualification

Integrated simulation with CIVA^{nde}

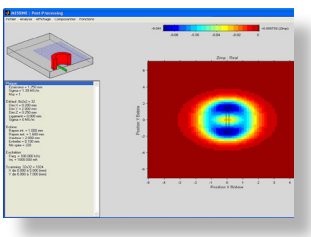
Thanks to its high level of integration, CIVA^{nde} provides easy-to-use simulation solutions even for non-NDE experts.
Any canonical configuration can be defined : 2D axisymmetric or 3D planar with flaws. A volume defect of parallelepipedic shape may be inserted in a conductive, non magnetic plate. CIVA^{nde} includes a library of sensors easy to define: encircling coil, bobbin coil, surface riding coil. The probe may use a ferrite core (cylindrical core, or «C» or «E» shaped ferrite pot). Eddy Current array probes and multiple frequencies configurations may be dealt with.
For multiple probes configurations, the different inspection modes (absolute, differential, transmit/receive functions) are simultaneously computed. The CIVA^{nde} solution is based on semi-analytical methods allowing fast computations and parametric studies.



Dedicated user interface and corresponding Lissajous curve



Dedicated interface to setup the piece, the flaw and the sensor parameters



Impedance changes due to the defect.

A specific post-processing tool is used to edit impedance variation scan as pseudo-color image. The user can also extract a row or a column to analyse EC data in the impedance plane. Other tools allow to efficiently and quickly analyse the model: normalised impedance diagram, filtering, signal to noise ratio evaluation, frequency mixing, normalization, balancing,...
Many quantities may be extracted: eddy currents density, electric and magnetic fields, vector potential.

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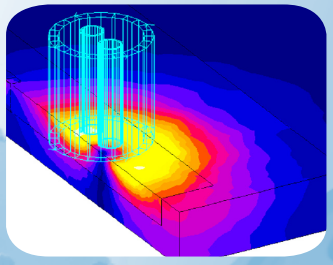


Eddy Current Non Destructive Evaluation

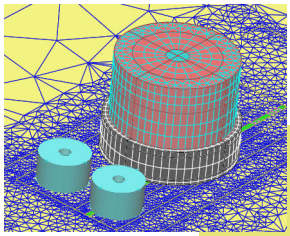
FE simulation of any device with Flux

Preprocessing

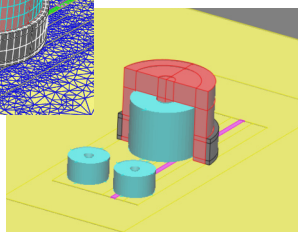
The Flux software allows to represent many configurations without true limits in the shape, position, orientation or in the number of flaws and sensors.

The description of the geometry and mesh will have a great influence on the accuracy of the results. In its standard range of tools, Flux offers many facilities for a proper design:

- Anisotropic mesh generators to perfectly account for physical phenomena such as skin effect,
- Propagation (copy paste) of geometry and mesh keeping parameter dependencies (e.g. for differential probes coils),
- Probe motion defined with partial re-meshing technique for mesh noise reducing, allowing a better accuracy.



Geometry and mesh of an EC inspection Finite Element modelling



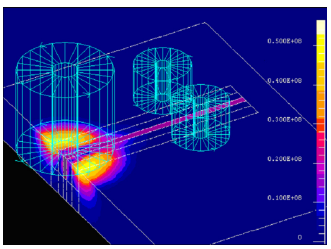
The geometry can be defined using the 3D CAD interfacing of Flux from different formats: STEP, IGES, or mesh import from I-DEAS, Pro-E, Patran, Nastran…
Any materials can be implemented allowing to design any sensor (with or without ferrite, copper shielded or not,…).

Solving

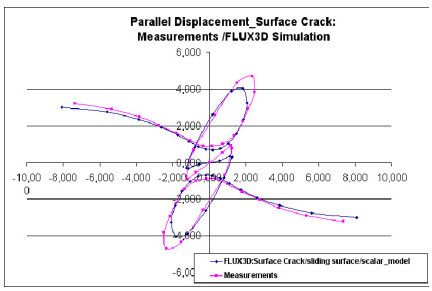
The accuracy and the fastness of the solution depend widely on the mathematical models provided by the software. To account properly for the eddy currents in the whole device, a scalar formulation using edge interpolation is available.

Postprocessing

For an easy and fast analysis of the results, sensors may be defined as function of any parameter or component. The computation of probes output (absolute or differential) may then occur directly during the solving and not need long postprocessing time. Of course, any electrical and magnetic quantity may be extracted: eddy currents distribution, current / voltage out of the probe, electric and magnetic fields…



Eddy currents distribution around a parallelepipedic flaw surrounded by a differential probe.



Lissajous curve exerted from FLUX and compared to measurements (TEAM Workshop 8).

References

CEDRAT's solutions are worldwide references used in many organisations, such as:
Airbus, Boeing, Cegelec, Centro Tecnico Aerospatial Brazil, DCN, Dassault, EADS, EDF, EPRI, ESA, EWI, Framatome, GE Inspection Technologies Gmbh, Honeywell, Imasonic, IRSN, JRC, MBDA, Mitsui Babcock, NRI, PSA, Slovenske Elektrarne, Snecma, TWI, Vallourec, VTT, Wesdyne…

CIVA^{nde} is developed by the CEA SACLAY, France

WEB LINKS

CIVA^{nde} for canonical configurations

Flux for FE analysis on any device

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