*CIVA Education: Physics of NDT made clear by simulation*

**"CIVA Education"**, a simplified version of the reference NDT simulation software **"CIVA"**, is the **ultimate tool to help you teach the "physics behind NDT"** to your students and trainees efficiently and at a low cost.

The raw results provided by NDT systems are not always easy to interpret due to the numerous input parameters and the complex physical phenomena involved in an NDT inspection.

Moreover, the available time to train students or operators on the physics of NDT is quite limited as the schedule is often focused on the practice of NDT (manipulating the probe, setting the system, etc.).

The **simple, realistic and interactive interface of CIVA education** makes it easy to highlight the main phenomena and **understand typical NDT results** in a visual and comprehensive environment.

It **provides a lot of images and analysis curves, assisting the understanding** of results more efficiently than comparing single signals together.

With **quick computations**, users can easily **try various inspection configurations** and understand the importance and influence of the main input parameters (component geometry and dimensions, material properties, type and settings for probes/sources, defects location and dimensions, etc.).

*Discover this tool, designed for universities and training centers from the reference NDT simulation software!*



**More information and videos on CIVA Education on:**

http://www.extende.com/physics-of-ndt-made-clear-by-simulation

## CIVA Education is available in 3 modules that can be purchased together or separately:

### 1) UT Module:

In this module, two types of computations are available: beam computation and inspection simulation.

#### - 3D Beam Computation:

Find below the features that you will find in the UT beam computation module:
- Planar and Cylindrical component geometries, one weld example
- Isotropic material, one anisotropic example
- Contact or Immersion testing
- Conventional single element probes and linear PA (limited to 28 elements) probes
- Focused probe available for immersion testing
- Point focusing or beam steering with delay laws (for PA probes)
- Accounts for L waves, T waves and mode conversions

### Example of Simulations:

In UT, among other possibilities, the beam module of CIVA education can help you to illustrate the following phenomena:
- Visualize and characterize **the different parts of the beam** for a given probe (near field, far field, location of the maximum, beam sport size, etc.).
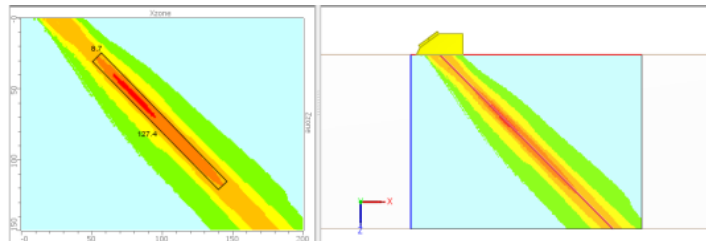


- Visualize the **beam propagation**, especially when specific phenomena occur (propagation in an anisotropic material, grating lobe phenomena with a Phased-Array Probe).
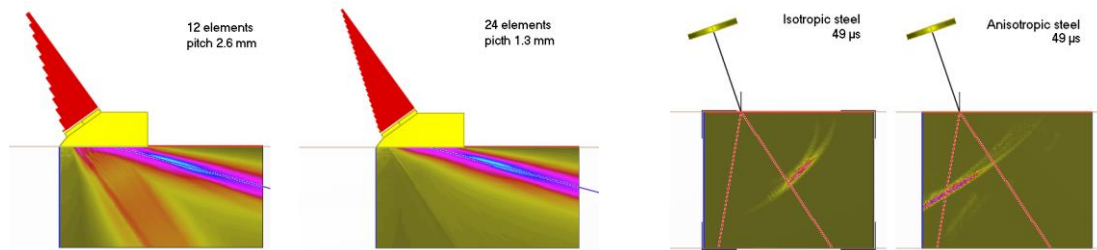
o Understand and see the effects of **focusing or beam steering**.



