

SCANCO MEDICAL

ScanProgram



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Before using the ScanProgram application, you must read the instructions for use (IFU) of your specific scanner model. Ensure you understand and follow all instructions and safety messages contained in the IFU to operate the scanner correctly and safely. The most recent version of the IFU is available online at www.scanco.ch/support/ifupdf.

1 Measurement Procedure

To make a single scan the following workflow is used:

1. Start the ScanProgram application and wait for the warm up of the scanner. See [Initialization of the Scanner](#).
2. Fix your sample inside the sample holder and place the holder on the carousel. See [Placing a Sample on the Carousel](#).
3. Click the **Check/Refresh** button and select the carousel position of the sample. See [Checking Carousel Positions](#).
4. Select the sample name or number. See [Selecting the Sample](#).
5. Select a controlfile. See [Controlfiles \(Measurement Protocol\)](#).
6. Perform a scout view and set the reference line. See [Scout View](#).
7. Start the scan. See [Single Measurement](#).

It is also possible to prepare several scans by using the task list. The workflow is then as follows:

1. Start the ScanProgram application and wait for the warm up of the scanner. See [Initialization of the Scanner](#).
2. Fix your samples inside the sample holders and place them on the carousel. Samples can also be placed on top of each other inside the same sample holder. Take note which samples are placed at which position. See [Placing a Sample on the Carousel](#).
3. Click the **Check/Refresh** button and select the carousel position of the sample. See [Checking Carousel Positions](#).
4. For each sample:
 1. Select the sample name or number. See [Selecting the Sample](#).
 2. Select a controlfile. See [Controlfiles \(Measurement Protocol\)](#).
 3. Perform a scout view and set the reference line. See [Scout View](#).
 4. Click **Add Scan**.
5. Open the task list and click **Start Interact. Tasks** or **Submit Batch Scans**. See [Task List](#).

It is also possible to perform scout views through the task list.

2 Starting the ScanProgram application

After logging in to the Application Center, click the **Sc** button to start the ScanProgram application.

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Figure 1: Start ScanProgram application

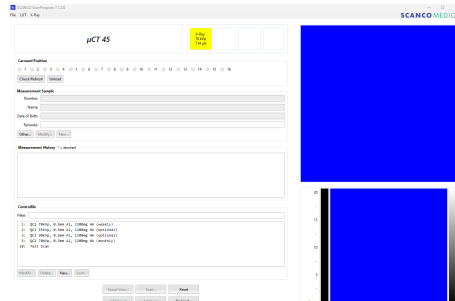


Figure 2: ScanProgram main application window

2.1 Initialization of the Scanner

After starting up the ScanProgram application, the scanner will be initialized and the power up of the X-ray tube will begin.

2.2 Placing a Sample on the Carousel

After the initialization the following dialog will appear on the screen:

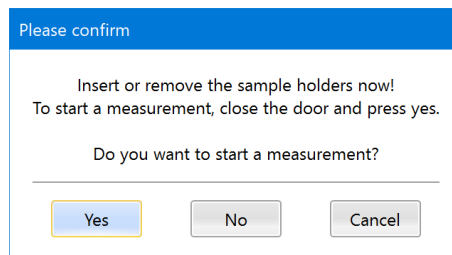


Figure 3: Sample placing

Now it is time to insert or remove the sample holders. The **door open** status is indicated on the scanner's display. Close the door after placing the sample holders onto the carousel and click the **Yes** button. If multiple sample holders have been placed please note the location of each sample. The carousel positions are marked with numbers 1 to 12. You should note the size of the sample holders regarding the setting up of the scan settings in the controlfile.

NOTICE

Scanned objects must be fully contained in the sample holder tubes. Make sure that absolutely no fluid can drip on the scanner mechanics! Use parafilm to seal the sample holders which may prevent the spilling of fluids! Do not fill the sample holders to the top!

2.3 Checking Carousel Positions

After clicking the **Yes** button, the application will check the carousel positions to locate the sample holders. This procedure must not be done if no samples holders have been inserted or removed. After opening and closing of the door the checking procedure needs to be reinitialized by clicking the **Check/Refresh** button. To open the door, click the **Unload** button.

