Technical Procedure: Scout and Zoom for High Resolution Interior Tomographies

1 Abstract

Scout and Zoom is a unique capability of ZEISS X-ray Microscopy (XRM) instruments. It allows a user to perform a low resolution, large field of view, "Scout" scan to identify interior regions for higher resolution "Zoom" scans. This document describes the procedure for this technique.

2 Overview

Performing an interior, or local, tomography at high resolution can be a very powerful technique. Conventionally, the first step of aligning any sample for an interior tomography is to use low resolution 2D projections. This is followed by fine tuning the alignment using the 2D projections at higher resolution. However, this is usually done when the ROI (Region of Interest) is a non-specific area, or when the features of interest are easily visible in the projections.

When it is required to image a more specific interior region, obtaining correct alignment can be quite challenging using only 2D projections. Examples of this include: imaging a specific region of trabecular bone inside an intact bone, a particular solder bump in the interior of large semi package, or a specific area of cracks or voids in a composite sample. For these types of cases, collecting a lower resolution overview scan to help guide the higher resolution interior tomography scan can be very helpful.

This method is essentially broken into two steps: a "Scout" step and a "Zoom" step. First the Scout scan, a quick, low resolution tomography, is acquired. The Scout scan is then examined in XM3DViewer to identify the co-ordinates for centering a feature or ROI for the high resolution Zoom scan. With the information from XM3DViewer, a calculator is used to determine the proper sample stage position for the Zoom scan.

3 Procedure

***Note: In order for this technique to work the sample must remain mounted in the sample holder in its original position. If the sample is dismounted between the Scout scan and the Zoom scan this procedure will not work. ***

3.1 Follow procedures from the user guide to establish all standard scanning parameters.

3.2 Take a quick 15-30 minute Scout scan using a low resolution objective. An example recipe for of a short 16 minute scan using the 4X objective is shown in Figure 1

Figure 1: A quick 16 minute scan is taken at approximately 4.5µm resolution

3.3 Reconstruct without any crop or rotation and open the Scout scan in the 3DXMViewer as shown in Figure 2.

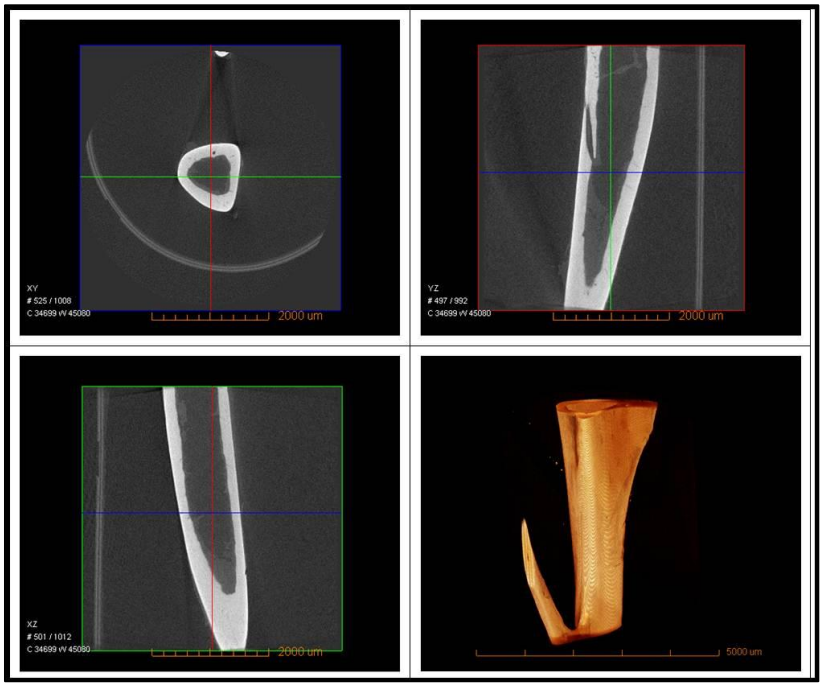

Figure 2: ZEISS's XM3DViewer shows reconstructed 2D slices. Each of the quadrants represents a different orthogonal virtual slice. The colored lines correspond to slices with the same border color.