No Focusing    Focusing    Beam steering    Steering + Focusing
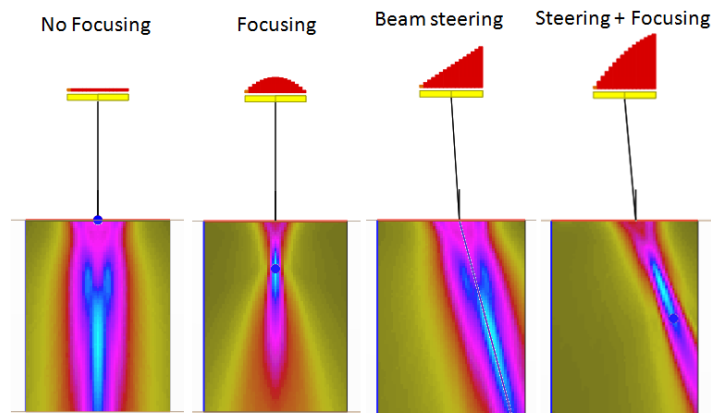
o Visualize the **impact of physical parameters** such as the probe frequency, material velocity or other ones on the radiated beam.
o Evaluate the **sensitivity zone of a separate T/R probe** (such as TOFD or Tandem) with the combination of the emitted beam and the zone of sensitivity in reception.
o And many other possibilities…

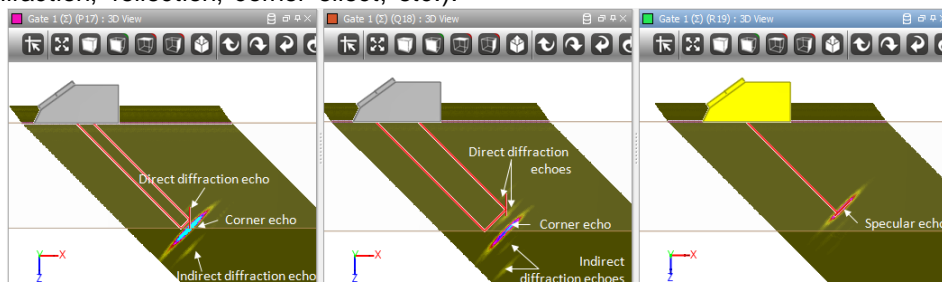- **2D inspection simulation for qualitative and fast computations:**

The inspection simulation module includes the following capabilities:
o Planar and Cylindrical component geometries, one weld example
o Isotropic material
o Contact testing
o Conventional single element probes and linear PA (limited to 28 elements) probes
o Pulse Echo, TOFD, Tandem
o Point focusing, beam steering, sectorial scanning with delay laws (PA probes)
o Simulations with planar and SDH flaws with various dimensions, locations and orientations
o Accounts for L waves, T waves and mode conversions

## Examples of Simulations

In UT, among other possibilities and ideas, the inspection simulation module of CIVA education can help you to illustrate the following points:
o The **different types of echoes** scattered by an indication or by the component boundaries (diffraction, reflection, corner effect, etc.).

- o Identify the **different modes** and for instance mode conversions phenomena.
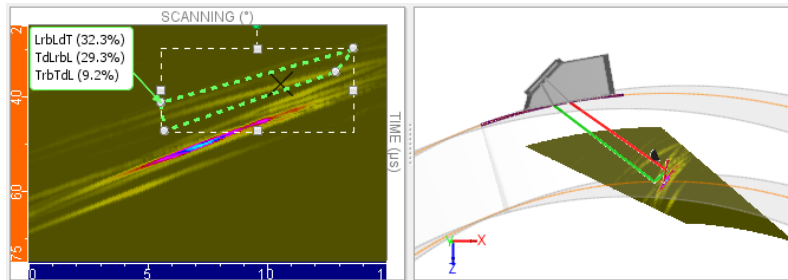


