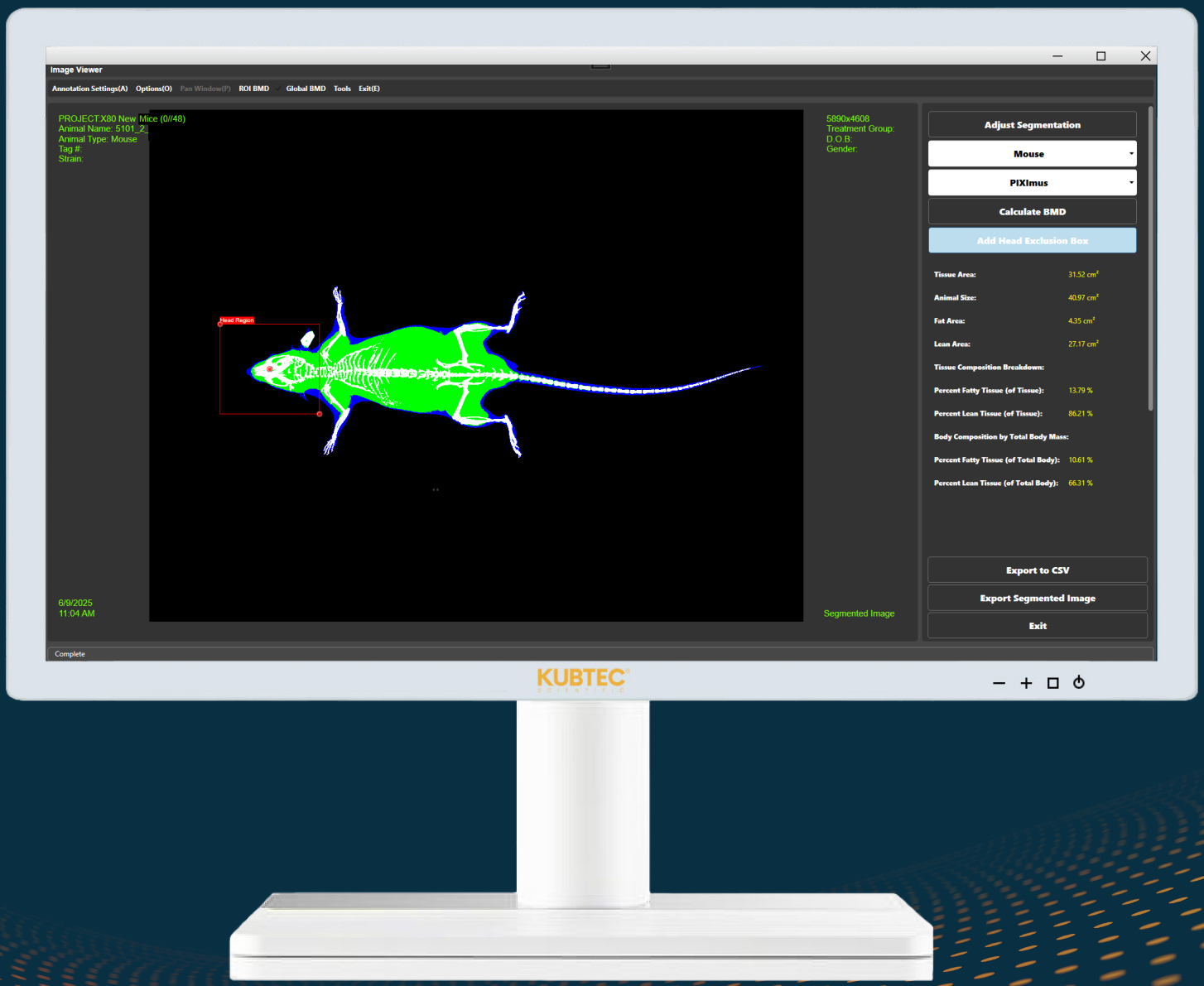
DIGIMUS® multi

Bone Mineral Density (BMD) and Body Composition Imaging and Analysis Software

For The XPERT® 80 X-ray System



KUBTEC® SCIENTIFIC

DIGIMUS® Multi Software For The XPERT® 80 Systems
Instructions for Use PN: IFU-47 Rev B

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CHAPTER 1: SOFTWARE INTERFACE OVERVIEW

Introduction

The DIGIMUS® Multi Software is the only dual-energy, X-ray absorptiometry (DXA) software currently available that offers powerful proprietary algorithms capable of generating accurate readouts of nuclear magnetic resonance (NMR), chemical carcass analysis (CCA), and our original DIGIMUS® alignment algorithm correlated to the PIXImus – the gold standard in small animal DXA - from just one DXA scan.

A major advancement in next-generation DXA imaging, The DIGIMUS® Multi Software allows robust measurements of bone quality and body composition to aligned with multiple gold-standard analyses.

Main Screen

To use the DIGIMUS® Multi application, click the DIGIMUS icon . The software's Main screen will display.

