



User Manual

Version 1.0.0

AIMEN
July 1, 2024

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1 Introduction

This application is designed to search for defects in a composite structure with non-destructive testing (NDT) methods, both with Active Thermography, by clicking on the left image on the home page, and with Ultrasound Testing by clicking on the right image on the home page.

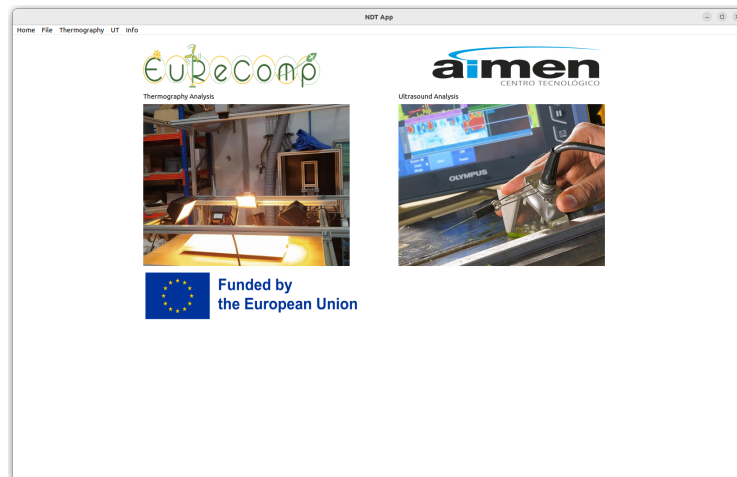


Figure 1: Home page of the application.

2 Active Thermography

On this part of the Eurecomp's NDT application the user can use Active Thermography for automatic detection and tagging of defects. It has both a lecture mode and a capture mode.

2.1 App Structure

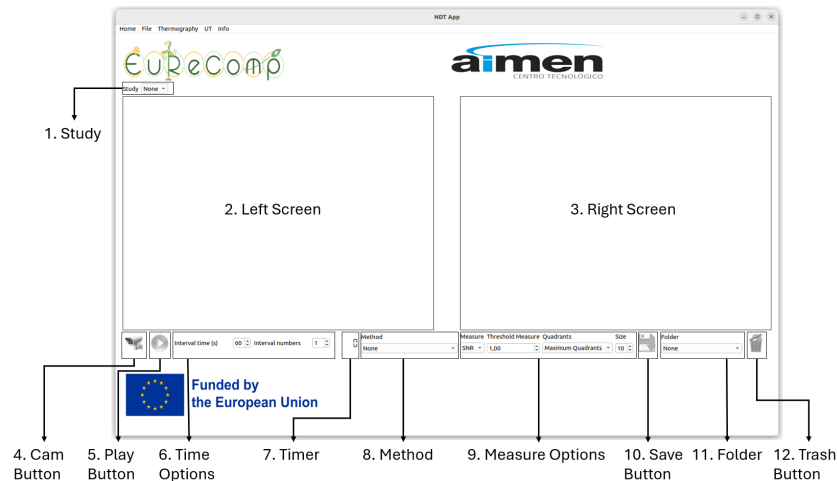


Figure 2: Eurecomp's Active Thermography app structure.

1. **Study:** In this option the user can switch between different active thermography studies already saved.
2. **Left Screen:** On this screen the thermographic video is shown. The Region of Interest (RoI) can be selected by keeping the left mouse button pressed until the target area is selected, as shown in Figure 3.

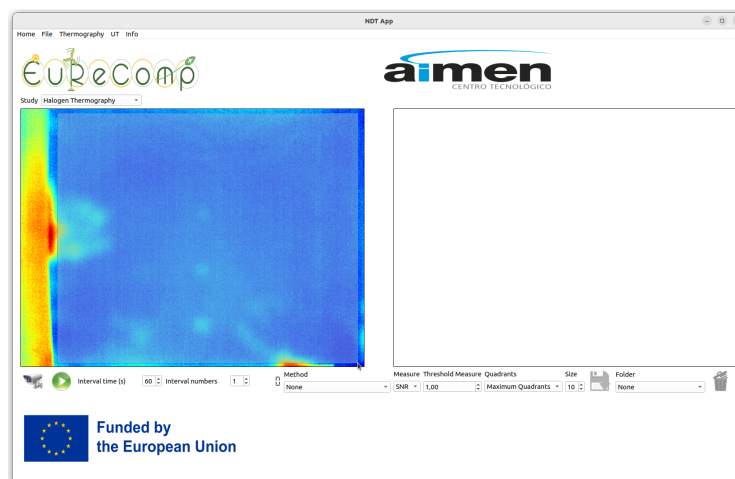


Figure 3: RoI selected on left screen.