- o Illustrate the **different UT techniques**: **Straight beam, Angle beam, TOFD, Tandem, Phased Array**, etc.
- o Show **calibration block set up** to obtain DAC like curves.
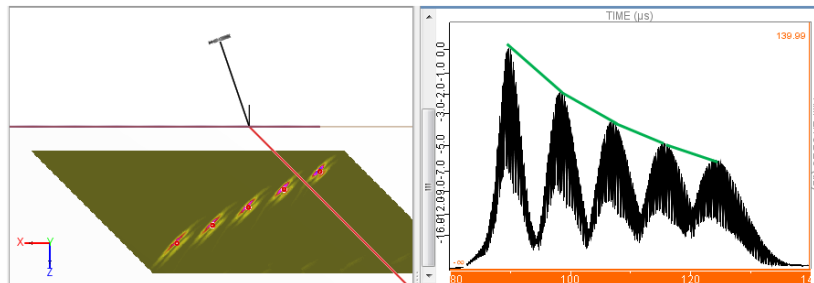


- o Understand **defect sizing techniques** such as the −6 dB drop or using the tip diffraction.
- o Show the impact of **influential parameters on the signal sensitivity** (such as flaw location and orientation, or probe parameters ...).
- o Among numerous capabilities.

## 2) RT module :

- **Direct radiation computation for qualitative and fast simulation:**

The RT simulation module includes:
- o Planar and Cylindrical component geometries, one weld example
- o Material database including various steel alloys
- o Gamma-Ray isotopes: $Co^{60}$, $Ir^{192}$, $Se^{75}$
- o X-ray source database of different energies (from 50 kV to 450 kV)
- o Argentic film database and image plate detectors
- o ASTM Hole penetrameters and wire EN-IQI
- o Planar or spherical defects (void or inclusion)
- o Accounts for geometrical unsharpness
- o Photon paths display

## Example of Simulations

Among many other ideas, the RT module of CIVA Education will help you to teach the following topic:
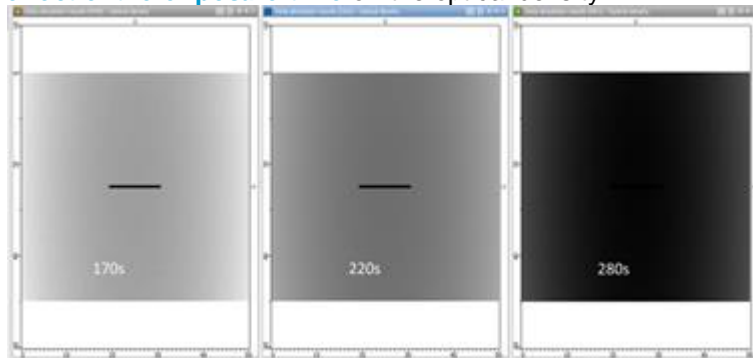
- o Visualize the **impact of thickness change** on the radiogram obtained.
- o Highlight the **impact of specimen materials** on the photons path and the radiogram obtained.
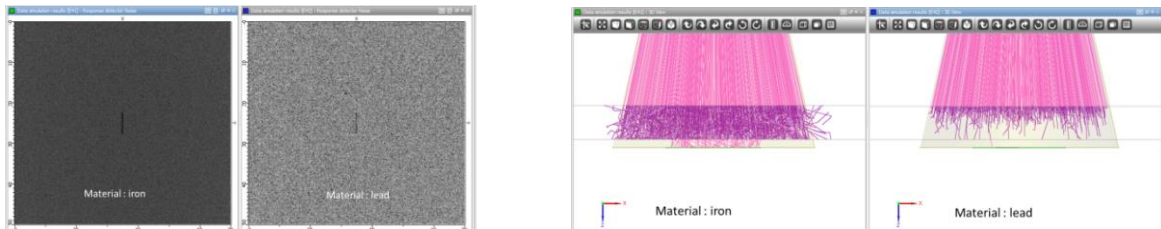


- o Illustrate the **sensitivity of the RT technique** depending on the defect orientation.
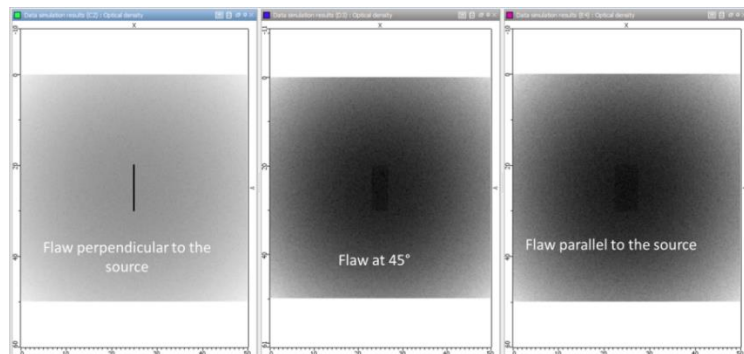


- o Check the **effect of the exposure time** on the optical density.