After checking the carousel positions, the valid samples will be displayed. Select the position on the carousel of the sample to be scanned.

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Figure 4: Checking carousel positions

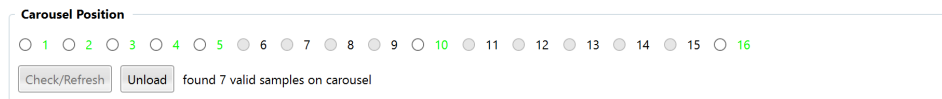


Figure 5: Samples found on carousel

3 Selecting the Sample

After checking the carousel, the following dialog appears in the middle of your screen:

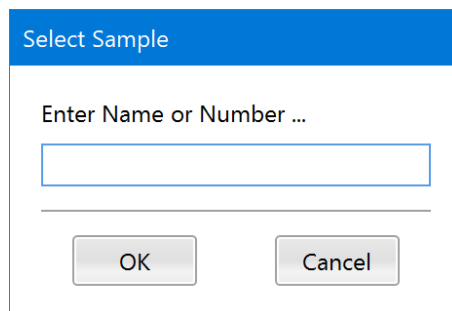


Figure 6: Input of Sample's Name or Number

Enter either the sample name, part of the sample name or sample number in the input field. Confirm your input by clicking **OK**. You can also click the **OK** button without entering any text for a list of all available sample names.

Pay attention to the spelling. The application is case sensitive!

As in the Sample Registration application, a list of all samples now appears that correspond to your entry. Click on the sample that you want to scan and confirm with **OK**.

If the desired name cannot be found in the database, the following error message will appear:

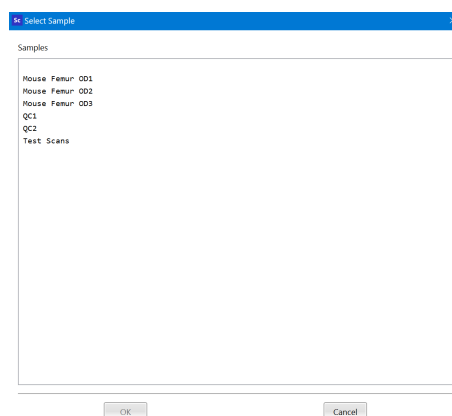


Figure 7: List of matching samples to select from

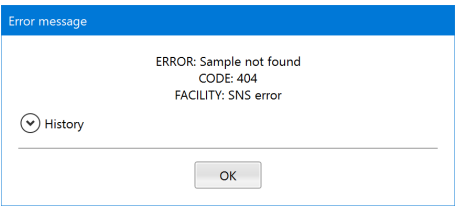


Figure 8: Sample name or number not found

After you have chosen or entered a sample name, the sample information appears in the main application window. If the sample is not being measured for the first time, its measurement history will also be displayed, with date and number of slices.

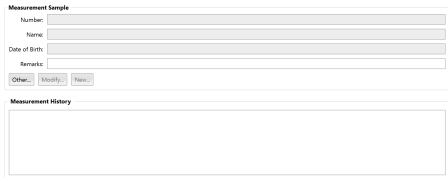


Figure 9: Measurement Sample and Measurement History

4 Controlfiles (Measurement Protocol)

After successfully choosing the sample, select a pre-defined controlfile or set up a new controlfile for your scan.

CAUTION

For users operating the **XtremeCT or XtremeCT II scanners** in a clinical setting: Only use the predefined standard controlfiles as specified in the scanner's instructions for use (IFU). Using any other controlfiles may compromise the safety and effectiveness of the medical device.

4.1 Controlfile Types

The controlfiles define all measurement parameters for the scan. There are two types of controlfiles:

- Pre-defined (with fixed measurement protocols)
- User-defined (can be altered by user)

4.2 Selecting a Controlfile

Select the desired controlfile by clicking on an item in the list.