3. **Right Screen:** On the right screen the image resulting from the selected method, including detected defects, is shown.

An additional defect can be added by keeping the left mouse button pressed until the target area is selected. A false defect can be selected as a false positive and subsequently be deleted by clicking the right mouse button inside the defect, as shown in Figure 4.

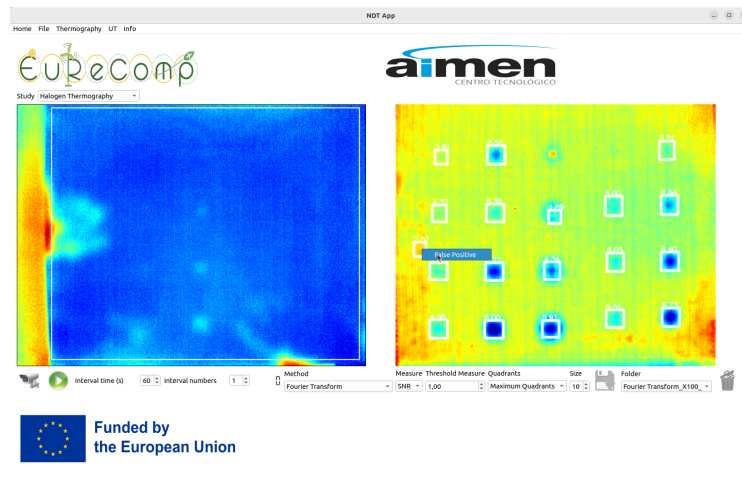


Figure 4: Defect selected as a false positive.

4. **Cam Button:** Reconnects the camera.
5. **Play Button:** Starts the record or the replay of the thermographic video on the left screen and shows the resulting image on the right screen.
6. **Time Options:** Options for the thermographic record:
 - **Interval time (s):** It's the time for each on-off interval of the heat source. By default its value is 60.
 - **Interval numbers:** It's the number of on-off intervals. By default its value is 1.
7. **Timer:** A timer to see the videos duration in seconds.
8. **Method:** The method used to process thermographic images. The options are:
 - (a) **None:** Only showing the thermographic video without post-processing.
 - (b) **Fourier Transform:** After saving the video Fast-Fourier-Transform (FFT) will be applied to analyse the results and detect defects.

- (c) **Principal Components Analysis:** After saving the video Principal Components Analysis (PCA) will be applied to analyse the results and detect defects.
9. **Measure Options:** Parameters to adjust the measurement that is used to detect defects:
- **Measure:** The type of measurement that is used over the image, resulting from the method of defect detection. It can be **SNR** (*Signal to Noise Ratio*) or **CNR** (*Contrast to Noise Ratio*).
 - **Threshold Measure:** Threshold value of the measurement deciding if a quadrant is considered as a defect or not. By default threshold value is 1, the minimum value in case of **CNR** is 0.
 - **Quadrants:** The way in which the defects are displayed. It can be:
 - (a) **Maximum Quadrants:** Shows the smallest quadrants that enclose the intersection of all contiguous quadrants of the image that have a bigger threshold than the selected **Threshold Measure**.
 - (b) **Resume Quadrants:** Shows the median quadrants of the intersections of all contiguous quadrants of the image that have a bigger threshold than the selected **Threshold Measure**.
 - **Size:** The size of the quadrants used to detect defects. By default it will be 10 pixels, the minimum is 3 pixels.
10. **Save Button:** Saves the measure options modifications in an already saved post-processing image.
11. **Folder:** A saved post-processing image with its defects can be selected, it will be shown on the right screen.
12. **Trash Button:** Eliminates the post-processing image selected in **Folder**.

2.2 Capture mode

To record a new video, a new active thermography study must be created and a camera must be connected to the computer. Otherwise a warning will appear.

On the left screen the camera capture is displayed and the RoI can be selected for the analysis. To select all the window, it's only necessary to click into it.