3.4 Using the 3D cropping tool make a box equivalent to the FOV of the desired high resolution scan. The measurement tool is useful to size the cropping box to the size of the intended interior tomography FOV. Figure 3 has a box of volume $(0.6mm)^3$ to represent a 0.6µm voxel size, high resolution scan.

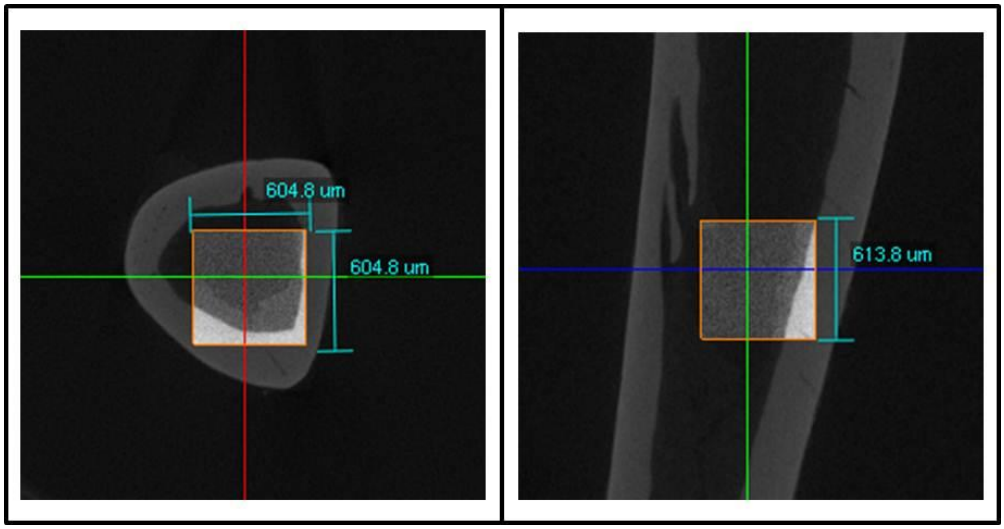

Figure 3: Using the 3D crop tool and the measurement tool, a box is made to represent the area for desired high resolution, interior tomography

3.5 Using the mouse mode move the box to the desired ROI. Next, move the colored lines so they are centered on this ROI. These colored lines correspond to specific slice numbers representing the center of the new ROI and will be used to calculate the correct sample stage position.