After the controlfile is selected, you can perform a scan or a scout view by clicking **Scan...** or **Scout-View....**

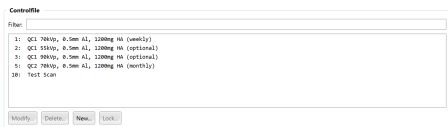


Figure 10: Selecting a controlfile

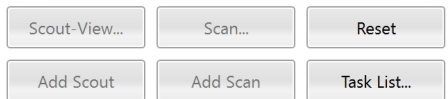


Figure 11: Start a scan or scout view

4.3 Creating a New Controlfile

If you want to define a new controlfile, click **New...** and the **Definition of Controlfiles...** dialog appears.

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4.4 Deleting a Controlfile

If you have selected a user-defined controlfile, you can delete it by clicking **Delete....** You will be asked to confirm the deletion of a controlfile.

4.5 Locking a Controlfile

If you have created or modified a user-defined controlfile, you can lock it and prevent any modification or deletion. To lock a controlfile, click **Lock....** You will be asked to confirm your action.

NOTICE

Locked controlfiles cannot be modified anymore. Modifications to a locked controlfile can only be saved as a new controlfile using the **Save as New** button.

4.6 Modifying a Controlfile

You can alter a controlfile before starting the measurement by clicking **Modify....**

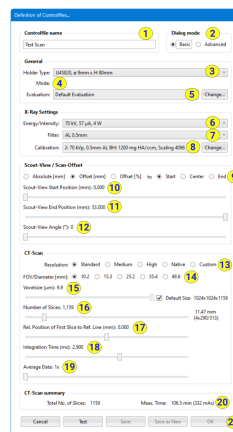


Figure 12: Modifying a Controlfile, Basic Mode

4.6.1 Basic Mode

Legend:

1. **Controlfile name:** Enter a meaningful name describing the measurement protocol.
2. **Dialog mode** of the controlfile: **Basic** or **Advanced** (see [Modifying a Controlfile, Advanced Mode](#)).
3. **Holder Type:** Choose the used sample holder type with the correct diameter.
4. **Mode:** No selectable option for this scanner type.
5. **Evaluation:** Choose which evaluation script shall be preselected in the evaluation application by clicking **Change....**

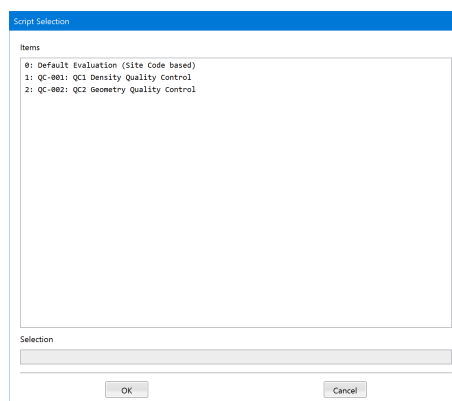


Figure 13: Evaluation Script Selection

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6. **Energy/Intensity:** E (kVp), I (μ A): Choose energy (voltage) and intensity (current) settings. Standard energy setting for bone measurements is 70 kVp. Intensity settings affect image noise and level of detail, energy settings affect aspects such as image contrast, signal-to-noise ratio, penetration depth, and radiation dose. Increase the energy for higher absorbing materials and decrease the energy for lower absorbing and lower contrast materials.
7. **Filter:** If applicable, choose a filter. Available options vary by scanner type. Typical filters include 0.5mm Al, 0.1 mm Al, 0.1 mm Cu and air. Standard filter is 0.5 mm Al.
8. **Calibration:** Select the appropriate calibration record for the chosen energy and sample by clicking **Change....**
9. Choose between **Absolute [mm]**, **Offset [mm]** and **Offset [%]** to specify how the scan position is defined. The **Start**, **Center** and **End** options define whether the reference line position is the start, center or end point of the scan region.

