CIVA N·D·E | 11

Simulation Software for Non-Destructive Testing

Application Example N°13

Optimize the tomographic reconstruction through simulation

Background

As for all NDT techniques, tomographic inspection needs a preparation stage in order to optimize the specification of:

- The X-ray generator with the appropriate voltage and current.
- The detector (size, resolution, efficiency, etc.).
- The acquisition parameters: geometry (trajectory, magnification), number of projections, integration time, etc.

The CT reconstruction can be performed with different algorithms, more or less adapted to the imaged sample. Therefore, in addition to the optimisation of the acquisition process, the reconstruction can be optimized by:

- A proper choice of the algorithm and of its parameters.
- The evaluation of the necessary number of projections.
- The evaluation of the noise level and of its impact on the final result.

Benefits

The CT module available in the current version of CIVA simulation software allows you to find the most suitable configuration to optimize not only the acquisition but also the reconstruction process.

The CT setup can be prepared through simulation. Thus the time necessary for a setup may be optimized. Among others, CIVA will help you with:

- Improving control of the acquisition set-up to find the best configuration.
- Evaluation of various factors affecting the image quality, such as the misalignment of the source/ detector system.
- Evaluate the misalignment effects of the source/ detector system.
- Visualization of the reconstructed volume (3D) through arbitrarily oriented sections.
- Evaluation of the performance of different reconstruction algorithms.

EXTENDE CIVA

Optimize the tomographic reconstruction through simulation

Case study

Select the best reconstruction algorithm and optimize the number of projections

THE PROBLEM

In order to obtain the best results for a given sample, different reconstruction algorithms can be tested. The iterative algorithms use several parameters which can be optimized for each case.

The reduction of the number of projections used is of high interest, mainly in order to reduce the acquisition time and in order to reduce the radiation dose. Advanced iterative algorithms are capable of giving similar results using only a fraction of the projections needed by a standard algorithm.

CIVA'S CONTRIBUTION

CIVA can help in :

- Choosing the most suitable algorithm. Several CT reconstruction algorithms are implemented as plugins into CIVA, either as Fourier-based reconstruction or as iterative algorithms.
- Finding the minimal number of projections needed in order to obtain an accurate result. As an example, the user can use CIVA to simulate as many projections as wanted and then optimize the process by reducing gradually the number of projections.

In order to illustrate this procedure, 512 projections equally distributed over a full rotation were simulated with a 2D detector of 512x512 pixels. The sample is a numerical object formed by 15 cylinders in water with different densities, aluminum and bone-equivalent. Two algorithms are chosen for comparison, the classical FDK algorithm and an advanced iterative with TV regularization algorithm called PixTV.

First, the reconstruction from all the 512 projections shows identical results. However, when reducing the number of projections, PixTV produces much better results than FDK. When using only 32 equi-distributed projections the result of PixTV is still very accurate, while the result of FDK has deteriorated from artifacts to the point it cannot be used for analysis.

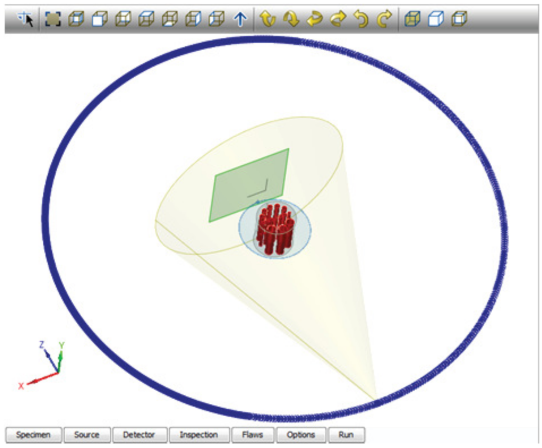

Figure 1. CIVA scene and CT setup for the comparison study.

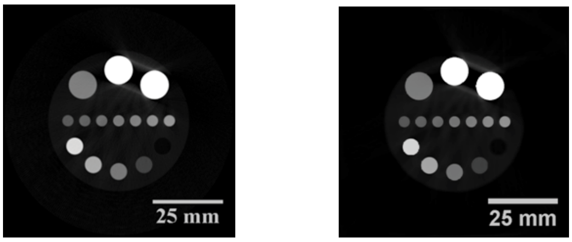

Figure 2. Reconstructions from 512 projections and profile plots along the central series of cylinders.

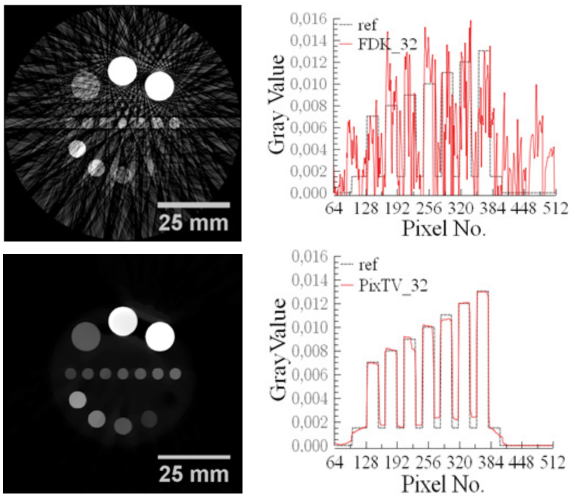

Figure 3. Reconstructions from 32 projections and profile plots along the central series of cylinders.

www.extende.com

EXTENDE CIVA

Le Bergson, 15 rue Emile Baudot
91300 Massy • France
contact@extende.com
Fax : +33 (0)9 72 13 42 68

PO BOX 461, Ballston Spa
NY 12020 • USA
contactus@extende.com
Fax : +1 518 602 1368