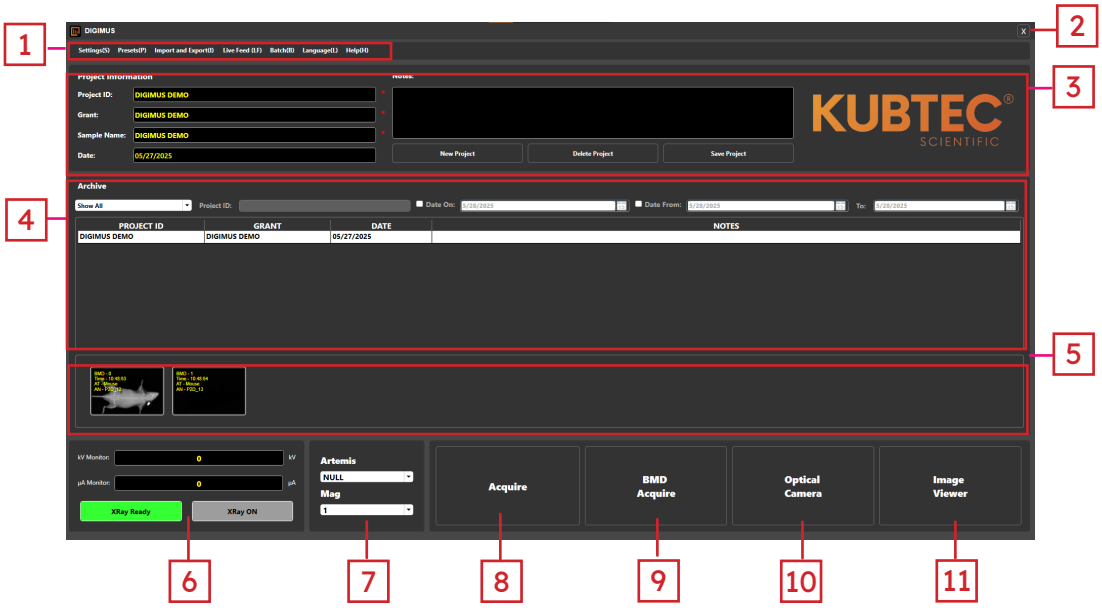


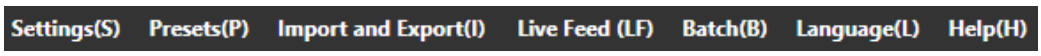
Figure 1-1: Main Screen

Figure Legend

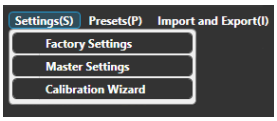
No.	Name	Function
1	**Menu Bar Functions**	• **Settings(S):** Provides options to return to Factory Settings; create Master Settings, such as a copy path; and access the Calibration Wizard. • **Presets (P):** Displays the Presets Manager screen. • **Import/Export(I):** Import allows users to import TIFF files into the current case session. Export allows animal studies to be securely sent to a removable storage device, such as a DVD, CD, hard drive, or flash drives. • **Language(L)**: Allows users to change system language. • **Live Feed**: Displays real-time optical video of the specimen inside the interior cabinet. • **Help(H)**: Provides access to the Instructions for Use and KUBTEC® contact information. The Registration option is for service personnel to register the software for use. • **Batch(B)**: Processes all BMD images within a Project, then calculates global BMD values and creates an exportable CSV report.
2	**Exit**	Closes down the system software program.
3	**Project Information**	Displays the Project ID, Grant, Sample Name, and the Date the project creation date. Also includes options to Save, Delete or Create a new case and to make Notes.
4	**Archive**	Enables users to search for stored project by project ID or by Date.
5	**Captures**	Displays thumbnails of the acquired images.
6	**Ready and X-ray On Indicators**	• **XRay Ready** light illuminates when the system is ready to generate X-rays. • **XRay ON** light illuminates when the system is generating X-rays.
7	**Image Filter**	Displays image filter and digital magnification options.
8	**Acquire**	Initiates the X-ray exposure process.
9	**BMD Acquire**	Initiates the dual-energy X-ray absorptiometry process.
10	**Optical Camera**	Provides a real-time optical view of the animal sample.
11	**Image Viewer**	Displays the last acquired image (or a user-selected one) along with an image processing toolbar.

Menu Bar

The menu bar provides options for setting up the system and customizing it for client use. The use of each menu bar option is described in the following section.



Menu Bar: Settings



Factory Settings: These are the original settings KUBTEC® loads onto all systems prior to delivery. The system's password is required to reset the system to this state. This process should only be done by KUBTEC or an authorized dealer.

Master Settings: These include Copy Path, Predefined Window Level, BMD Custom Fields, and Date Format.

Calibration Wizard: This is used to automatically calibrate the system. When you click this option, the **Calibration Wizard** is displayed.

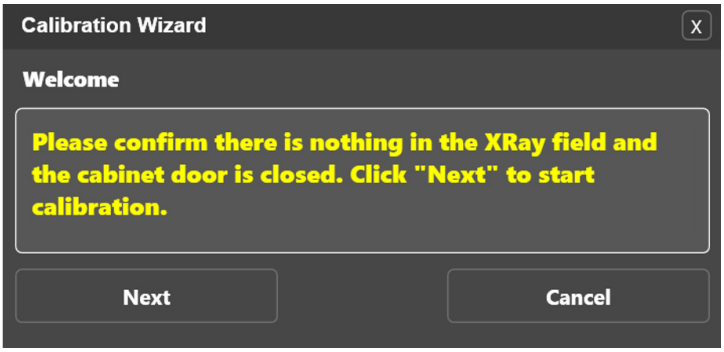


Figure 1-2: Calibration Wizard

To calibrate the system:

1. Remove any objects from the X-ray field.
2. Close the cabinet door gently and tightly.
3. Click **Next** to start the calibration.
4. When the calibration is complete, click **Back to Main Window**.

Menu Bar: Presets

The **Presets** option accesses the **Presets Management** screen, where users can create custom settings by defining combinations of exposure parameters. Each created preset displays as a selectable option in the **Presets** screen when the manual option is the selected mode for image acquisition.

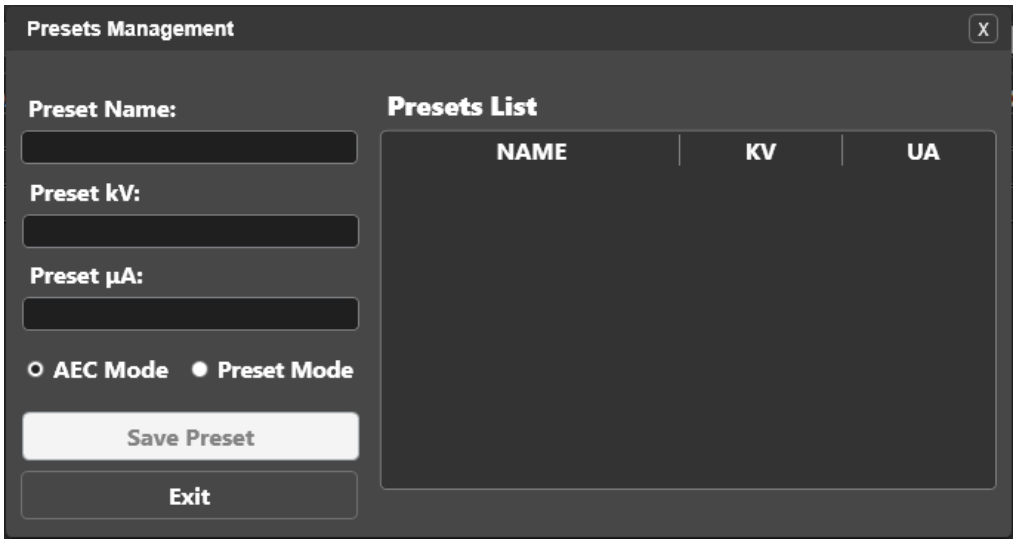


Figure 1-3: Preset Management Screen

To create a Preset:

1. In the **Presets Name** field, enter a name for the new preset.
2. Enter the kV and µA for this Preset.
3. Click **Save Preset**.
4. Click **Exit**.

Menu Bar: Import and Export(I)

The **Import and Export(I)** menu allows user to:

- Import images (e.g., TIFF files) into the current study.
- Export images from the current study to an external device such as a USB flash drive, external hard drive, CD, or DVD.

Menu Bar: Import and Export(I) (continued)

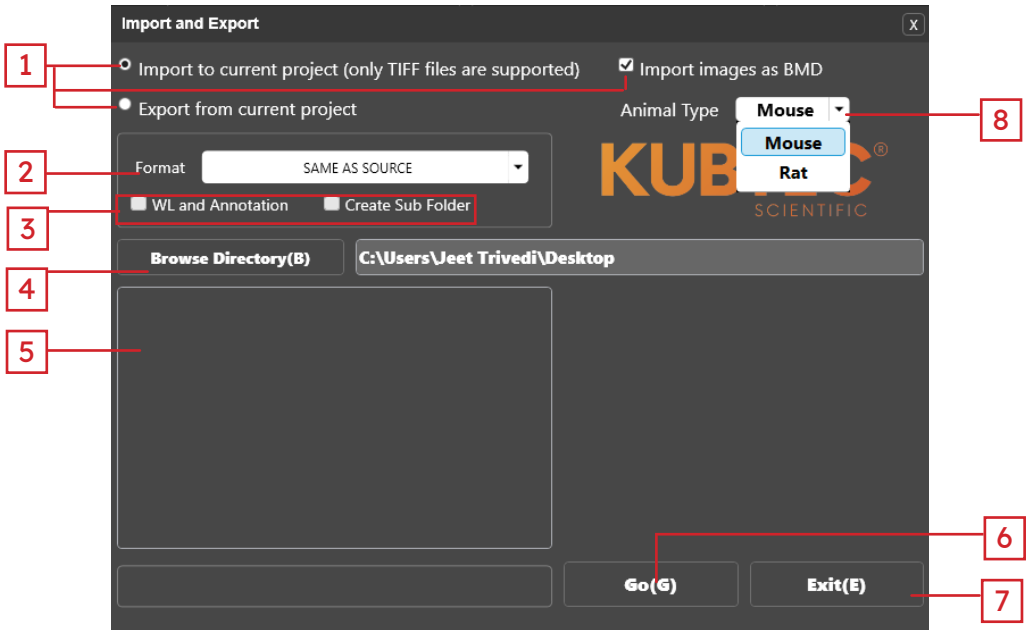


Figure 1-4: Import and Export Screen

Figure Legend

NO.	Name	Function
1	**Import/Export**	Import/Export selection.
2	**Format**	The dropdown menu, available during image export, provides the option to keep the existing image format or change it to .jpg.
3	**WL and Annotation**	Provides options to retain existing Window/Level settings and Annotations with the selected images. **Create Sub-Folder**: Option to have all selected images contained in separate folders when they are moved to the location in the **Browse Directory** field.
4	**Browse Directory**	When **Import** to current project is selected, **Browse Directory (B)** allows navigation of images to be imported. When **Export** from current project is selected, **Browse Directory (B)** allows navigation to the external storage device.
5	**Preview Area**	Displays the selected image(s) before import or export.
6	**Go (G)**	Selected images are imported to the current case or selected images are exported to the storage device location.
7	**Exit (E)**	Closes the Import and Export screen.
8	**Animal Type**	Allows for selection of the type of animal.