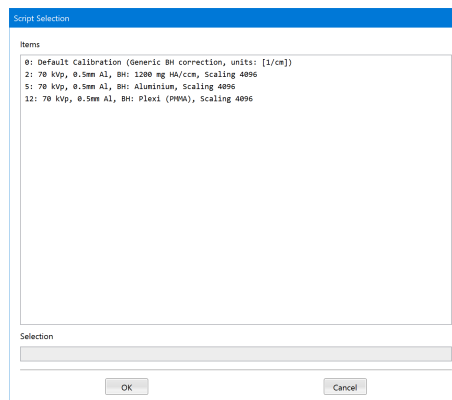


Figure 14: Beam-hardening script selection

10. **Scout-View Start Position (mm):** This value appears in the **Scout-View** dialog as the default value and can be altered for each measurement individually.
11. **Scout-View End Position (mm):** This value appears in the **Scout-View** dialog as the default value and can be altered for each measurement individually.
12. **Scout-View Angle (°):** Scout view mode only, rotating the object for a better visual presentation of the object.
13. **Resolution:** Depending on the scanner type, there are up to 5 resolution options: standard, medium, high, native, and custom. The table [below](#) shows the number of projections and the size of the reconstructed image matrix with each resolution option for the μ CT 100 scanners.

Resolution	Acquisition: # of Projections / 180°	Reconstructed Image matrix: MicroCT 100
Standard	250 projections	1024 x 1024
Medium	500 projections	1024 x 1024
High	1000 projections	2048 x 2048
Native	1500 projections	3072 x 3072 (corresponds to size of detector)
Custom	up to 2000 projections	up to 8192 x 8192 (selecting Custom automatically opens Advanced mode)

Table 1: Resolution table

14. **FOV/Diameter [mm]:** Choose the diameter of the field of view (FOV). The number indicated is the size of the reconstruction area. FOV sizes not marked: possible
Marked Yellow: possible, FOV smaller than diameter of sample holder for local tomography
Marked Red: not possible
15. **Voxelsize (μ m):** When the **Default Size** checkbox is selected, the voxel size is shown in the slider. The

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chosen voxel size is that of the reconstructed image data. After clearing the **Default Size** checkbox, you may select another voxel size of the reconstructed image, which is achieved by an interpolation during the reconstruction. The resulting image matrix size is displayed to the right of the **Default Size** checkbox. It only makes sense to reduce the voxel size if binning is 1. See [Modifying a Controfile, Advanced Mode](#). The voxel size will be displayed in yellow if it is not an optimal setting.

16. **Number of Slices:** Choose the number of slices by moving the slider to the left or the right. To the right of the slider, a number indicates the covered range in mm (number of slices x voxel size). Below the covered range, the number of stacks will be displayed together with the number of slices per stack (number of stacks x number of slices per stack / max number of slices per stack).
17. **Rel. Position of First Slice to Ref. Line (mm):** Relative position to scout view reference line or the absolute position 0 mm.
18. **Integration Time (ms):** Adapt the integration time to the sample's density and size. A longer integration time leads to a higher signal-to-noise ratio. The reconstruction time is not affected by this value, but the measurement time is. If the selected integration time appears in red it is too long and will saturate the detector.
19. **Average Data:** Multiply the integration time with the chosen factor (1-10 x).
20. **Total No. of Slices | Meas. Time:** The total number of slices and the resulting measurement time for the chosen measurement parameters.
21. After setting all the required parameters, the settings need to be tested by clicking **Test**, which double checks all the settings, especially whether the integration time would lead to a saturation of the detector or if the calibration matches the energy, intensity and filter. After successfully testing the settings, the **Save**, **Save as New** and **OK** buttons are activated. **Save** will overwrite this controfile. **Save as New** will save this controfile as a new controfile under a different name and number. **OK** will set this controfile only for the next measurement and then delete the modifications.

4.6.2 Advanced Mode

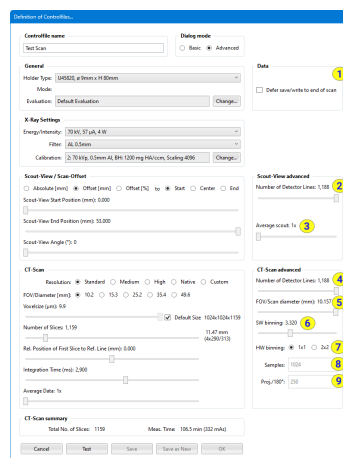


Figure 15: Advanced Mode

Legend:

