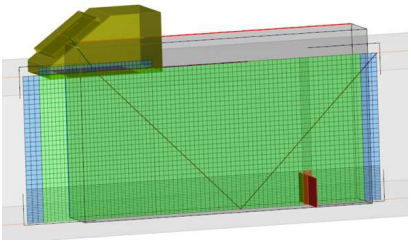
CIVA 2025: The Future of NDE & SHM Simulation & Analysis Software is Here

CIVA simulates both common inspection methods and innovative technologies.

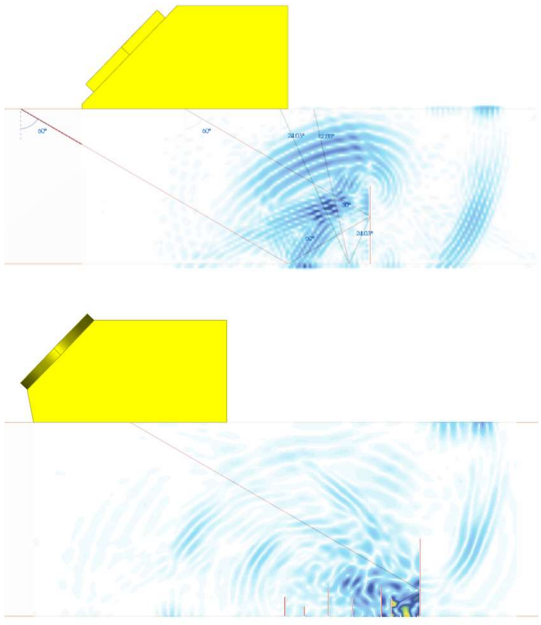
CIVA 2025 marks a significant advancement in CIVA UT with the introduction of the "Full FEM" module. **CIVA 2025** features new physical models in CIVA RT, **Virtual flaws/Data fusion** features available in **RT** and CIVA **Data Science**, and **rotating probes** in the Steam generator module of CIVA ET. Additional features include **False Alarm** rate estimation within the **POD** analysis module, multiple extractions in parametric studies, CIVA **Script compatibility with CIVA Analysis,** and much more. Check all the details below!

CIVA UT is now (also) a Finite Element software!

All CIVA UT 2025 users will have access to this new "FEM perspective", which includes FE Beam and FE Inspection Simulation tools.



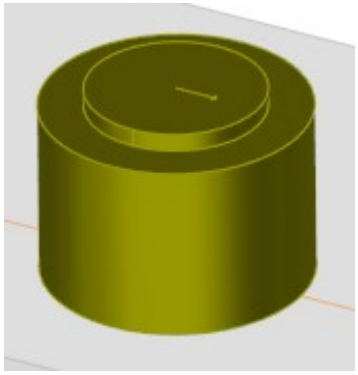
Only the source field and propagation in the coupling/wedge volume remains semi-analytical, the entire scene is then modelled using FE. As a widely **recognized reference** numerical method, this FEM module will provide the ability to **validate your CIVA simulations** performed with semi-analytical models within the same platform. This is a major bonus, especially for technical justification work. When necessary, this FEM perspective will also let you **explore beyond the limits** of SA models, such as in: more accurate modeling with complex materials like **anisotropic welds**, **surface wave** interaction with flaws and specimen boundaries (creeping, Rayleigh, etc.), **complex flaw** configurations (**clusters**, defect profiles defined in CAD, shadowing effects, etc.), overcoming computation limits for small flaws, and getting rid of ray/beam artifacts (caustics, etc.). This "Full FE approach" is complementary to the local "FE grid" feature still available in CIVA UT when it is relevant to limit the FE simulation to small areas around flaws. For better understanding of the physics, a great advantage of this Full FEM module is that it **shows the field propagation and interaction with discontinuities**. Totally embedded in the CIVA GUI, the use of CIVA FEM does not require specific skills. Mesh and geometry are automatically built in and very few settings have to be defined by the user. CIVA FEM is **available in 2D and 3D**. Computation times are very reasonable in 2D, while 3D simulations, even if competitive with other FE software, shall be targeted for "tailored" cases.