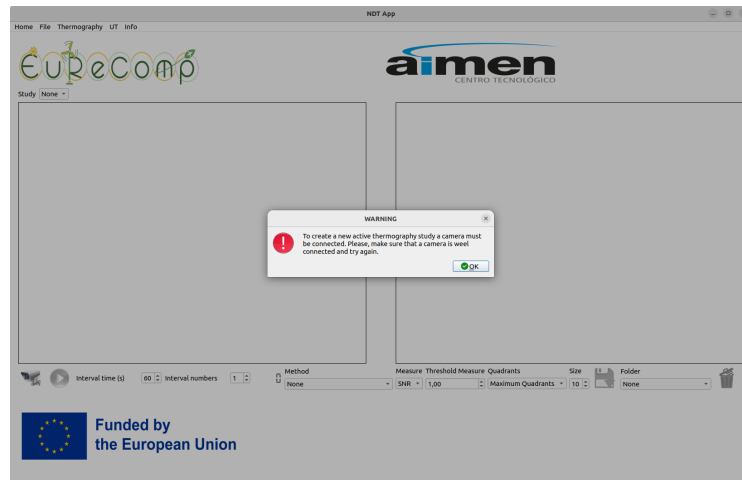


Figure 5: A warning appears for trying to record a new video without having a camera connected.

The time options can be modified for the record, and in case the user wants to post-process the image sequence after the record, the method and the measure options can be modified as well.

Once all options are selected, the app will start with the record of the images by clicking the *Play* button. The results of the post-processing can be observed on the right screen.

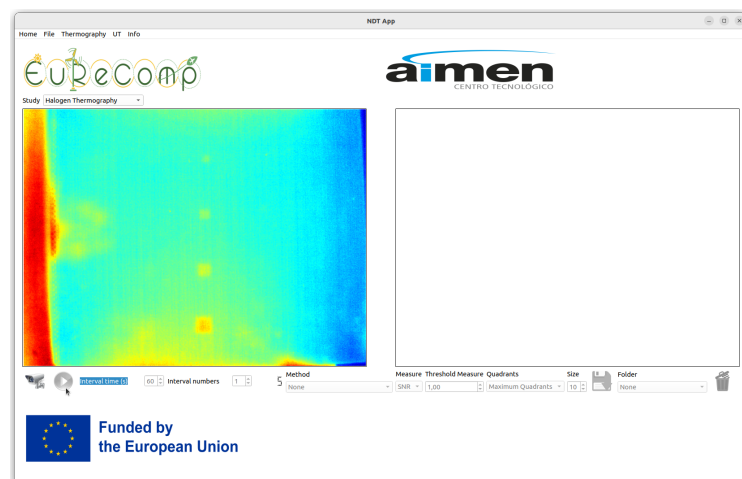


Figure 6: Capture mode.

2.3 Lecture mode

For the lecture mode its necessary to open a HDF5 file. Once opened, the first frame of the saved thermographic images can be seen on the left screen. A RoI can be selected and the method and the measure options can be modified to post-process the saved image sequence.

In addition, with the Folder option different saved results can be selected and displayed on the right screen. Once the folder with the desired results has been selected, the measurement options can be changed, new defects can be selected and false positives can be deleted. Click on the Save button to save the new changes or click on the Trash button to eliminate the folder.

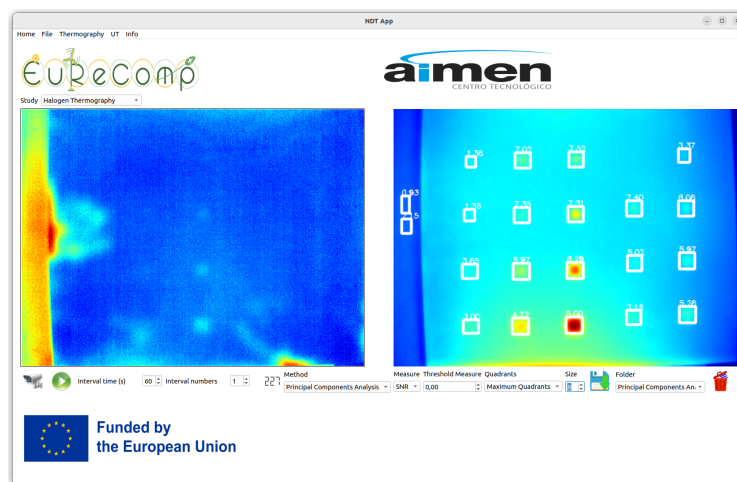


Figure 7: Lecture mode.