1. **Defer save/write to end of scan:** Option to save/write the data to the disk at the end of the scan instead of every stack. This reduces the time the subject is required to hold still (vivaCT and XtremeCT).
2. **Number of Detector Lines:** Defines how many lines of the detector shall be used during the scout view. Using all available detector lines provides faster scout views, but some artifacts may be seen at the stack overlaps. Limit the lines to a small number to reduce the number of slices per stack and to get scout views without those artifacts, but the acquisition time will increase.
3. **Average scout:** Averages the scout view projections in order to reduce noise on the scout view.
4. **Number of Detector Lines:** Number of lines of the detector used during the actual CT scan. Each complete rotation of the sample will produce a stack of slices. The number of slices in each stack will depend on the chosen number here. Limit the number of detector lines if you see residual cone-beam artifacts (scan time may increase). If not set manually, this number will be automatically changed to

optimize the usage of the detector with respect to the number of slices to scan.

5. **FOV/Scan diameter (mm)**: Diameter of the field of view (the number indicated is the size of the reconstruction area). This setting crops the area of detector, which leads to smaller image matrices to save space and reconstruction time.
6. **SW binning**: Factor by which original pixels on the detector are combined. Binning groups a cluster of pixels into a single pixel, for example, a binning of 2 combines 2 x 2 pixels into one. This process increases voxel size and reduces both image noise and size.
7. **HW binning**: Similar to software binning but performed at the hardware level resulting in significantly smaller file sizes and reduced scan times. It enhances the signal-to-noise ratio but at the cost of reduced resolution. Available options vary by scanner type, ranging from no binning (1x1) to a maximum of 3x3.
8. **Samples**: Number of pixels (potentially after binning) on the detector used for each slice. This count refers to the entire field of view (FOV), independent of the **FOV/Scan diameter (mm)** setting.
9. **Proj./180°**: Number of projections captured during a 180-degree rotation of the sample.

4.7 Unload

Use the **Unload** button to bring a specimen back to the carousel. It also unlocks the door afterwards.

4.8 Check/Refresh

Use the **Check/Refresh** button to reinitialize the carousel position and detect the positions of the available sample holders on the carousels.

5 Scout View

5.1 Overview

The scout view, comparable to a conventional radiograph, is used to determine the measurement area. On the scout view, a reference line has to be set. This reference line determines the position of the first slice or a fixed offset from this position (in mm or %), depending on the controlfile settings, and must therefore be selected very carefully.

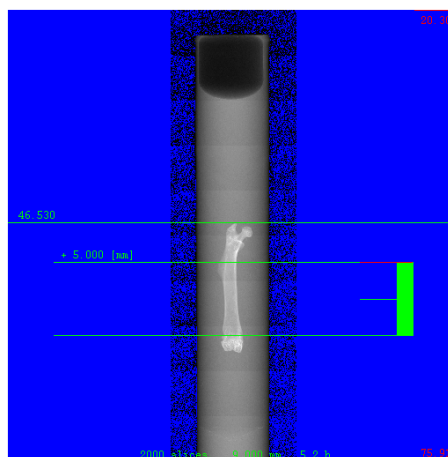


Figure 16: Scout view of a bone biopsy with reference line

5.2 Scout View Controls

The scout view can either be started by clicking **Scout-View...** or be put in the task list by clicking **Add Scout**. The task list groups prepared scans and scout views to be performed in a list that will be executed unsupervised one after the other, either in interactive mode or in batch mode.

Click **Scout-View....** If the scan offset has been set in mm, the following dialog will appear:

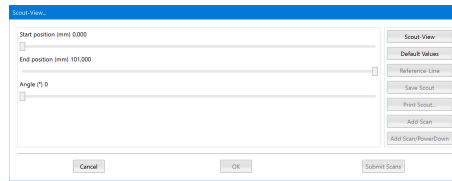


Figure 17: Scout view settings

The following can be done:

- Determine start and end position for the scout view
- Set the angle of the scout view
- Perform the scout view
- Set the reference line
- Save the scout view (this is done automatically for the first scout view of each sample (=reference scout view of reference measurement))

5.2.1 Defining Scout Area

Start and Endposition

With these two sliders the vertical area of the scout view can be determined. The default values are defined in the controlfile, which can be changed for a specific sample. The start position at 0mm is defined as the top of the sample holder.