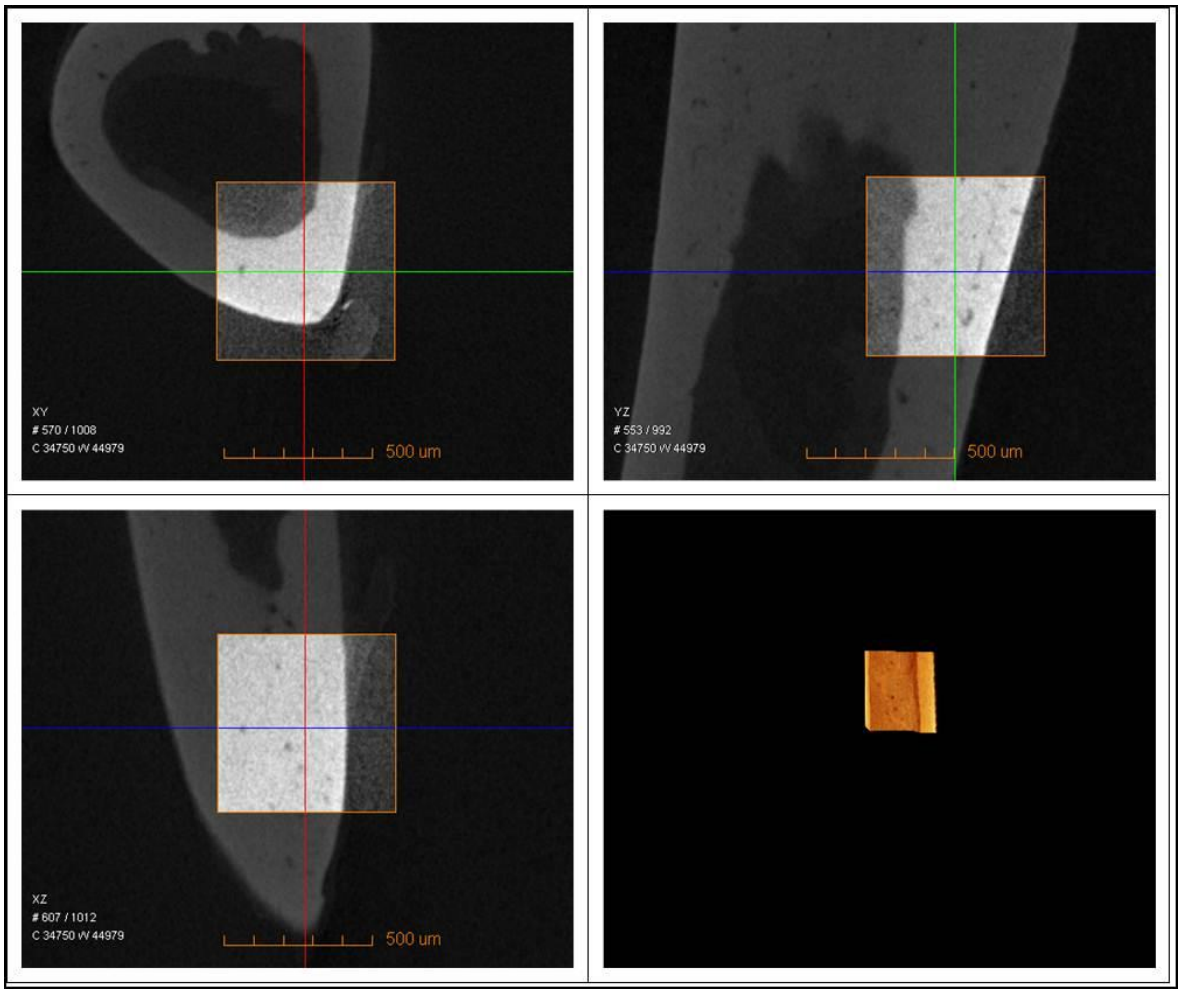

Figure 4: The selected FOV for the high resolution scan is highlighted. The axes are centered and the slice numbers are used as inputs for the next step.

3.6 The *Internal ROI Calculator*, found at the end of this document, is shown in Figure 5. The next steps describe the method of inputting the information to obtain the correct sample stage axes positions for a high resolution scan.

Internal ROI Calculator

Enter the Axis Position for the Scout Scan from the XMController	
x	-216
y	-37675
z	1081

New Axis Position	
x	41
y	-37378
z	1536

Total Number of Slices		XM3DViewer Plane
x	992	yz
y	1008	xy
z	1012	xz

Slice Position for Desired Center for Interior Tomography ROI		XM3DViewer Plane
x	553	yz
y	570	xy
z	607	xz

Pixel Size	4.50	µm

Reset

Figure 5: The *Internal ROI Calculator* is used to calculate the new sample stage positions for the center of the interior tomography.

a. The current axes positions are taken from the low resolution Scout scan. On the Run page, the required parameters are seen on the top left corner of the scout scan or the raw tomography window (Figure 6a). The parameters can also be found by opening the raw tomography (.txrm file) in the XMController (View>Image Control. Right click and select the Axes tab). (Figure 6b) Input these values into the correct field of the *Internal ROI Calculator.*

Figure 6: Find the axes position of the Scout scan.

b. The total number of slices is found from the XM3DViewer. The respective planes need to be checked for the individual axes as shown in Figure 7.