Note: If the changes are not saved, the last saved results are displayed when this folder is selected again, not the last changed results.

3 Ultrasound Testing

On this part of the Eurecomp's NDT application the user can use Ultrasound testing methods for automatic detection and tagging of defects.

3.1 App Structure

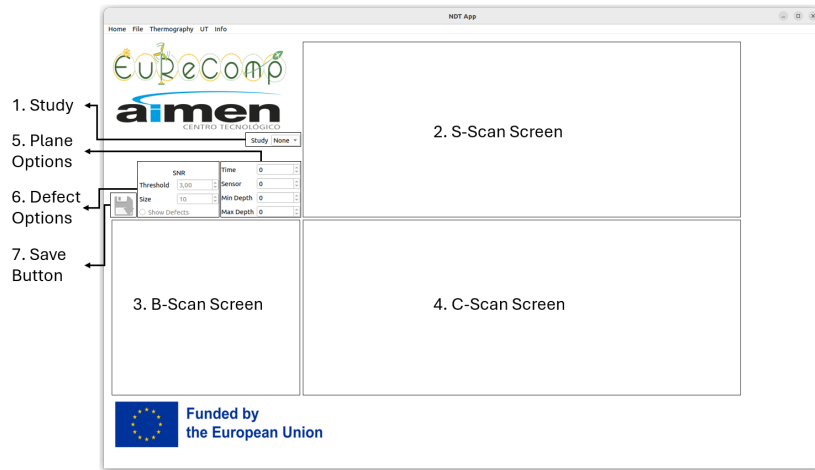


Figure 8: Eurecomp's Ultrasound Testing app structure.

1. **Study:** The user can switch between different ultrasound testing studies already saved.
2. **S-Scan Screen:** On this screen the S-Scan is showed.
3. **B-Scan Screen:** On this screen the B-Scan is showed.
4. **C-Scan Screen:** On this screen the C-Scan is showed.

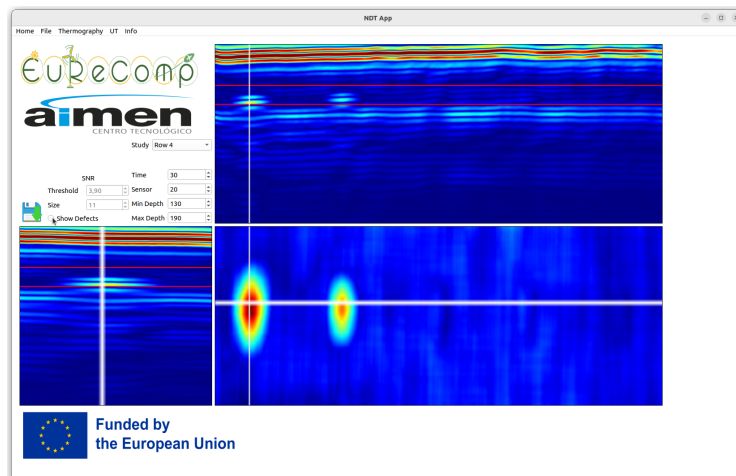


Figure 9: Ultrasound Testing study.

5. **Plane Options:** Change the plane of view of the S-Scan, B-Scan and C-Scan.

- **Time:** Change the plane of the B-Scan.
- **Sensor:** Change the plane of the S-Scan.
- **Min Depth:** Change the minimum depth to analyse the C-Scan.
- **Max Depth:** Change the maximum depth to analyse the C-Scan.

6. **Defect Options:** Options for the defect detection.

- **SNR:** The threshold of the Signal to Noise Ratio (SNR) for the automatic detection of defects on the C-Scan.
- **Size:** The size of the quadrants used to detect defects. By default it will be 10 pixels and its minimum is 3 pixels.
- **Show Defects:** If this option is activated, detected defects above the threshold of the SNR will be shown on the C-Scan. Also enables the option of adding a new defect or selecting a detected defect as a false positive.