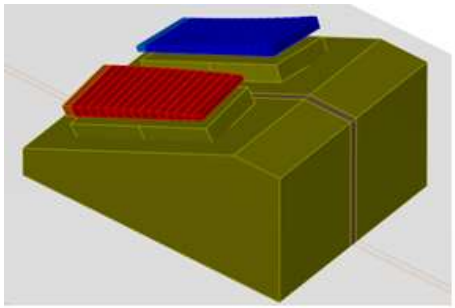
CIVA 2025

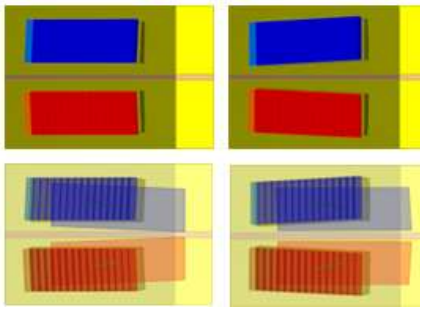
New features for contact probe wedges

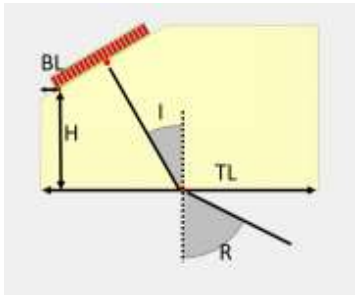
The latest version of UT contact probes includes several enhancements in wedge modeling. **Cylindrical wedges** are now available for normal beam inspections.



Additionally, you can define wedge dimensions for PA probes **based on the height of the first element**, aligning with the common conventions used in transducer datasheets. A significant new feature is the **projection of the crystal aperture on the bottom of the wedge.** This feature allows for quick evaluation of the main insonified surface at the top of a component, facilitating the optimization of roof angles in TRL/DMA probes. For dual element probes, users can now model the **acoustic barrier** and set its thickness, a previously unavailable option. Furthermore, flexible water wedges are now included in CIVA, following a recent service pack in CIVA 2023.

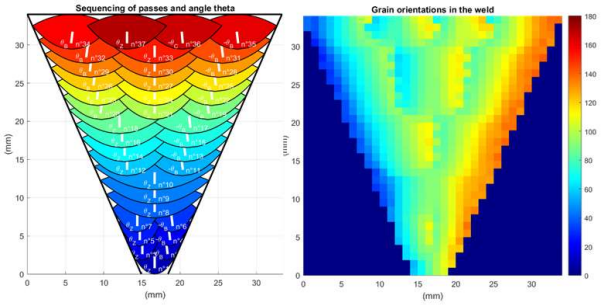






Welds and anisotropy

Modeling complex welds has always posed challenges, particularly in defining a representative distribution of grain orientations. A new solution is now available with the implementation of the **MINA©** model in CIVA. MINA© can predict weld stiffness maps from the definition of **welding process data** – such as the number of layers, electrode size, pass sequences – rather than relying on macrographs. After entering the welding information, users receive a visual map to verify the consistency. Additionally, CIVA 2025 introduces a feature called **orientation maps import**



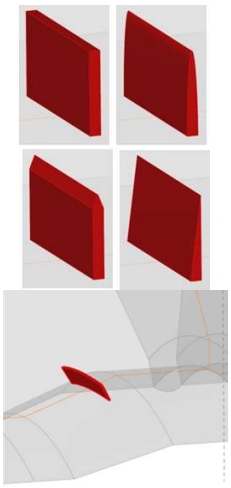
existing alongside current weld definitions like the parametric distribution (Ogilvy) or “fixed” grain orientation angles derived from macrographs.

Furthermore, as Cij input data is hard to obtain, CIVA can now compute the elastic constants “Cij” based on a set of wave velocity measurements provided for different angles.

Also new in CIVA UT 2025

CIVA now offers new flaw types including **« volumetric notches »** with various profiles such as Rectangular, “**Pencil**”, Elliptical and Triangular. Planar flaws can be extruded cylindrically to fit tubular shapes, allowing for accurate definition of **circumferential defects**. This capability is also available for embedded and surface breaking FE Grid flaws. Finally, beam simulation settings have been redefined for improved usability and clarity.