Menu Bar: Import and Export(I) (continued)

To import images, follow these steps:

1. Click **Import to current case**.
2. Select **Import images as BMD** to import DXA image sets.
3. Browse to the location of the files/folder to be imported.
4. Select the images to import.
5. Click **Go (G)**.
6. When the import function finishes, click **Exit** to close the screen.

To export images, follow these steps:

1. Click **Export from current case**.
2. In the Format field, select the format of the images to be exported.
3. Click **WL and Annotation** if you want to keep existing WL and annotations associated with the images to be exported.
4. Click **Create Subfolder** if you want all selected images to be exported into a folder on the external storage device.
5. Browse to the location of the files/folder to be exported.
6. Select the images to export.
7. Click **Go (G)**.
8. When the export function is complete, click **Exit** to close the screen.

Menu Bar: Live Feed

Click the **Live Feed** tab to view the sample placement area, as shown in the following figure. The camera remains active for 60 seconds at a time. A timer will appear upon opening the window. The live feed will automatically terminate after the timer finishes.



Figure 1-5: Live Feed View

Menu Bar: Batch

The **Batch** option allows user to calculate Global Body Composition and Bone Mineral Density (BMD) for an entire project of DXA images at once and save them to an external (.csv) file.

- Select the desired project for BMD batch analysis.
- Click **Batch** in the menu bar and select the **Batch BMD**.
- Click **OK** when the following pop-up displays.

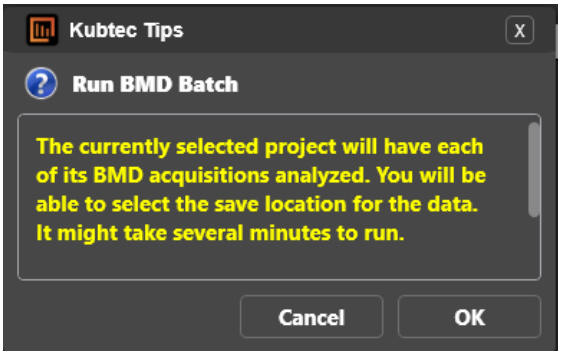


Figure 1-6: BMD Batch Screen

Menu Bar: Batch (continued)

- Select from the dropdown whether you want to perform Batch BMD processing with or without the Auto Head Inclusion Box.
- Select from the dropdown whether you want to remove the Ear Tag or keep it.
- Select from the dropdown appropriate **Alignment Algorithm** factor to be applied to the image.

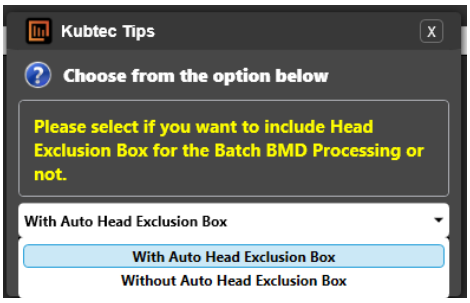


Figure 1-7: Exclusion Options

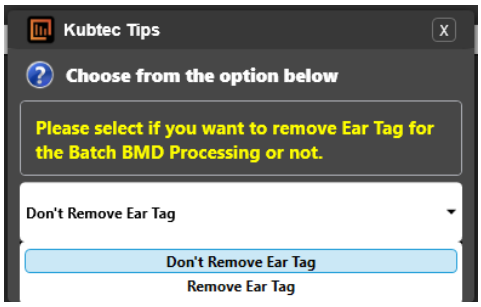


Figure 1-8: Ear Tag Options

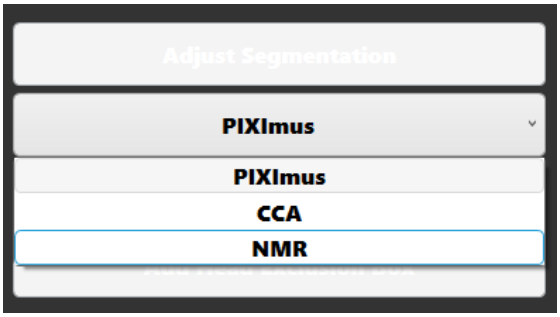


Figure 1-9: Alignment Algorithm Options

- After selecting your preferences, click **OK**. Then, select the location where you want to save the file.
- Enter a file name and click **Save**.
- Once the file location has been selected, the system will begin the batch analysis.
- When processing completes, click **OK** to close the batch processor.

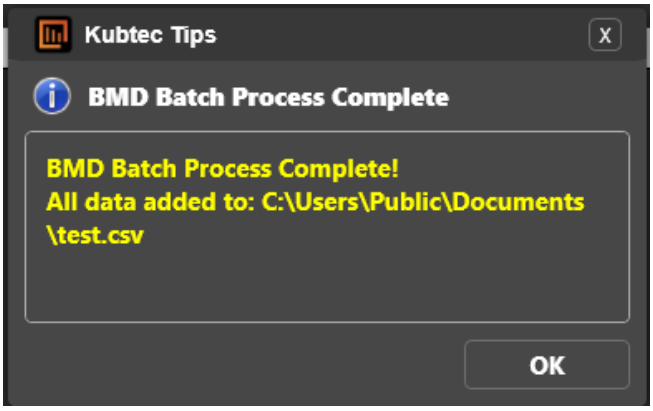


Figure 1-10: Image Save Path

Menu Bar: Language(L)

If the system supports with multiple languages, follow these steps to select the language that will display on the screen:

1. From the menu bar, select **Language**.
2. From the dropdown list, select the desired language.
3. The menu will close and the system interface will update to the selected language.
4. Restart the software for the language change to take full effect.

Menu Bar: Help(H)

The Help option provides access to information about the system:

- Click **Manual** to access the Instructions for Use (IFU) document for guidance on operating the system.
- Click **About** to see KUBTEC® contact information and the currently installed software version.
- Click **Unlock** to access the software registration screen. This is used by the application provider to register the software, enabling its full functionality.

  NOTE: The software is usually pre-registered at the factory, so no action is required from the end user.
- You will need to send the provider the alphanumeric string that displays in the **Machine Code** field, and registered Product Key for the software.

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CHAPTER 2: IMAGE ACQUISITION

Introduction

Once the system has completed startup and calibration, it is ready to start the image acquisition process. The first step is to identify the animal sample to be X-rayed. The system provides two options to do this:

- Create a new project.
- Add to an archived project.

The use of each of these options is explained next.

NOTE: For BMD DXA imaging, calibration follows a different workflow compared to standard scans. For detailed calibration instructions specific to BMD measurements, refer to the section **"Global BMD Analysis"** in Image Viewer Tools Chapter.