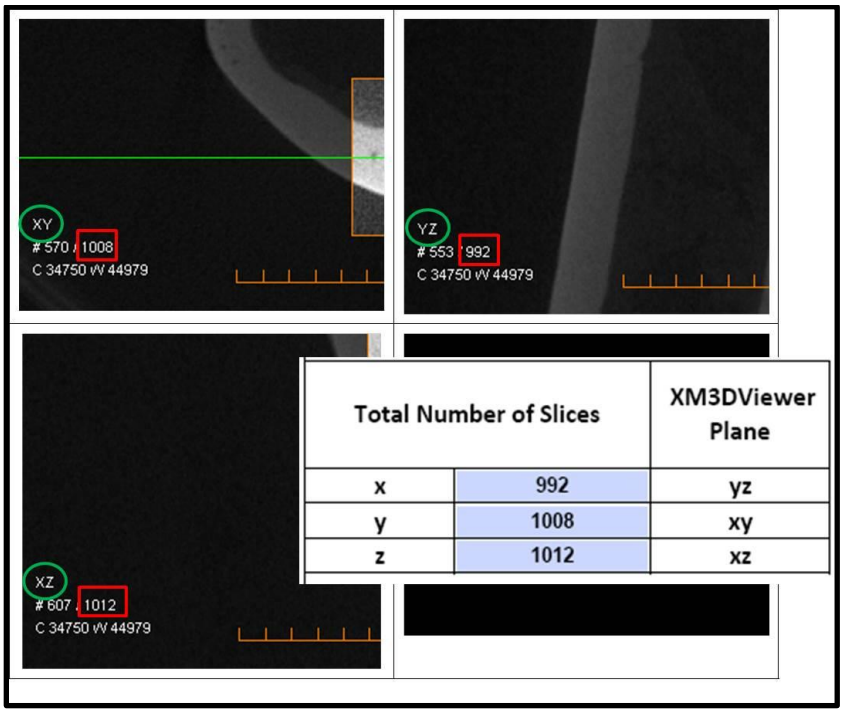

Figure 7: The total number of slices for each direction can be found in the lower left hand corner of their respective viewing panes.

c. The numbers for the desired center of ROI are taken from the slice numbers representing the colored lines placed at the center of the FOV in step 4 (Figure 8).

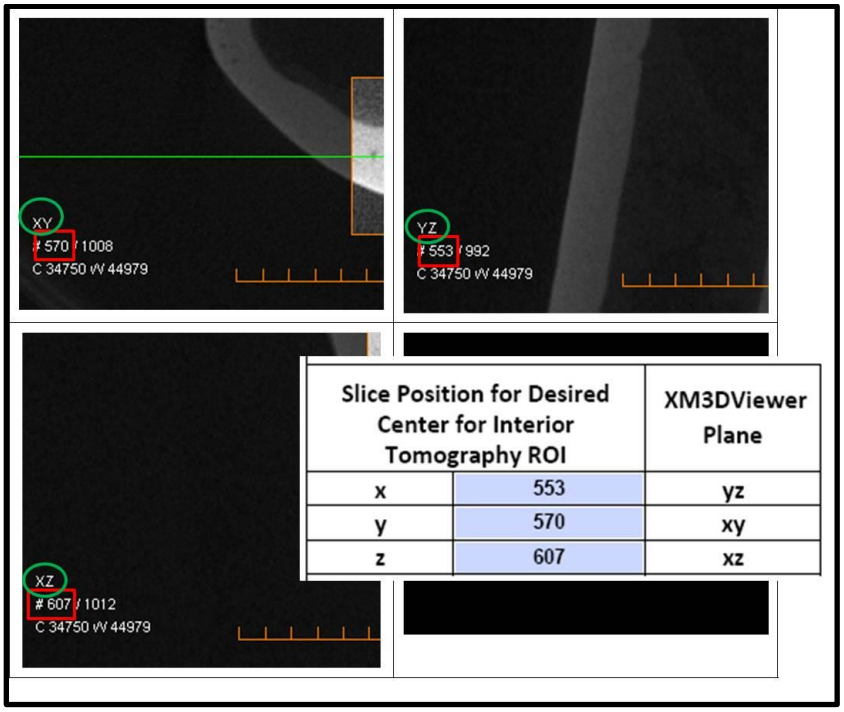

Figure 8: The current slice number for each direction can be found in the lower left hand corner of their respective viewing panes.

d. The pixel size is taken from the low resolution Scout scan. On the Run page, the pixel size is seen on the top left corner of the scout scan or the raw tomography window (Figure 9a). The parameter can also be found by opening the raw tomography (.txrm file) in the XMController (View>Image Control. Right click and select the Information tab). (Figure 6b) Input this value into the correct field of the *Internal ROI Calculator.*