Recent service packs updates in CIVA 2023, and of course still available in CIVA 2025, introduced the following new features: synthetic gaussian noise model by post-processing, the possibility to easily calibrate signals at 80% Full Screen Height, and new parametric geometries for welds with counterbore slopes and connections to elbows.

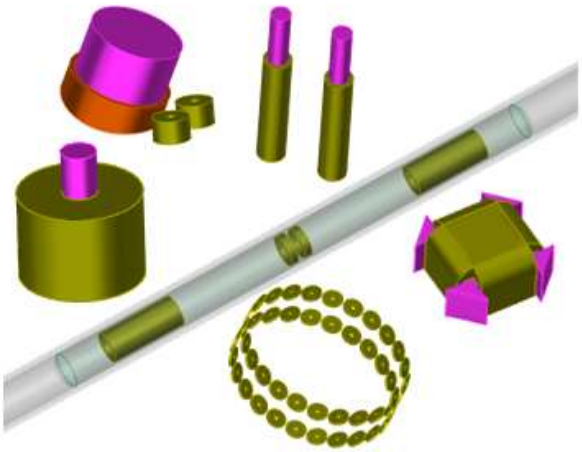


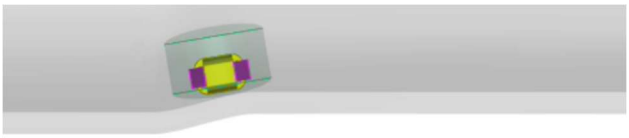
Expanded applications for Steam Generator Inspection

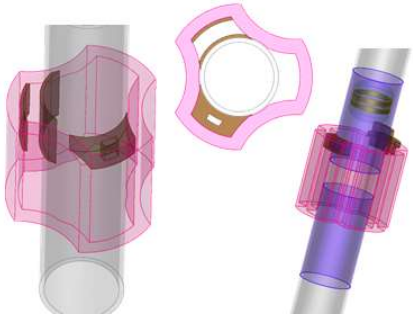
The Steam Generator Tube Inspection simulation tool has achieved a new milestone with the implementation of new Eddy Current probes: Rotating probes with adapted surface riding scanning patterns (transversal, longitudinal and simple rotating), the +Point sensor, Eddy-Current arrays and RFT probes.

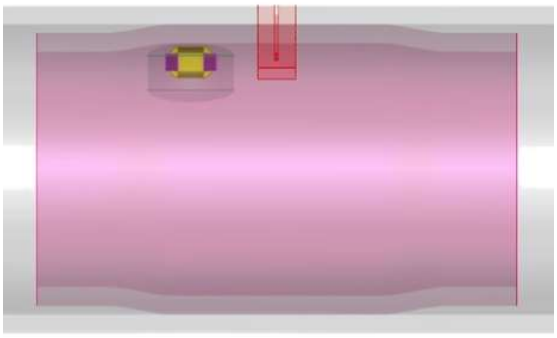
These probes are also available in the “regular” Inspection Simulation module.

In the SG Tube module, users can define specific clogging patterns in the support plate foils, and also several areas on the tube’s outer wall where some deposit exists. Additionally, the tool now allows for the simulation of sleeved tube inspections with configurable parameters.





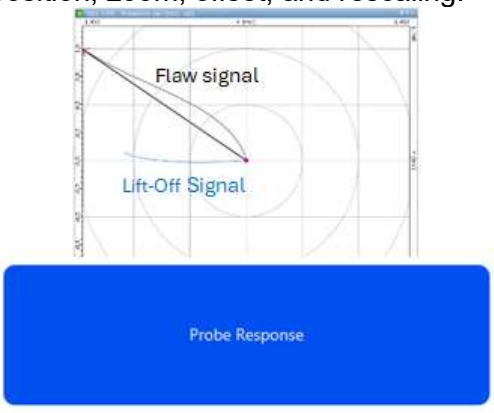


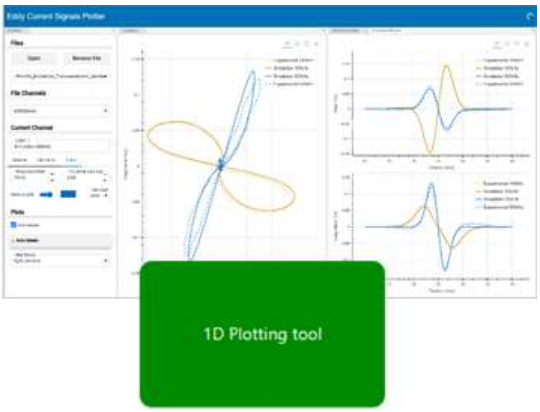


Also new in CIVA ET 2025

In this new version, **impedance diagrams** and **lift-off signal** computations can now be managed in a dedicated module called “**Probe Response**.” This allows users to save results, perform batch calculations, and benefit from the regular analysis environment for viewing and processing results. As a result, **lift-off signals can now be superimposed with defect response signals.**