Create a New Project

To create a New Project:

1. In the Main screen, click the **New Project** to access the **New Project** screen.

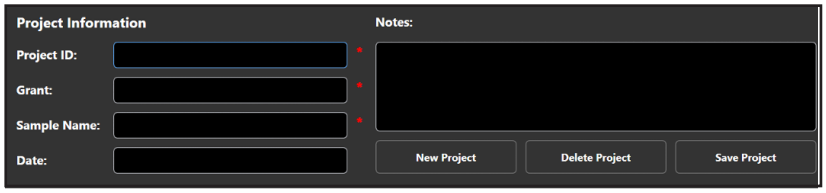


Figure 2-1: New Project Screen

2. In the **New Project** screen:
   - Enter the mandatory fields **Project ID** and **Sample Name, and Grant**.

     NOTE: The current date will be displayed automatically.
   - In the **Notes** section, enter any comments relevant to the project.
   - Click **Save Project**.

Archived Project

The Archived Projects section displays all available projects, with Show All selected by default. Users can apply different filter options as needed to narrow down the results. To add to an Archived Project: To add to an Archived Project:

1. From the dropdown menu in the **Archive** section of the screen, select **Show All** (OR, select Show by Project ID and then enter the ID). A list of archived projects will be displayed.

   NOTE: Additional filtering options allow you to search archived projects by a specific date or a date range.

Archived Project (continued)



Figure 2-2: Main Screen: Archive Project Options

2. Single-click the desired project. The project information will be displayed, and any images associated with the project will be displayed in the **Project Information** section.

Acquire Images

After selecting or creating a project, the system offers the Automatic Exposure Control (AEC) option or the Manual/Preset for acquiring X-ray images.

The following sections describe the functionality of this process.

Acquire with AEC

Automatic Exposure Control (AEC) feature automatically selects the optimal kV and µA settings for image acquisition.

To acquire images using the AEC feature:

1. Ensure that the right project is selected.
2. Center the sample in the imaging area.
3. Close the cabinet door tightly.
4. At the bottom of the screen, left-click the Acquire button.

When the X-rays turn on, the KUBTEC® logo on the control panel flashes red, and **"Acquiring images, please wait..."** is displayed. Shortly thereafter, the image displays in the Image Viewer.

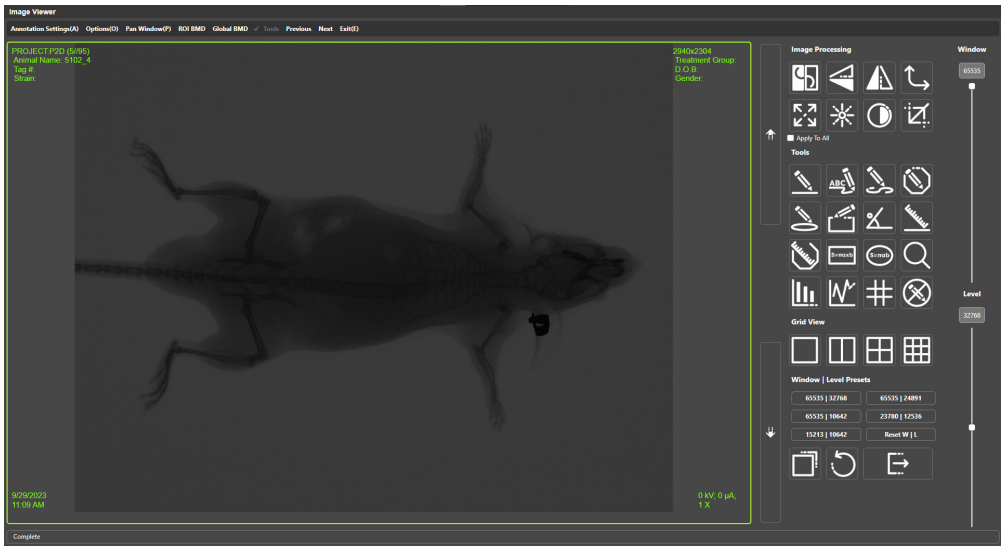


Figure 2-3: Image Viewer

Acquire with Preset or Manual

To acquire an images using a Preset or Manual settings:

1. Ensure that the right project is selected.
2. Center the sample in the imaging area.
3. Close the cabinet door tightly.
4. Right-click the **Acquire** at the bottom of the screen to display the **Presets** screen.

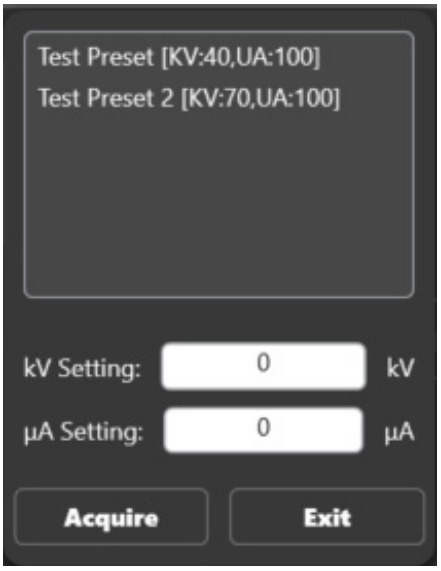


Figure 2-4: Presets Screen

5. Acquire the image:

- To acquire an image using a Preset, either double-click the preset option you want from the list, or click the **Preset** option from the menu bar and click **Acquire**.
- To acquire an image using Manual settings, right-click the **Acquire** button, type in the desired kV and µA settings, and then click **Acquire**.

  The Artemis filter is selected by default. The use of this filter results in an enhanced X-ray image after the **Acquire** button is clicked. If you prefer a raw X-ray image, select **Null** from the **Filter** dropdown menu before you click the **Acquire** button.

  When the X-rays turn on, the KUBTEC® logo on the control panel flashes red, and **"Acquiring images, please wait..."** displays. Shortly thereafter, the image displays.

Magnification

This system can acquire images at three levels of magnification.

NOTE: Magnification is strictly intended for imaging purposes only. BMD analysis must not be performed on magnified X-ray images, as this will result in inaccurate and invalid measurements.

To use the magnification feature:

1. Place the magnification tray in the rails for the desired magnification level, system will automatically detect which level is being used.
2. Place the sample on the magnification tray.
3. Close the door gently and tightly.



Figure 2-5: Magnification Level Options

4. Acquire the image using AEC, Presets, or Manual settings.

Acquire Optical Image

To acquire an optical image:

1. Click the **Optical Camera** button.
2. The acquired optical image opens in the Image Viewer, and the optical camera window closes automatically.
3. The image becomes part of the project study and displays along with other acquired images on the Main screen.

CHAPTER 3: IMAGE VIEWER TOOLS

Introduction

Tools for processing and annotating acquired images appear as icons on the right side of the Image Viewer when the monitor is positioned horizontally. They appear at the bottom of the screen when the monitor is positioned vertically.