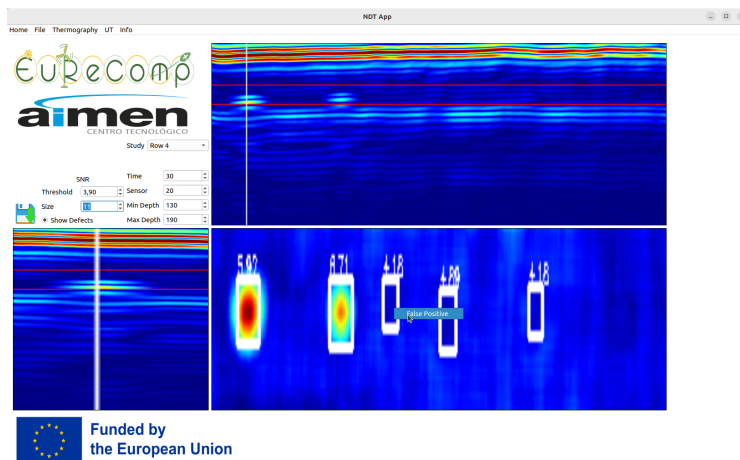


Figure 10: Defect selected as a false positive.

7. **Save Button:** Saves the options selected for the current study.

3.2 New Study

To create a new Ultrasound Testing study, it's necessary to open a NDE file of a previous inspection with OmniScan MX. Once the file is opened, the dataset is loaded and the first S-Scan, B-Scan and C-Scan are displayed.

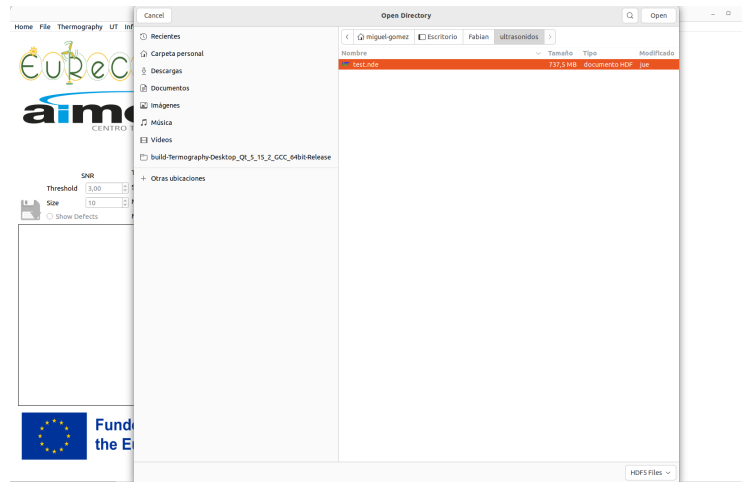


Figure 11: Open a NDE file for create a new Ultrasound Testing study.

4 HDF5 Files

The application uses HDF5 (Hierarchical Data Format) format, which is designed to save and retrieve data in/from large structured files. Thereby all results can be saved and structured in one file.

4.1 Basic Structure

HDF5 files have the following structure:

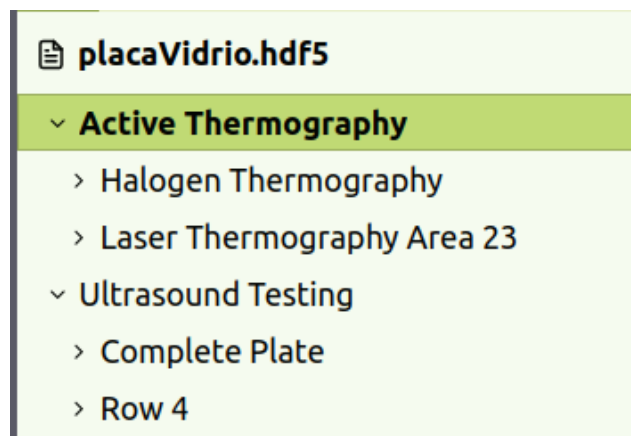


Figure 12: Basic HDF5 file structure.

- **Active Thermography:** A folder containing other folders with NDT studies using active thermography.

- **Ultrasound Testing:** A folder containing other folders with NDT studies using ultrasound testing.