Angle

The specimen can be rotated using this slider (scout view only). This allows to better visualize structures which are not visible from one angle but possibly from another view (e.g. growth plate of a joint).

Default values

The **Default Values** button resets the sliders to the values as defined in the controlfile.

Offset [%]

If the scout view setting **Offset [%]** was selected in the controlfile, there will be an additional row on the right-hand side of the **Scout-View...** dialog. Define the given length of a reference object, e.g. arm length or object length. The relative offset in % of this object is calculated automatically.

5.2.2 Start Scout View

Click **Scout-View**. The scanner starts acquiring the scout view image. First it will show half of the radiograph, then continue with the second half of the image.

You can interrupt the scout view at any position by clicking **Cancel**. If it is scanning the first half, it will continue immediately with the second half, if you click while scanning the second half, it will stop. You may have to click twice to interrupt the scout view completely.

5.2.3 Reference Line

Click **Reference-Line** and move the cursor to the acquired scout view in the upper right pane. The green reference line now follows the cursor. Click in the pane to fix the reference line. To correct the positioning of the line, click the **Reference-Line** button again and perform the corrections.

As you move the reference line, you can adjust the number of slices by pressing and holding **Shift**. Moving the cursor adjusts the end of the scan (scan length, scan area). By releasing **Shift**, you can move the reference line again.

NOTICE

In the **XtremeCT/XtremeCT II systems**, the number of slices cannot be changed when using locked controlfiles.

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To center a certain number of slices, move the reference line to the top of the specimen, press **Alt** and move the cursor to the bottom. The reference line will be centered in between. Click to set this centered reference line. At the bottom of the scout view, the number of slices and size of the region [mm] to be measured is displayed together with the predicted measurement time.

5.2.4 Saving/Printing Scout Views

Save Scout View

The reference scout view (first measurement) is automatically saved when the scan is started, and is shown for every follow-up measurement of the same sample. The function **Save Scout** therefore is only used if the reference scout view for some reason should be replaced.

The scout view is saved as a .SCV-file (low resolution) and a .RAD-file (high resolution).

Print Scout View

Click **Print Scout...** to make a hardcopy of the image in the top-right pane. You can choose between PostScript (sheet including sample name, number etc.) or Encapsulated PostScript and TIFF format (image data only, file only).

5.2.5 Add Scan (Batch Measurement)

Clicking **Add Scan** will put the measurement you have just defined into the task list. You can define multiple measurements.

You can put multiple specimens in one sample holder. Please be aware that if you have multiple specimens and batch mode measurements on all of those different specimens, choose the appropriate number/name for each specimen before you click **Add Scan** or **Submit Scans**. You can modify the sample by clicking **Other....**

Clicking **Add Scan/Power Down** will add the scan to the task list and shut down the X-ray tube after completion of the scan.

You can do either a single interactive scan by setting the reference line, clicking **OK** and then **Scan...** in the main application window, or you can perform multiple scans by clicking **Add Scan** for each scan to be performed and then either clicking **Submit Scans** or going via the task list.

5.3 Zoom/Pan in Scout View

Once you have performed a scout view (interactive or reloaded via task list), you can zoom in or out in the scout view pane using the scroll wheel of your mouse.

For panning, right-click and drag the image in any direction.

5.4 Adjusting Brightness in Scout View

By holding **Shift** and scrolling with the mouse wheel within the scout view pane, you can increase or decrease the brightness of the currently loaded image.

5.5 High-Resolution Radiographs

Scout views are stored in low resolution (*.SCV). In addition to this format, a high-resolution image (*.RAD, native scanner resolution) is stored in the directory of the corresponding measurement.

5.6 OK/Scan

After positioning the reference line as described, click **OK** to confirm the placement of the reference line. This also saves the scout view if it is the first scout view for that specimen. After clicking **OK**, start the scan by clicking **Scan...** in the main application window.

5.7 Cancel

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If you notice an error in your inputs (for example, wrong controlfile, wrong sample etc.), or if the scout view is not optimal and you need to reposition the sample, you can click **Cancel** to return to the main application window. Correct the errors and start again with the scout view.