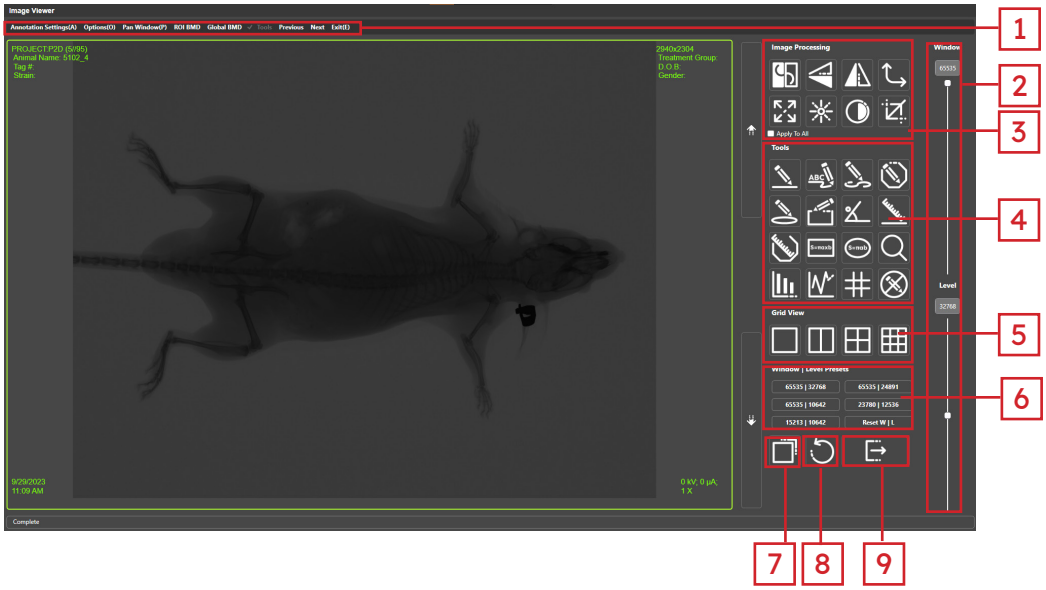


Figure 3-1: Image Viewer

Figure Legend

1. Image Viewer Menu
2. Window/Level Sliders
3. Image Processing Tools
4. Annotation Tools
5. Multi-View Options
6. Window/Level Presets
7. Create a copy of current image
8. Reset All Annotations
9. Exit the Image Viewer

How to Use Image Viewer Tools

To activate an **Image Viewer** tool, click the tool icon.

- The tools, such as Invert, Flip V, Flip H, and Reset, perform their stated function upon activation.
- Other tools require additional steps. The following tables provide details for use of each tool.

Image Processing Tools

Table 3-1: Image Processing Tools

Icon	Name	Function
	**Invert**	• Click the **Invert** icon to change the black pixels to white pixels. • Click this icon again to reverse the pixels.
	**Flip V**	• Click the **Flip V** icon to reverse positions of the top and bottom of the image. • Click the icon again to return the image to its original position.
	**Flip H**	• Click the **Flip H** icon to reverse positions of the left and right side of the image. • Click this icon again to return the image to its original position.
	**Rotate**	• When you click the **Rotate** icon, the Rotation window displays. • Select any of the programmed rotation angles, or use the slider to select another rotation angle. • The Crop option removes areas of the image that fall outside of the image frame during rotation. • The Resize option fits the image within the frame, so that no data is lost. When you close the Rotation options window, the Rotate tool function ends.
	**Zoom**	• Click the **Zoom** icon to access the Image Zoom Window. • Select from one of the Zoom presets at 50, 100, and 200 percent. OR, manually zoom in 10% increments (using the + and - icons). • There are also options to vertically or horizontally fit the image into the screen.
	**Brightness**	• Click the **Brightness** icon to access the Brightness adjuster. • Move the slider up to make the image brighter. Move the slider down to darken the image.

Image Processing Tools (continued)

Table 3-1: Image Processing Tools

Icon	Name	Function
	**Contrast**	• Click the **Contrast** icon to access the Contrast adjuster. • Move the slider toward High to incrementally increase the contrast (decrease the gray scale in the image). • Move the slider toward Low to incrementally decrease the contrast (increase the gray scale in the image).
	**Crop**	• Click the **Crop** icon, then click on the image. Draw a box over the area that you want to extract from the image. • Select the Crop icon, then click OK. The image is cropped, but it is not saved as a separate image in the project. The original image is updated with the cropped view. • Crop does not save it as a separate image in the project. • Click Reset Image to revert the crop and restore the image to its original image
	**Apply To ALL**	Click the **Apply To ALL** check box to apply processing to all images in the grid.

Annotation Tools

Table 3-2: Annotation Tools

Icon	Name	Function
	**Line**	• Click the **Line** icon, then click on the image. • Move the mouse to draw a line from one point to another, then click to end creation of the line. • To delete a line from the image, click the line, then press the Delete button on the keyboard. • To stop the tool, double-click on the image.
	**Texts**	• Click the **Texts** icon, then click on the image. • The Text Input screen appears on the image allowing you to add text on the image. • You must close the Text Input screen to stop the Texts tool.

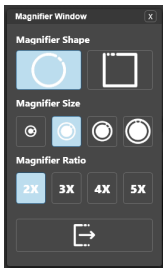
Annotation Tools (continued)

	**Free Hand**	• Click the Free Hand icon, then click on the image. • Move the mouse to draw free-hand on the image, then click again to finish the creation of the drawing. • To delete a Free Hand shape from the image, click the shape, then press the Delete button on the keyboard. • To stop the tool, double-click on the image.
	**Polygon**	• Click the **Polygon** icon, then click on the image. Move the mouse to create one side of the shape, then click and move again to create another side of the shape. • Repeat this sequence to create the desired shape, and then double-click to end creation of the shape. • To delete a polygon from the image, click the polygon, then press the Delete button on the keyboard. • To stop the tool, double-click on the image.
	**Ellipsis**	• Click the **Ellipsis** icon, then click on the image. Move the mouse to create the shape, then click to end creation of the shape. • To delete a Ellipsis from the image, click the Ellipsis, then press the Delete button on the keyboard. • To stop the tool, double-click on the image.
	**Rectangle**	• Click the **Rectangle** icon, then click on the image. Move the mouse to create a rectangle shape, then click to end creation of the rectangle. • To delete the rectangle, select it in the image, then press the Delete button on the keyboard. • **NOTE:** the delete action can be performed on all other drawn shapes as well.
	**Angle Ruler**	• Click the **Angle Ruler** icon, then click on the image. Move the mouse to create one side of an angle, then click. • Move the mouse to create the other side of the angle. The degree of the created angle displays.

Annotation Tools (continued)

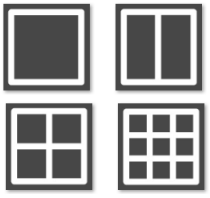
	**Ruler**	• Click the **Ruler** icon, then click one end of the area on the image to be measured. • Move the mouse along the path to be measured, then click at the end of that path. • The distance between the two points displays while you move the mouse. To change the measurement from inches to mm or cm, click Annotation Settings in top menu bar. In the drop-down menu for Unit Type, select mm or cm and then click Save. • To delete the ruler path, select the marker in the image, then press the Delete button on the keyboard.
	**Polygon Ruler**	• Click the **Polygon Ruler** icon, then click on the image. As you move the mouse to create one side of the shape, the measurement displays. • Click and move again to create another side of the shape. • As you repeat this sequence to create the desired shape, measurements show. Double-click to end creation of the shape.
	**Rectangle Area**	• Click the **Rectangle Area** icon, then click on the image. • As you move the mouse to create the rectangle, the area of the shape displays. • Click to end creation of the shape.
	**Ellipsis Area**	• Click the **Ellipsis Area** icon, then click on the image. • As you move the mouse to create the ellipsis, the area of the shape displays. • Click to end creation of the shape.

Annotation Tools (continued)

	**Magnifier** 	• When you click the **Magnifier** icon, the Magnifier Window displays a variety of options. • Select the tool shape, size of the viewer, and the number of times you want the view to zoom in. • Then, move the mouse over the image. A window appears. As you move this window around the image, all data within the window is magnified. • When you click the Exit icon in the Magnifier screen, the tool stops.
	**Histogram**	View a graph (Histogram) of pixels vs. gray scale values of the whole image or for a selected area of the region of interest.
	**Density Profile**	• View a graphical representation (Density Profile) of gray scale values across a line drawn through any part of the image. • This tool is useful in highlighting breaks in continuity or distinct changes in the density of the sample.
	**Show Grid on Image**	• When you click the **Grid** icon, a grid displays on the image along with the Grid Size window. • Options in this window allow adjustment to the Width and Height of the displayed grid, and to show/hide the grid. • Use the grid to section out the image in desired dimensions. To Hide Grid, click the hide button then uncheck the “show grid” checkbox.
	**Hide Annotations**	Click the **Show/Hide** icon to show/hide annotations on an image.