- o Evaluate the **impact of the source orientation** on a pipe component to locate the flaw.
- o Understand the impact of **geometrical unsharpeness** and its origin.
- o Illustrate the impact of different **sources of different energy on the final RT image.**
- o And numerous other capabilities.

### 3) ET module

As in the UT module, the ET part comes with 2 modules: the field computation and the inspection simulation.

- **Field Computation:**

The capabilities of the field computation include:
- o Planar (potentially multilayer) and Cylindrical component geometries
- o Ferromagnetic or non-ferromagnetic materials
- o Surface coil (air core or cylindrical ferrite core), bobbin coil configuration
- o Variable operational frequency
- o Computes electromagnetic fields, impedance diagram and lift-off signal

**Example of Simulations:**

The ET field computation module of CIVA education can help you to make visible what is a bit hidden and looks complex in this electromagnetic technique:
- o Illustrate the Eddy Current **penetration depth** and observe the impact of the frequency, the material but also the sensor size on the actual penetration.
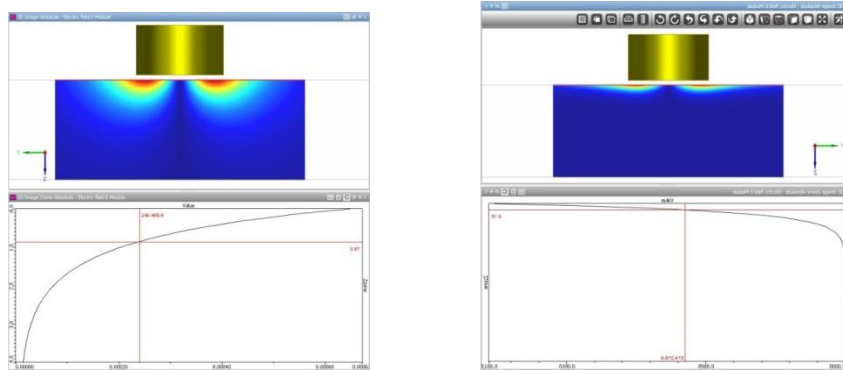


- o Visualize the **action zone** of an ET sensor.
- o Observe **Eddy Current distribution** in a tube or a solid bar.
- o Understand and interpret **Impedance diagram**.
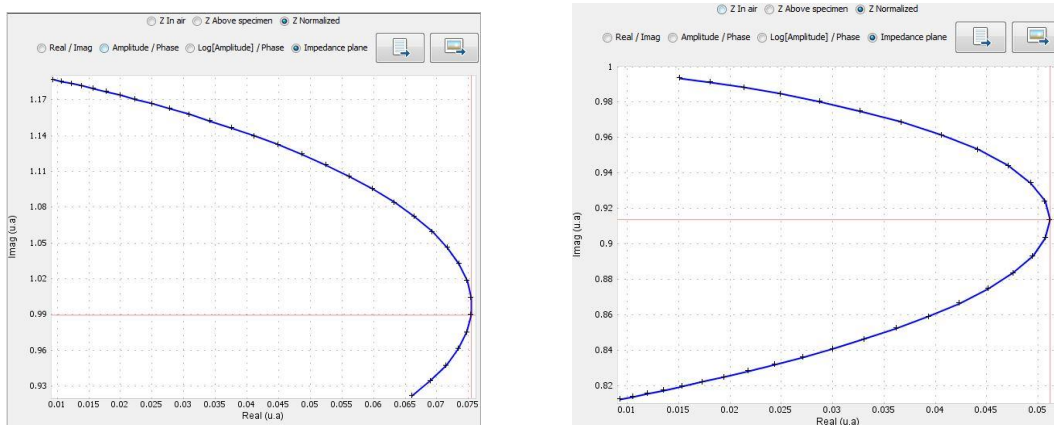