Additionally, a new analysis application, the “**1D plotting tool**”, simplifies the analysis process, especially when comparing different cases or signals with different scales through features like superimposition, zoom, offset, and rescaling.

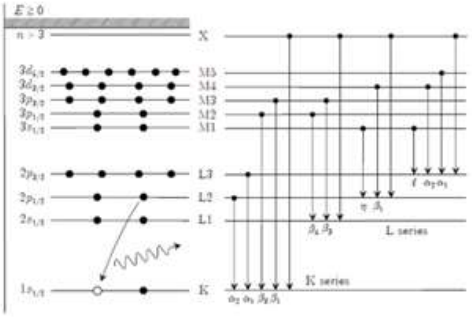




Improvements have been made when defining simulations with complex specimen profiles in the Inspection Simulation 3D module (such as 2D CAD). Users can now view the integrated display of the mesh and define a **complex scanning pattern** (“External trajectory”) allowing the ET sensor to navigate a complex scanning surface.

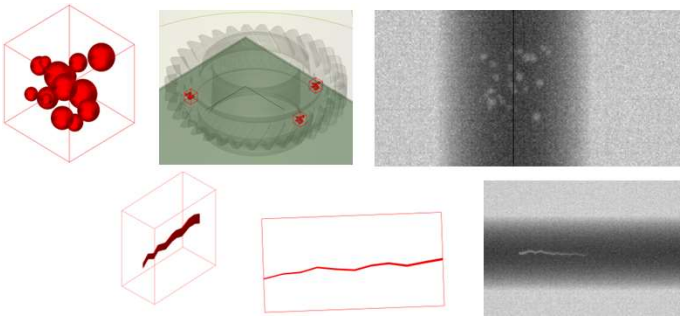
New physical models in CIVA RT

Several major improvements are in CIVA RT 2025 regarding the modelling of physical parameters and phenomena. First, scattering radiation simulation (Monte-Carlo) can now account for the "**Bremsstrahlung**" effect (mainly relevant for high energy sources and thick specimen) and **X-ray Fluorescence** interactions in the specimen (mainly relevant for heavy materials). The computation model has been optimized through a variance reduction technique in order to converge faster (reduction factor between 2 and 4). In terms of input data, state-of-the-art **material databases** from **NIST** and **ENDF** libraries are now available, as well as a new X-ray source spectrum generator from "**SPEKY**" that is faster and suitable for higher voltages than previously available.

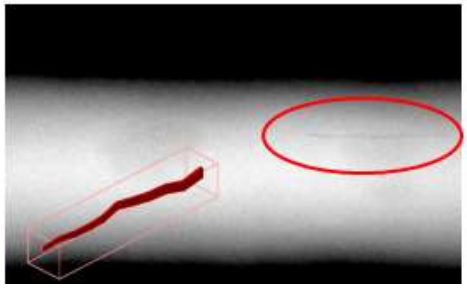


Additionally:

Two new types of parametric defects are available in CIVA RT to more easily model these realistic flaw types: "**Cluster porosities**" and "**parametric cracks**".