Grid View Tools

Table 3-3: Grid View Options

Icon	Name	Function
	**Grid View**	Click the single grid to display one image in the viewer. Click one of the other icons to display multiple images at the same time. Images are displayed in the multi-view in sequence and in the order in which they are stored in the series/project.

Window/Level Tools

Table 3-4: Window/Level Presets

Icon	Name	Function
Window/Level Presets 	Click a Preset to have the image automatically adjust to the stated values. To change a Preset, use the Window and Level sliders on the right side of the image viewer to adjust the image. Right-click the Preset that you want to change, then select Yes to the prompt.	**Window/ Level Sliders** 

Other Image Viewer Tools

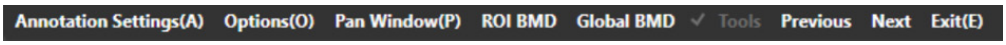
Table 3-5: Other Image Viewer Tools

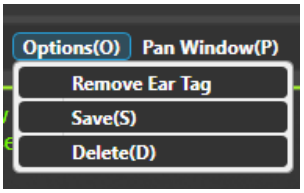
Icon	Name	Function
	**Copy Current Image**	Click the **Copy** icon to copy copy the image that shows in the viewer. The copied image is added as the last image in the series.
	**Reset Annotations**	Click the **Delete** Annotations icon to remove all the annotations that are on the image that is displayed in the viewer.
	**Exit Image Viewer**	Click the **Exit Image Viewer** icon to return to the Main screen.

Image Viewer Menu

The Image Viewer menu at the top of the screen has options for displaying and handling acquired images. Menu items are described in the following table:

Table 3-6: Image Viewer Menu



Menu Item	Function
Annotation Settings(A)	Provides options for the appearance of annotations on the image. You can select the color and size of the overlay as well as the grid, and you can change the unit of measurement.
Options(O) 	**Remove Ear Tag:** Applies to Global BMD only. If the specimen has a metal ear tag, select this option. **Save**: Click Save(S) to overwrite the original image with the current image that displays in the image viewer. **Delete**: Click Delete(D) to remove the displayed image from the study. **IMPORTANT: Deleted images cannot be recovered.**
Pan Window(P) 	Click Pan Window to display the image in a zoomed state. A checkmark indicates the selected Pan Window option. • Select the + icon to zoom in. • Select the – icon to zoom out. • Select the horizontal arrow icon to Fit Width (show image borders). • Select the vertical arrow icon to Fit Height (show image borders). • Select the o icon to display the image in full screen mode.
ROI BMD	Click to analyze the BMD for specific regions of interest. Description of the tools on this screen is found in “ROI BMD Screen Options”.
Global BMD	Click to access the Global BMD image processor.
Previous / Next	• Click **Previous** to display the previous image in the series. • Click **Next** to display the next image in the series.
Exit	Click to Exit the Image Viewer.

Global BMD Analysis

To acquire a DXA image:

1. Create a new project by clicking the **New Project**. This is where the DXA images will be saved
2. The **New Project** window will open. Enter the relevant information, and select **Save Project**.
3. Center the sample on the imaging area at the bottom of the cabinet, directly on the detector.
4. Close the cabinet door tightly.
5. At the bottom of the screen, left-click the BMD Acquire button. The **KUBTEC Tips** dialog box is displayed before image acquisition. Follow the on-screen guidance to ensure proper sample positioning.

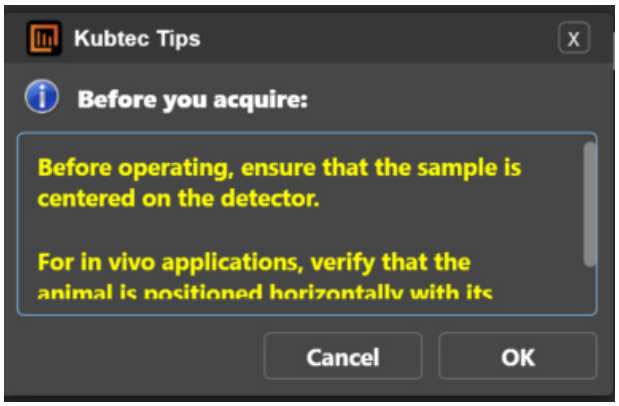


Figure 3-2: BMD Acquire check

6. Enter the experiment details like animal name, tag #, and other details and click **OK**.

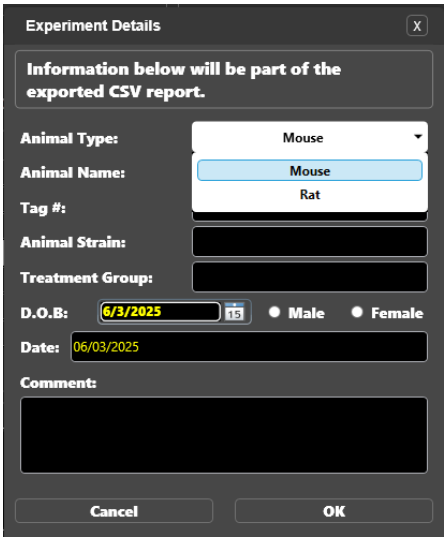


Figure 3-3: Experiment Details

7. When the images are acquired, it will be displayed in the BMD Image Viewer.

Global BMD Analysis (continuation)

8. To analyze DXA images, click the **Calculate BMD** button.

   NOTE: To analyze a DXA image, double-click the image thumbnail under the associated Project ID. It does not matter whether the image was acquired at high or low kV. After selecting the DXA image for analysis, a new Image Viewer window will open.

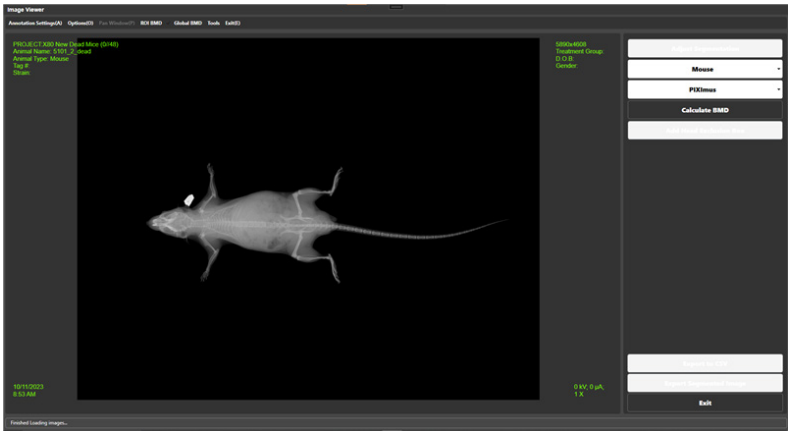


Figure 3-4: Global BMD Analysis Screen

9. Click **Calculate BMD** to run a whole-body (global) BMD and body composition analysis.
   - Ensure the **Remove Ear Tag** option is set correctly.
   - To remove the signal from ear tags only, select **Options(O)** in the toolbar at the top of the window and then select **Remove Ear Tag**.