- o See the influence of a **ferrite core** on the field induced by an ET sensor.
- o Explain the **lift-off signal** and its potential consequence on calibration procedure.
- o And many other ideas…

**- Inspection simulation:**

The features available in the ET inspection simulation module are:
- Planar and Cylindrical component geometries
- Conductive non-ferromagnetic materials
- Surface coil (air core or cylindrical ferrite core), bobbin coil configuration
- Simulation of cylindrical hole in tubes or rectangular notch in planar component
- Variable operational frequency
- Absolute or Differential mode

**Example of Simulations:**

The ET inspection simulation module of CIVA Education can reproduce typical Eddy Current signals and help you for instance in the following contexts:
- Explain the different types of acquisition modes: **Separated or common functions, absolute or differential measurement**.
- Simulate classical **tube inspection** setup and explain the use of the phase angle for the defect characterization.
- Illustrate **signals obtained at the quadrature frequency** for different defect depths in tube inspection.
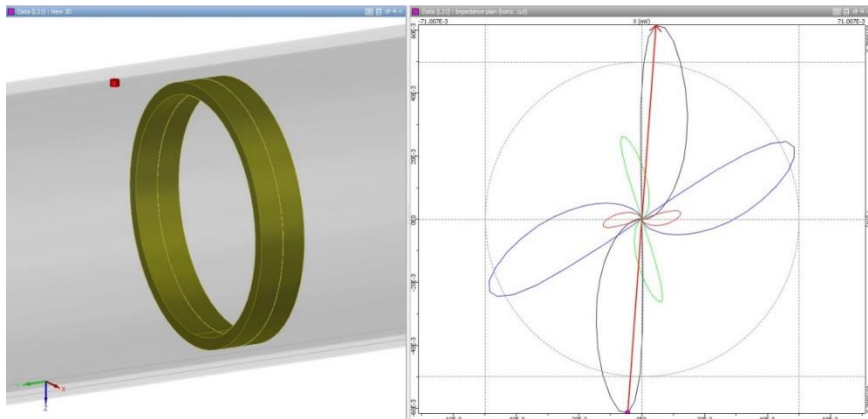


- Highlight the **influence of the filling rate** on the inspection sensitivity.
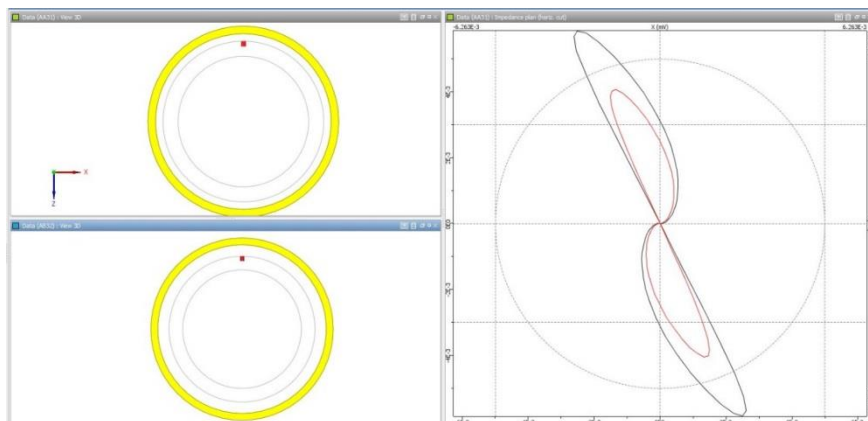


- Show the **impact of the inspection speed** on the signal resolution for a given operational frequency.
- Illustrate the **impact of the sensor size** for a given flaw on the obtained response.
- See what happens if you apply or not the "**law of similarity**" on a defect signal.
- Evaluate the **impact of the material conductivity** on the signal obtained for a similar defect.
- Visualize the **phase separation of lift-off and defect signal** depending on the sensor and the operating frequency.