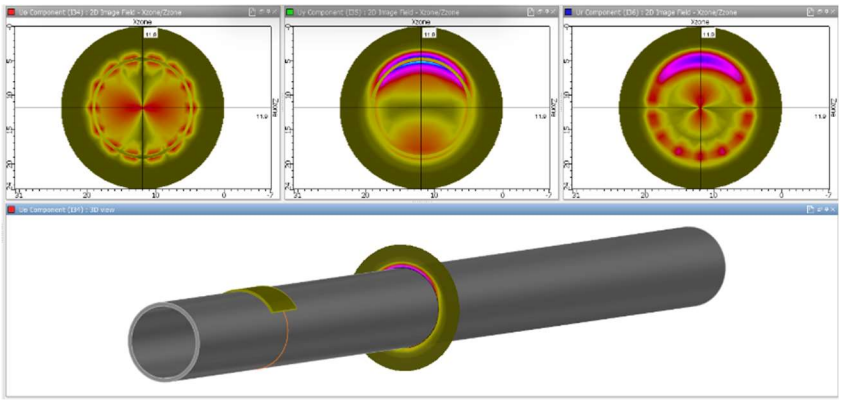
Merged image with virtual flaw



To provide even more realistic images, **Data Fusion** techniques have been implemented that let you insert **virtual flaws** (simulation results) into real images. A new type of detector is coming (will be available in CIVA 2025 SPx), the **Photon counting detector** (**PCD**), making it possible to analyze and post-process the spectral distribution of incident photon energies thus providing interesting analysis features and image improvement capabilities.

Improvements in surrounding media for GWT simulations

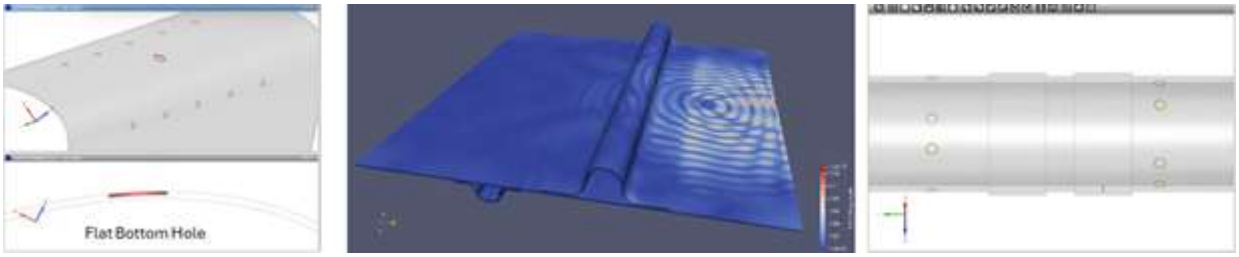
Fluid or solid surrounding media around the test component can be taken into account in mode and field computation tools for a more accurate modeling of buried and immersed components in guided wave simulation. It used to be limited to the mode computation module before this version. If the fluid medium is defined as a layer between two solid parts, this modelling process can even be defined in the Inspection Simulation module (i.e. defect/discontinuity response).



And also: CIVA GWT also includes the possibility to simulate **solid inclusions (2D or 3D)**, and the capacity to compute dispersion curves on **2D CAD section specimens with anisotropic materials**. Furthermore, computation time for GWT simulations has improved up to a factor 2.

Increased possibilities with sleeves and stiffeners in CIVA SHM

For Structural Health monitoring applications by guided waves, CIVA SHM can account for stiffeners on a component (such as a composite panel) and sleeves on/in tubes and plates. In CIVA 2025, **several sleeves and stiffeners** can be defined on these specimens. Their geometry can be described more precisely with the option to define the **thickness reduction** of these objects at their edges. A new **"C – Stiffener" parametric geometry** is also available in the library.

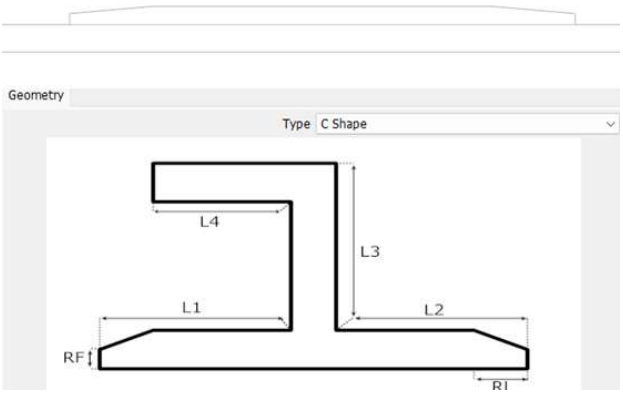


Also new in CIVA SHM 2025

This new version also features new defect types such as the Flat Bottom Hole as well as the ability to insert an Erosion/Corrosion parametric flaw in multi-layer specimens.