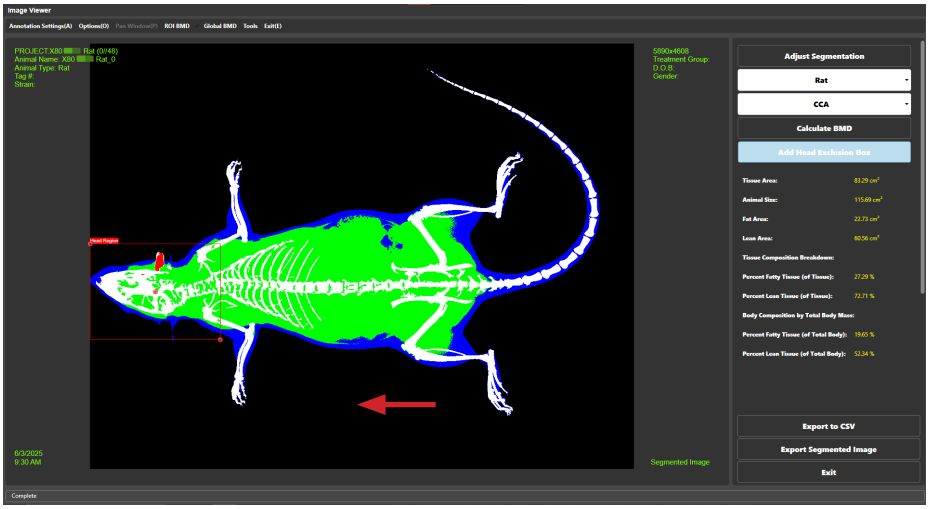
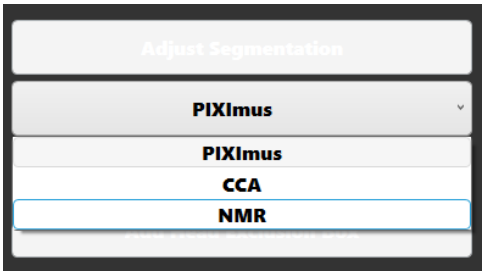


Figure 3-5: Global Segmentation Results Screen

10. The results will appear on the right-hand side of the Image Viewer window.
    - The **Head Exclusion Box** will generate automatically and can be used to remove background noise from nose cones, ear tags, etc.
    - Toggle **Head Exclusion Box** button to turn off this feature and include the specimen's head in calculations.

12. Various Alignment Algorithms factor options are available. When a different Alignment Algorithm factor is selected, the values will be automatically recalculated—there is no need to click **Calculate BMD** again.

NOTE: PIXImus alignment algorithms are for mice only.



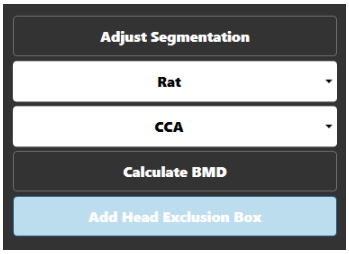


Figure 3-6: Alignment Algorithms Factor Figure 3-7: Animal Type Selection

13. The output with CCA and NMR correction images is provided for reference.

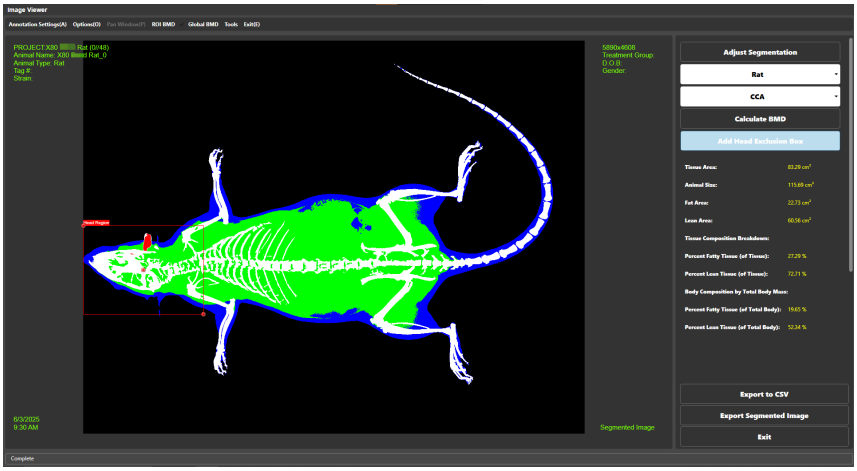


Figure 3-8: Output with CCA correction

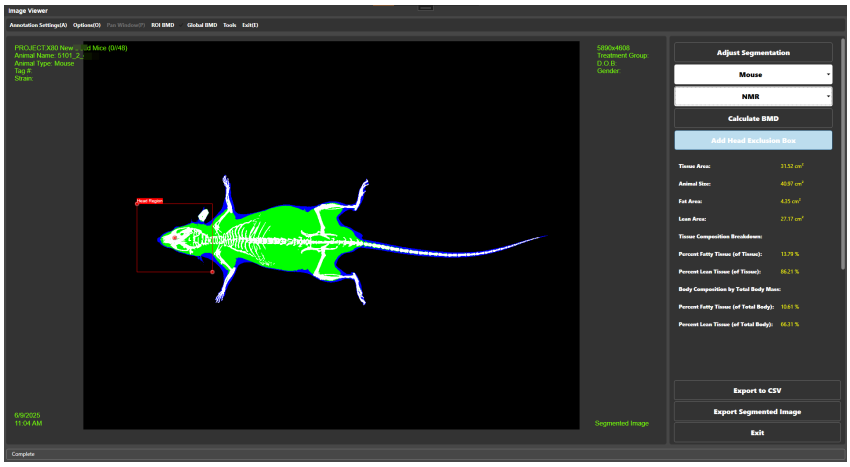


Figure 3-9: Output with NMR correction

ROI BMD/BMC Analysis

The **ROI BMD** screen allows the user to calculate the BMD/BMC for specific Regions of Interest (ROI), such as the femur, tibia, vertebra, and other regions.

NOTE: For ROI BMD analysis, there is no correction option like in Global BMD. By default, the values are correlated with the PIXImus reference.



Figure 3-10: ROI BMD Screen

ROI BMD Screen Options

ROI BMD Screen Options

ROI	The following options are displayed: • Save ROI • Load Saved ROI • Clear all ROI • Draw ROI Preset **NOTE:** The bone being analyzed must be centered in the ROI box, with soft tissue showing on either side of the ROI.
Calculate BMD	Opens the ROI **Bone Segmentation** screen, which is the ROI BMD analysis screen.
Zoom	The zoom options of 100%, 150%, 200%, and Fit to Window will display on the left side of the screen.
Rotate Image	Preset angles of rotation display on the left side of the screen, along with a slider for manual selection of an angle.
Import Image	Click **Import Image** to bring in a DXA image for ROI BMD Analysis.
Export Image	Click **Export Image** to save the displayed image with ROI markings to a selected location on your computer.

ROI BMD/BMC Analysis (continued)

This section will explains how to measure bone mineral density (BMD) in a specific region of interest (ROI).

1. Select the ROI BMD tab at the top of the image viewer as shown in Figure 3-11:

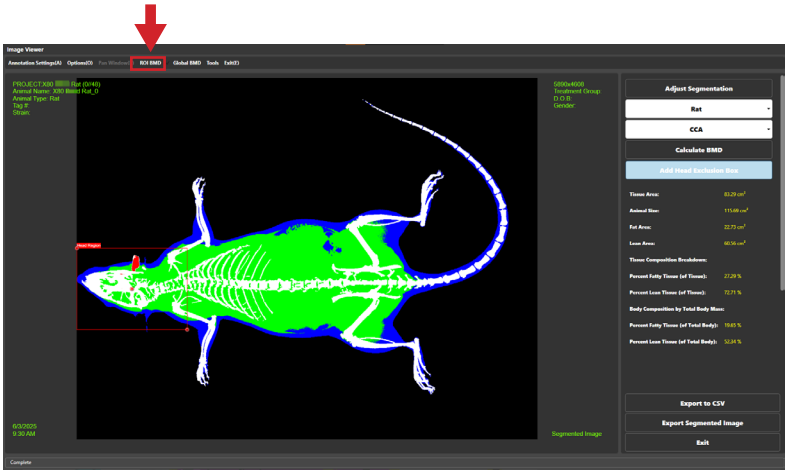


Figure 3-11: ROI BMD Option

2. After the ROI BMD Processor opens, adjust the image view by magnifying the region of interest. Selecting **Zoom** options to set the magnification to 100%, 150%, 250%, or Fit to Window of DXA image.