5.8 Examples of Scout View Modes

In the examples below, cases of offset given in mm or % from the reference line to the start, center and end of the stack are shown.

Scout-View / Scan-Offset

☐ Absolute [mm]
 ☒ Offset [mm]
 ☐ Offset [%]
 to
 ☒ Start
 ☐ Center
 ☐ End

Scout-View Start Position (mm): 20,304

Scout-View End Position (mm): 65,384

Scout-View Angle (°): 0

CT-Scan

Resolution: ☐ Standard ☐ Medium ☐ High ☒ Native ☐ Custom

FOV/Diameter [mm]: ☒ 10.2 ☐ 15.3 ☐ 25.2 ☐ 35.4 ☐ 49.6

Voxelsize [μm]: 4.5

Number of Slices: 2,000

Rel. Position of First Slice to Ref. Line (mm): 5,000

Integration Time (ms): 2,520

Average Data: 1x

Figure 18: Definition of relative offset [mm] to start of scan

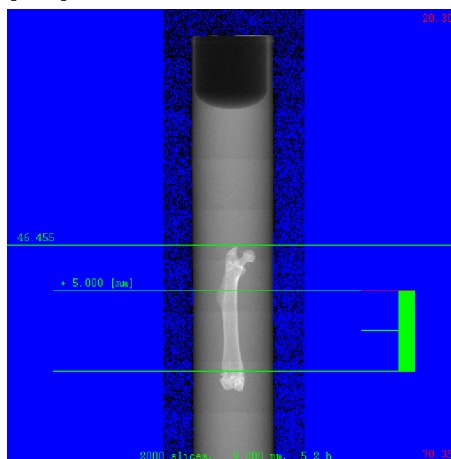


Figure 19: Example relative offset [mm] from reference line to start of scan.

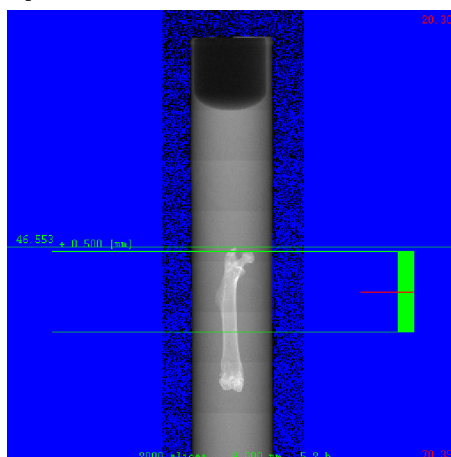


Figure 20: Example relative offset [mm] from reference line to center of scan.

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Scout-View / Scan-Offset

☐ Absolute [mm]
 ☐ Offset [mm]
 ☒ Offset [%] to
 ☐ Start
 ☐ Center
 ☒ End

Scout-View Start Position (mm): 20,304

Scout-View End Position (mm): 65,384

Scout-View Angle (°): 0

CT-Scan

Resolution: ☐ Standard ☐ Medium ☐ High ☒ Native ☐ Custom

FOV/Diameter (mm): ☐ 10.2 ☒ 15.3 ☐ 25.2 ☐ 35.4 ☐ 49.6

Voxelsize (µm): 4.5

Number of Slices: 2,000

Rel. Position of Last Slice to Ref. Line (%): -10,000

Integration Time (ms): 2,520

Average Data: 1x

Figure 21: Definition of relative offset [% of limb/object length] to end of scan

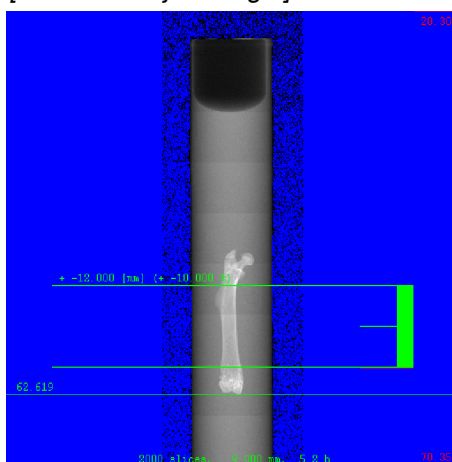


Figure 22: Example relative offset [% of limb/object length] from reference line to end of scan.