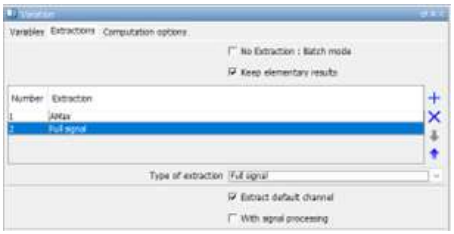
Absorbing layers boundary conditions are now available, which will help to reduce model sizes and thus, computation times.

In this version, you will also be able to **import experimental data** to analyze and post-process then in CIVA SHM.



Parametric analysis

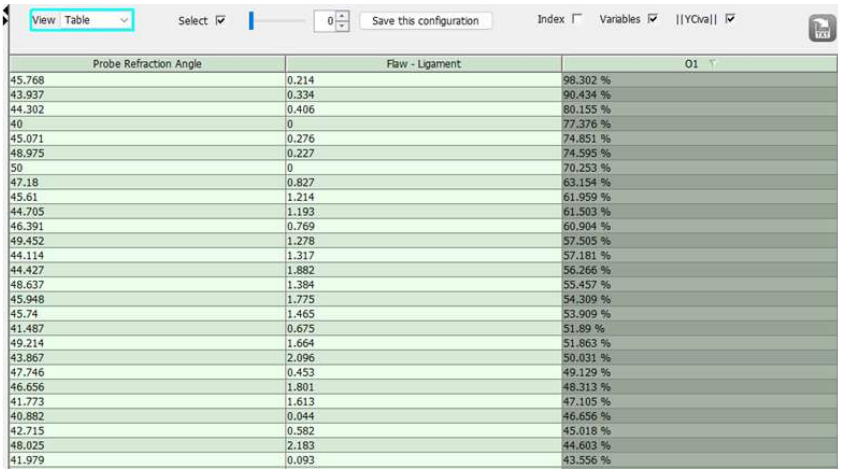
An important aspect of parametric studies is to define relevant output criteria to analyze the impact of parameters. With CIVA 2025, users can now extract **multiple criteria in a single run**.



A table will let you define the list of extractions (Amax, Full Signal, etc.).

All the graphs available in parametric analysis pages (Parallel plots, 2D maps, tables) can now **display results in dB and percentage units**.

With CIVA 2025, the parametric results table **columns can be sorted by ascending and descending order**!



Probe Refraction Angle	Flaw - Ligament	O1
45.768	0.214	98.302 %
43.937	0.334	90.434 %
44.302	0.406	80.155 %
40	0	77.376 %
45.071	0.276	74.851 %
48.975	0.227	74.595 %
50	0	70.253 %
47.18	0.827	63.154 %
45.61	1.214	61.959 %
44.705	1.193	61.503 %
46.391	0.769	60.904 %
49.452	1.278	57.505 %
44.114	1.317	57.181 %
44.427	1.882	56.266 %
48.637	1.384	55.457 %
45.948	1.775	54.309 %
45.74	1.465	53.909 %
41.487	0.675	51.89 %
49.214	1.664	51.863 %
43.867	2.096	50.031 %
47.746	0.453	49.129 %
46.656	1.801	48.313 %
41.773	1.613	47.105 %
40.882	0.044	46.656 %
42.715	0.582	45.018 %
48.025	2.183	44.603 %
41.979	0.093	43.556 %

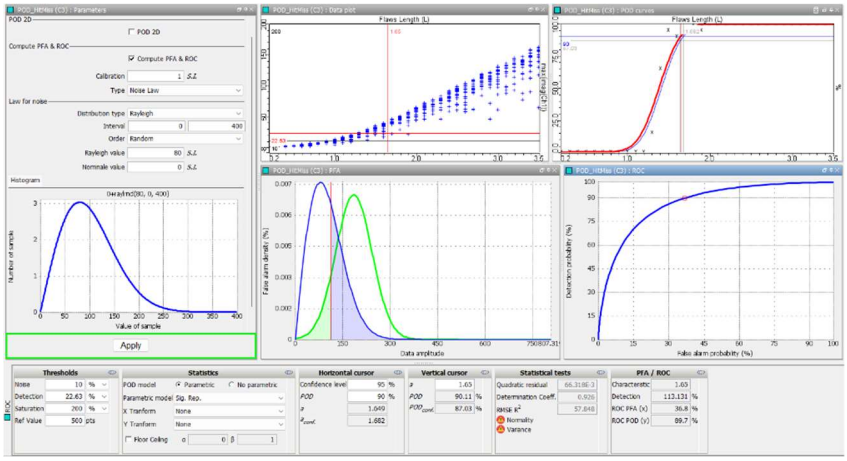
This is a very useful and convenient way to **easily identify the worst or best case scenarios**.