Figure 3-12 ROI BMD Zoom



Figure 3-13: ROI Rotate

3. Selecting **Rotate Image** option to change the image orientation.

   NOTE: Rotating the image is optional and is not required for the analysis.

ROI BMD/BMC Analysis (continued)

1. Images can be imported and exported from this screen.
2. Selecting the **ROI** button opens the Region of Interest menu on the right-hand side of the screen.



Figure 3-14: ROI BMD Screen

3. ROI can be drawn using the **Polygonal ROI** tool which can be used after the ROI toolbar appears. Click once for each of the four corners of the ROI. This tool allows to create rectangular or square ROI.
4. Drawn ROI can be saved to the image using **Save ROI** button and recalled using the **Load Saved ROI**. To remove drawn ROI, select **Clear All ROI**.
5. To draw a preset ROI, click the **Draw ROI Preset** button. Then, select the desired ROI preset from the list displayed below the button
6. To save an ROI preset, right-click on the ROI that has already been created and select **Save as Preset**. Name the ROI and click Save. ROI preset can then be found under the ROI preset list.

   NOTE: For cleaned, excised bone samples, it is recommended to place the bones between two strips of medical-grade silicone to simulate soft tissue.

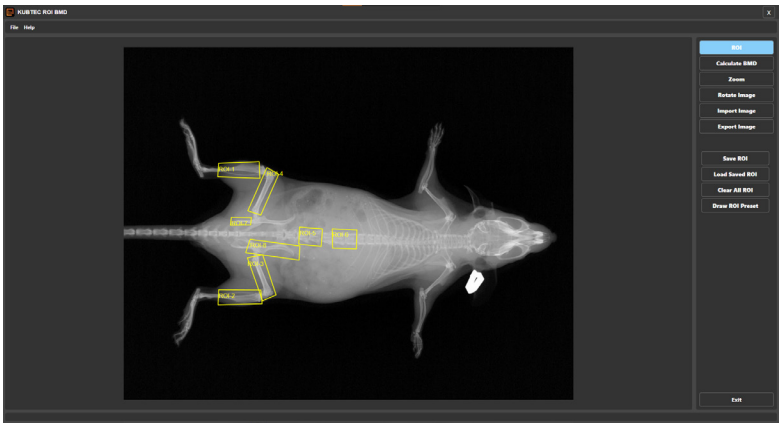


Figure 3-15: ROI BMD Screen

ROI BMD/BMC Analysis (continued)

7. After drawing the desired ROIs, click **Calculate** button to initiate ROI analysis. Up to eight ROIs can be analyzed at once. The process may take one to two minutes to complete.

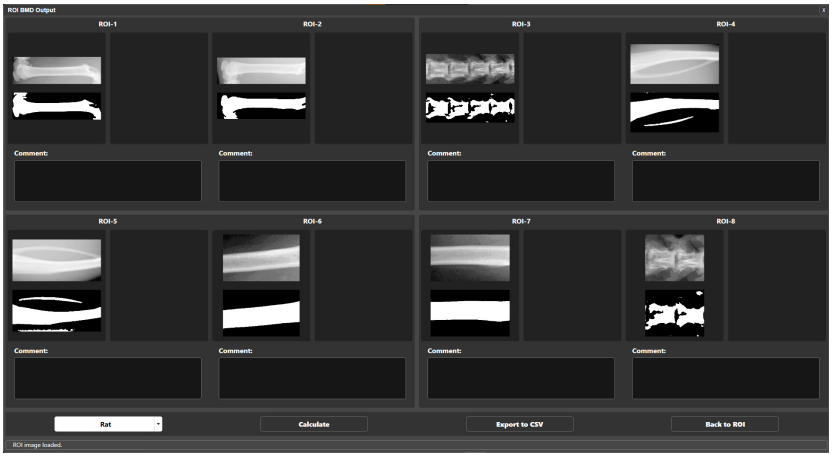


Figure 3-16: ROI BMD Segmentation

8. The calculations for the regions of interest selected are shown in Fig. 3-17. The calculated values are Total Area, Bone Area, Tissue Area, BMD, and BMC.

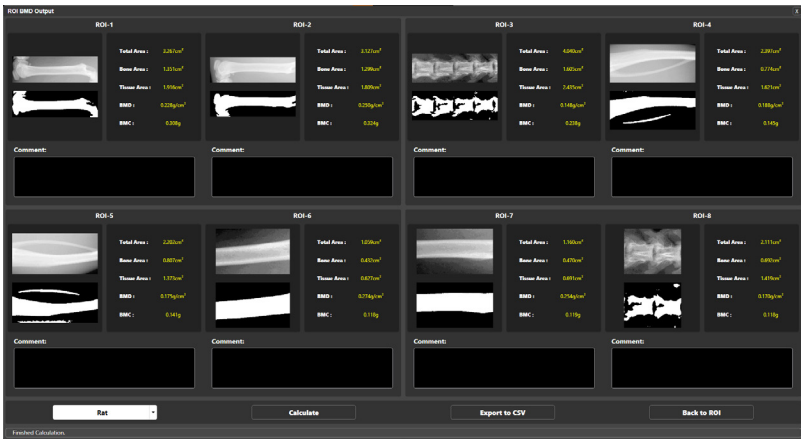


Figure 3-17: ROI BMD Segmentation Result

9. View the preview of bone segmentation in the box below or to the side of the drawn ROI. The preview box for the ROI segmentation will show clean separation between the background and bone tissue. If there is no clear separation, redraw or reposition the ROI until a clear separation is achieved.
10. To export numeric values and ROI images, select **Export to CSV**.

ROI BMD/BMC Analysis Tips & Tricks

1. If bone has been excised and cleaned (i.e., no residual tissue on the sample), it is recommended to wrap the bone in a soft, flexible material to simulate soft tissue.
   - We recommend using medical-grade silicone strips, often marketed at pharmacies as “silicone scar sheets” or “scar-healing strips” which are reusable, easy to clean with 70% ethanol or other common lab-grade cleaners, and do not require wrapping of the bone. (See the example sample placement in Figure 3-18.)

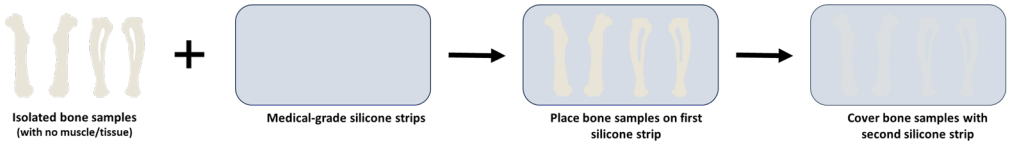


Figure 3-18: Ex vivo Bone Placement Tips

   - Other soft, flexible material may work to simulate soft tissue, such as wet paper towels.
2. Redraw ROI with an equal amount of background on either side of the selected bone. The bone should be centered within the ROI. Try at least three times for optimal segmentation.
3. Consider analyzing a different region. Long bone ROIs, such as the midshaft of the femur, often yield better results.
4. If possible, retake DXA images of the specimen.
5. For further support, contact the KUBTEC® Customer Care Center (CCC) via phone or email.

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