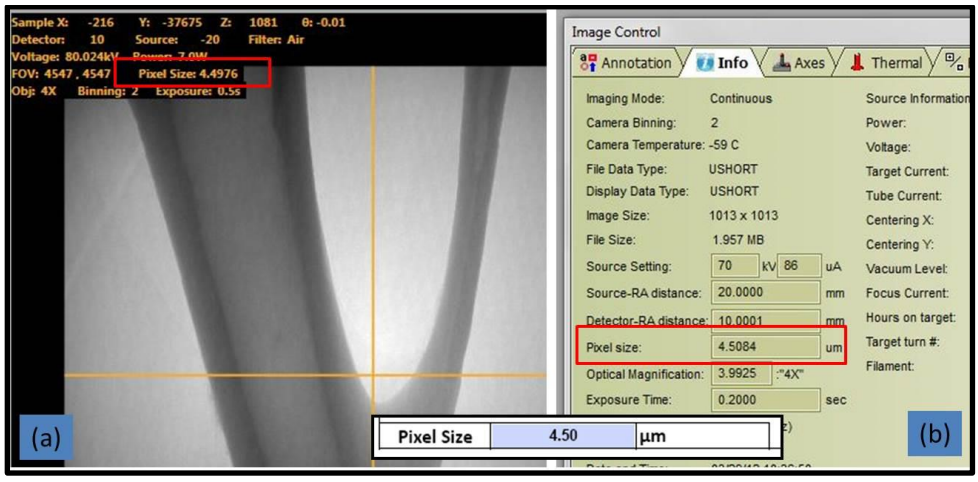

Figure 9: Find the pixel size of the Scout file.

e. The stage positions for the interior tomography has been calculated and displayed in the *Internal ROI Calculator*. Move the sample to these positions using the Motion Controllers on the Load or the Scout page for the high resolution scan, as shown (Figure 10.)

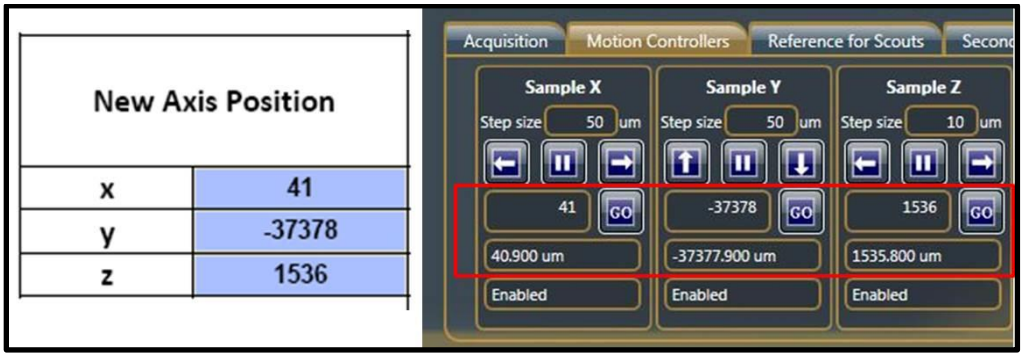

Figure 10: The sample is moved to the calculated new axis positions using the Motion Controllers.

3.7 The sample is now positioned with the axes at the center of the new ROI desired for the high resolution scan.

3.8 Proceed to setting up the interior tomography using standard acquisition guidelines found in the User's Manual.

For the example in this document, the 0.6 µm voxel size interior tomography is shown in the Figure 11. Comparisons between the estimated ROI from the Scout scan and the true ROI from the Zoom scan are shown in Figure 12.