CIVA 2025

POD analysis environment now includes Probability of False Alarms

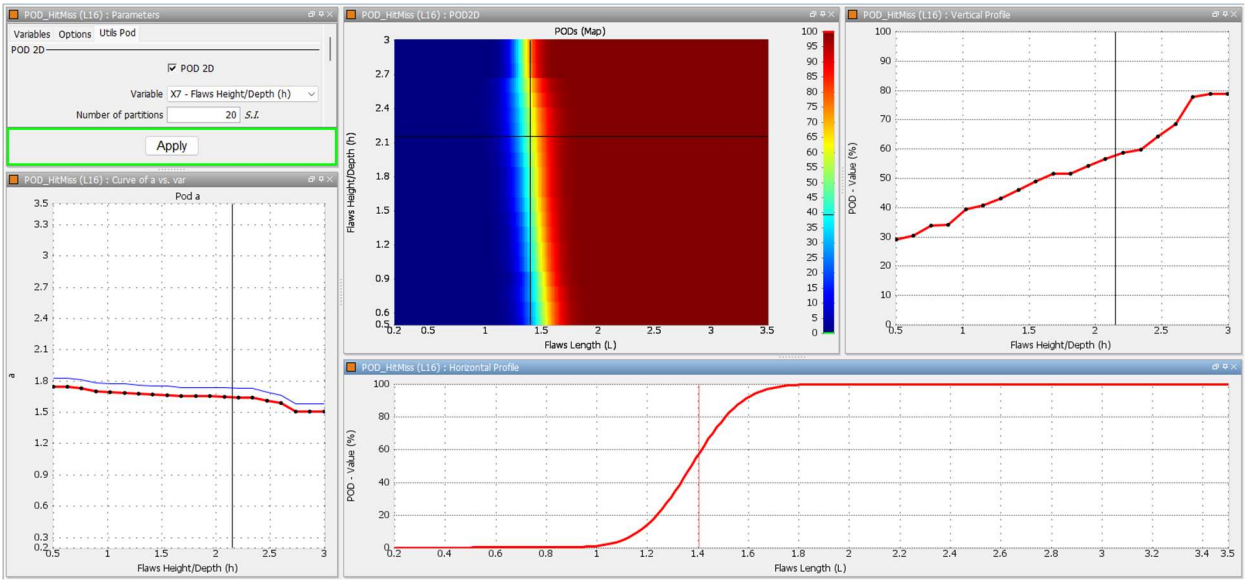
In CIVA 2025, you can compute False Alarm Rates by defining noise data (or “PFA” for Probability of False Alarms).

Two ways are possible: Define density functions to represent noise signals amplitude distribution in an inspection or load data.
Since **POD and PFA** are defined in the same analysis environment, you can also compute **ROC** (Receiver Operating Curve) **curves** which link these two indicators for a specific defect size versus the **detection threshold**.



Other new features for POD

New statistical models are available to compute POD curves: **Hit Miss NT-TR394** (in addition to the existing Hit/Miss Berens one), the **Floor-Ceiling** model and new link functions (Cloglog and Loglog) available for Hit-Miss analysis. **2D POD** maps can also be plotted to display the Probability of Detection versus 2 characteristic parameters (defect length, height, location, etc.). All these new features take place in a rebuilt environment offering a more user-friendly interface.

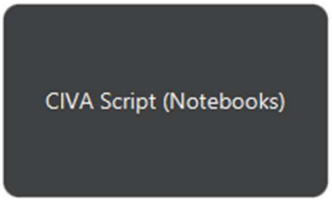


New CIVA Script features to process binary files

CIVA Script provides extended APIs in Python (“database”, “simulation editor”) to more efficiently process binary files issued from script simulations or data exported from CIVA Data Science.