Scout-View

Default Values

100% [mm]: 30.0

Reference-Line

Save Scout

Print Scout...

Add Scan

Add Scan/PowerDown

Figure 23: Input field for limb/object length in Scout View... dialog

6 Single Measurement

Click the **Scan...** button. The following dialog will appear:

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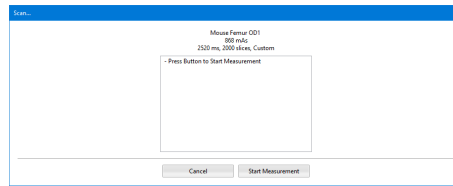


Figure 24: Start Measurement

6.1 Start Measurement

Click the **Start Measurement** button. First, the disk space needed for the measurement is allocated, then the *reference intensity* (I0) and *dark* are measured. One projection after the other is then continuously performed. In the lower right pane, the progress is shown as a grid of sinograms (raw data), with each tile representing the sinogram of a scanned stack. The upper right pane displays a preview of the reconstructed middle slice from the most recently scanned stack.

6.2 Cancel

If you notice an error in your inputs (for example, wrong controlfile, wrong sample etc.), or if the scout view is not optimal and you need to reposition the sample, you can click **Cancel** to return to the main application window. Correct the errors and start again with the scout view.

7 Task List

7.1 Scanning Modes

Both scout views and/or scans can be placed in a task list. The tasks from this list can then be started in interactive mode or in batch mode (scans only). The individual tasks are performed one after the other without any further user intervention. The interactive mode is similar to batch mode, but still under user control through the application interface.

To use the scout views that have been performed through the task list, mark the task in the task list and click **Load Scout**.

7.2 Adding Tasks

The procedure is not much different from the standard way of starting scout views or scans. The **Add Scout** and **Add Scan** buttons will add the selected scout view or scan to the task list for consecutive execution.

If you perform a scout view and have defined a reference line, you can add the task (scan) to the list by clicking the **Add Scan** button. This may take a few seconds as the high-resolution scout view (radiography file, .RAD) is stored to the measurement disk at this stage. Afterwards, a confirmation message appears as in the image below.

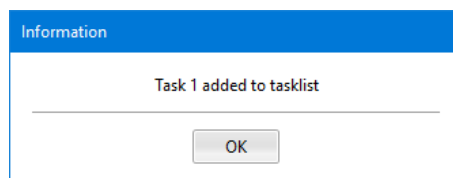


Figure 25: Adding Tasks

7.3 Starting Tasks

Click the **Task List...** button in the main application window to open the list. You can click on individual tasks, check the parameters (under **Current Task:**), sort the list using the arrow buttons, delete by clicking **Remove...** or activate/deactivate a task using the **Active** checkbox (task remains in the list, but will not be performed). Once you have all tasks ready, you can start executing all active tasks by clicking **Start Interact. Tasks**. If you click **Submit Batch Scans**, only scans (and not the scout views) will be started in batch mode (unattended batch jobs,

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application will close).

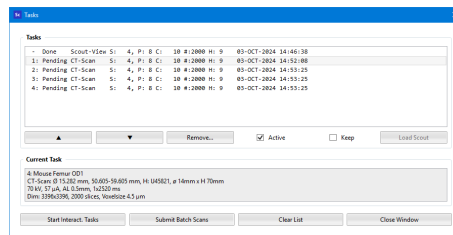


Figure 26: Task List

7.4 Keeping/Deleting Tasks

Scout view tasks are kept in the list. Once they are all done, you will have to reselect them, load the corresponding scout view image (**Load Scout**), and then define the reference line to be able to add a scan to the list. Therefore, these tasks have to be deleted manually once you do not need them any further.

Scan tasks get the **Keep** checkbox cleared by default. This means that the tasks are deleted automatically from the list if they were executed successfully. Should an error occur during the scan (e.g. sample holder too big, calibration error, x-ray tube error, power loss etc.), the scan will reside in the list and can be restarted easily the next time you launch the ScanProgram application.