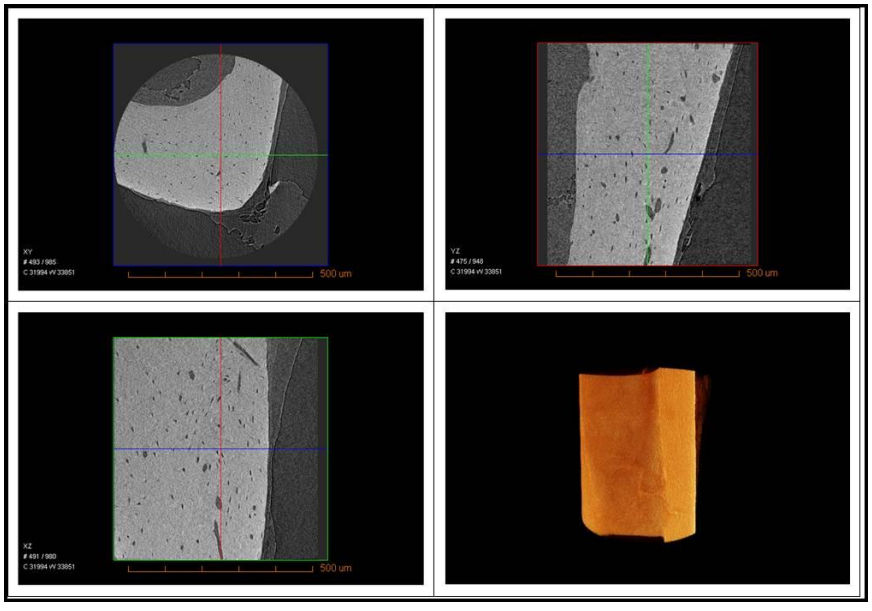

Figure 11: The results of the high resolution scan using 0.6µm voxel size.

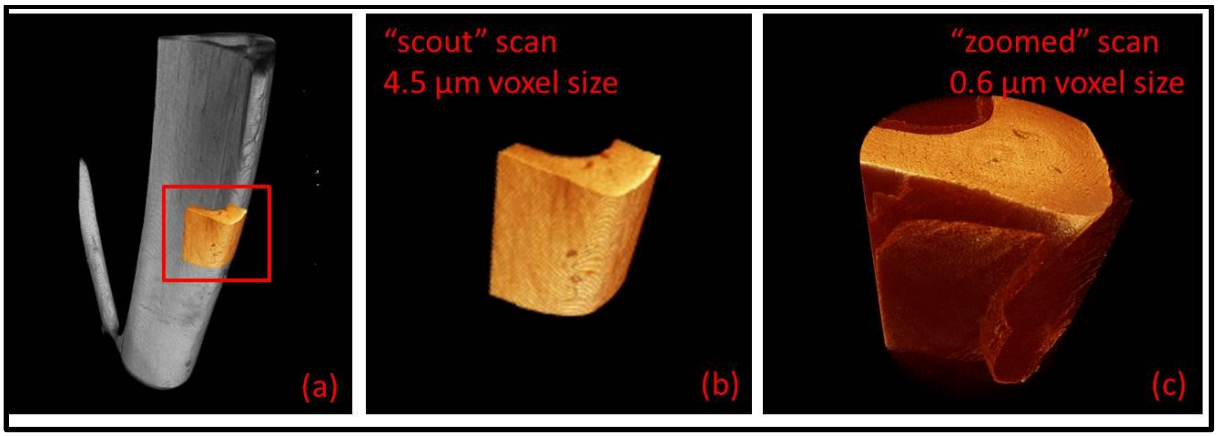

Figure 12: The desired ROI in relation with the whole Scout scan is shown in (a). This selected ROI is digitally zoomed (b) and compared with the 3D rendering of the high resolution scan (c) showing that the desired and the actual ROI's are the same.

4 Summary

The method of "Scout and Zoom" is described here. This technique enables easy determination of the correct sample stage position for any interior ROI using a short Scout scan allowing for accurate and efficient high resolution interior tomographies on a variety of different sample types.

Internal ROI Calculator

Enter the Axis Position for the Scout Scan from the XMController	
x	
y	
z	

New Axis Position	
x	0
y	0
z	0

Total Number of Slices		XM3DViewer Plane
x		yz
y		xy
z		xz

Slice Position for Desired Center for Interior Tomography ROI		XM3DViewer Plane
x		yz
y		xy
z		xz

Pixel Size		µm

Reset