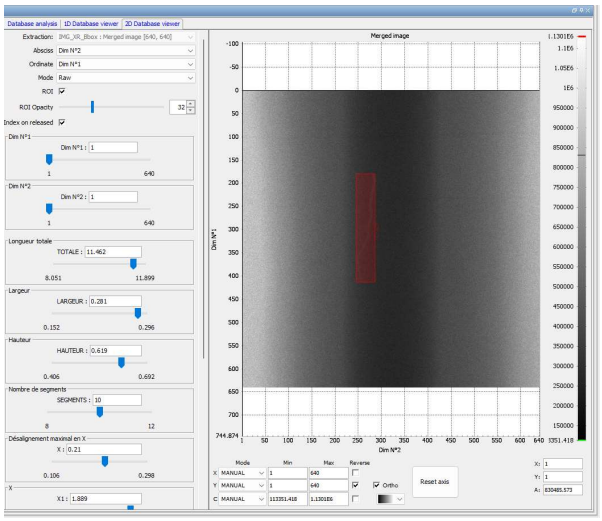
Many **Notebooks** are provided to help use this new feature (read, write, export, merge) in CIVA.

CIVA Script 2025 now works with **Python version 3.12**



Virtual Flaws/Data fusion features available in Data Science

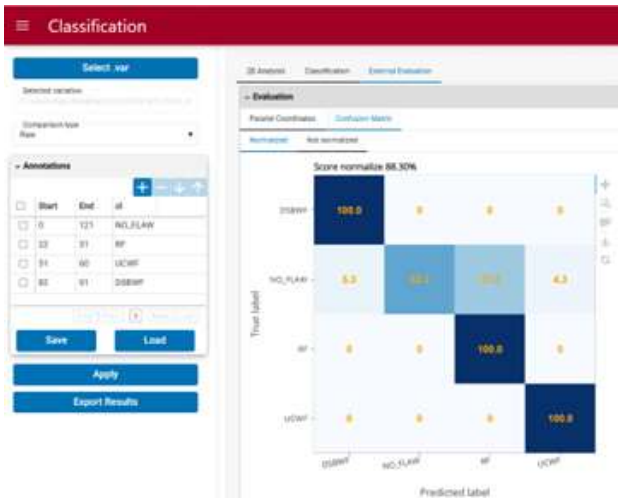
An extended feature compared to what is presented above in CIVA RT: **CIVA Data Science** can process **series of data fusion** between experimental RT images without flaw and RT simulations with flaws. It displays the fusion of all generated images. This is really useful in building more realistic data sets for **automatic analysis AI model training processes**.

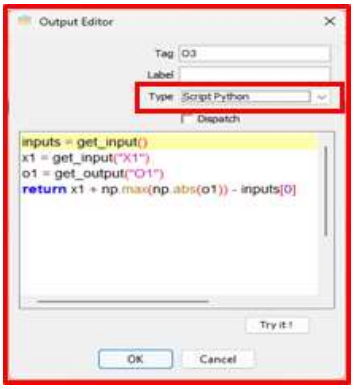


Other news from CIVA DATA Science

This second release of the Data Science module also includes new classifiers: **Time Series Correlation** (well suited for time-based signals) and Multi-Layer Perception (Deep Learning, **Neural Network technique**).

Python Scripts can now be directly used in the database management tool to customize output criteria before the training process. It is worth mentioning that it is now possible to include an **external test dataset** to evaluate models more directly, without going through the external evaluation step (in addition to cross-validation).





CIVA Analysis is now compatible with CIVA Script!

CIVA Script can now drive your UT analysis process in CIVA Analysis without using the Graphical User Interface through the “workflow” API.

This includes the capacity to:

- Load UT experimental and simulated data,
- Apply series of CIVA Templates (including many analysis features such as page layout / signal processing, PlugIn calls),
- Extract results and export images.

Also: CIVA 2025 provides new import capabilities as you can now load experimental data in **MFMC format**.

We hope you will enjoy this new version.
Thank you for continuing to share your CIVA modelling experiences with us.

Your feedback drives the CIVA roadmap for the future!

A complete description of CIVA 2025 is available on our website: www.extende.com