4.2 Active Thermography Studies

Each study in the Active Thermography folder has the following structure:

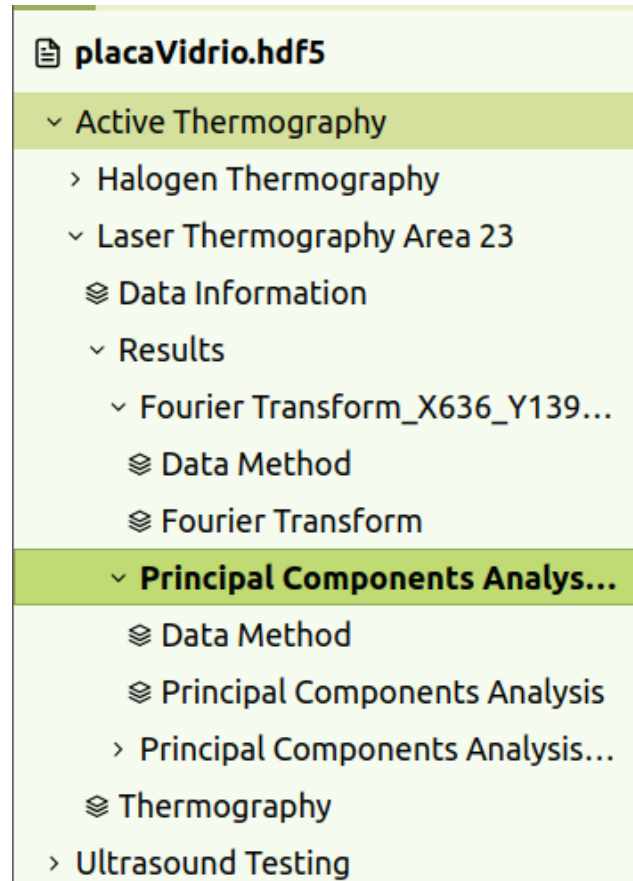


Figure 13: Structure of Active Thermography studies.

- **Data Information:** A JSON that contains information about the interval time, the number of intervals and the number of the saved images.
- **Thermography:** A 3 dimensional dataset where the generated image sequence is saved.
- **Results:** directory where other folders with results are saved. Each result folder has the name of the method used as well as the region of interest selected, and contains the following data:

1. **Data Method:** A JSON where the options selected in the thermographic analysis and the positions of detected defects are saved.
2. **Fourier Transform/Principal Components Analysis:** The resulting image after applying the method (Fast Fourier Transform or Principal Components Analysis) to the **Thermography** dataset.

4.3 Ultrasound Testing Studies

Each study in Ultrasound Testing folder has the following structure:

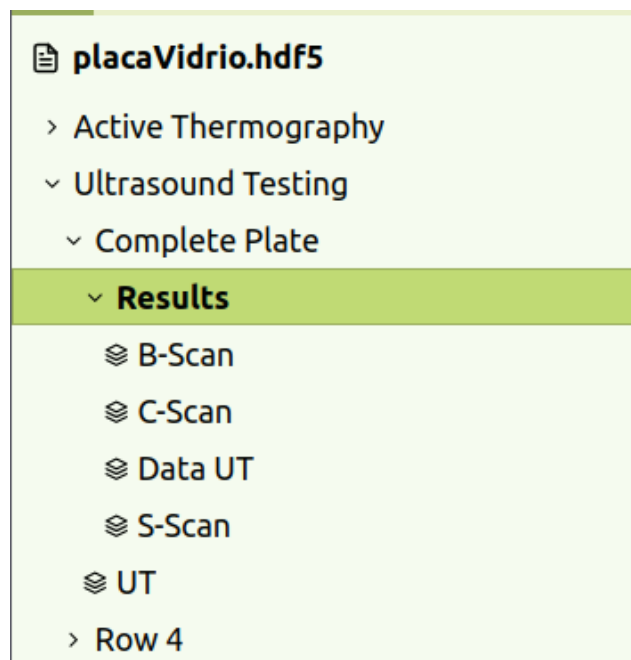


Figure 14: Structure of Ultrasound Testing studies.

- **Results:** The folder where the scans and the data of the defects are saved. It contains the following data:
 1. **B-Scan:** The image of the B-Scan.
 2. **C-Scan:** The image of the C-Scan.
 3. **Data UT:** The information of the detected defects.
 4. **S-Scan:** The image of the S-Scan.
- **UT:** The data collected with Ultrasound Testing.

5 Keyboard shortcuts

The app contains the following keyboard shortcuts:

- **CTRL + O**: Open a file.
- **CTRL + N**: Create a new file.