

VX3D v2.9

Manual

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Manuals are subject to change without notice due to product quality improvements and additional features.

Software and manual version

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Manual Document Version: V_2.9.01

Publisher: 3D Industrial Imaging Co., Ltd

Product Configuration

1 USB with installer and manual

1 USB dongle key

1. Introduction

VX3D is a software for analysis of volume data from CT (Computed Tomography) scan. VX3D is optimized for 3D visualization of the various industrial data such as circuit, chip, automobile components, and so on and provides the interface for 2D plane analysis.

VX3D focuses on basic visualization features for analyzing volume data. Advanced functions for analysis will be provided in add-on modules.

1.1 Key Features

VX3D incorporates the following key features:

- VISUALIZES CT volume data
- SUPPORTS various types of data
- MEASURES 3D object
- ANALYZES and filters volume data
- PUBLISHES various forms of report
- ACCELERATES 3D visualization by using GPU
- LOAD / SAVE the project file
- RESTORES (Undo) or REPEATS (Redo) tasks based on Operation History
- SUPPORTS a user-friendly interface

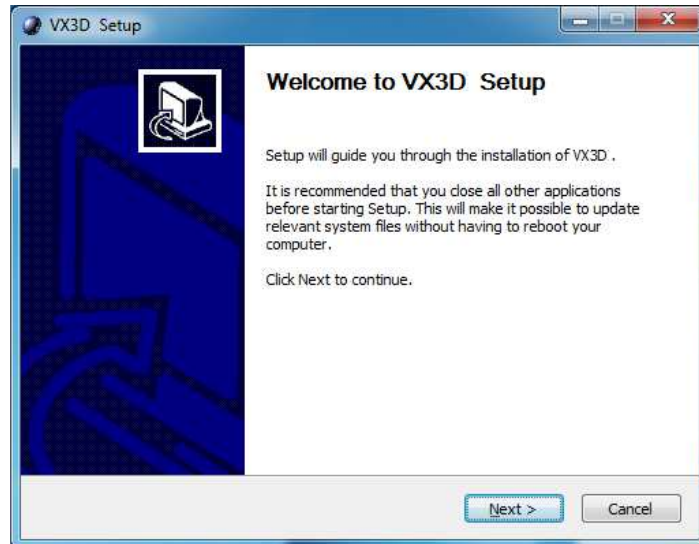
2. System Requirements and Installation

2.1 System Requirements

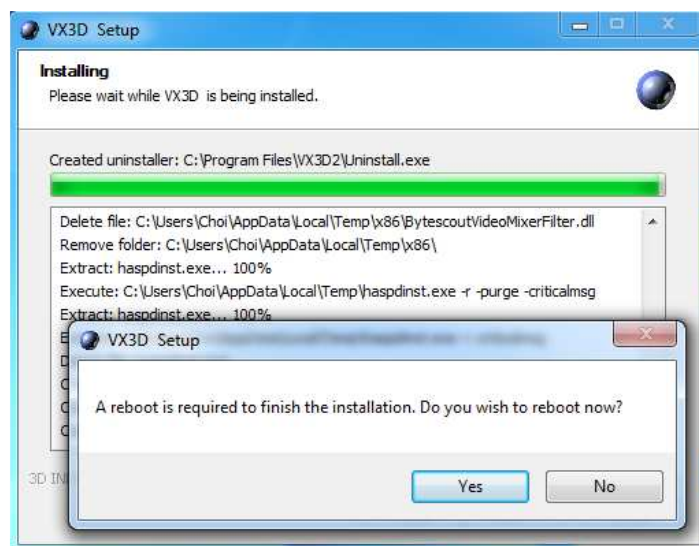
Components	Minimum System Requirements	Recommended
OS	Windows Vista/7/8/10 (64-bit)	Windows Vista,7,8,10 (64-bit)
RAM	2GB	6 GB or more and at least three times as big as the data size
Graphics Card	Graphics cards compatible with Direct X 10.1	High end graphics cards compatible with Direct X 11 or higher GPU-dedicated memory 1GB or more
CPU	Intel i3 Dual Core	Intel i5 Quad Core or higher
HDD	2GB free space	2GB free space and free disk space of more than three times of loaded data size

2.2 Installation

- ① Run the 'Setup' file to begin installation.



- ② During the installation, users will be asked to install other programs required to execute VX3D. Click 'Next' to proceed.
- ③ At the end of the installation process, users will be asked to reboot the PC. Click 'Yes' to reboot.



- ④ After rebooting, insert the provided dongle key.
If not, VX3D will be shut down with a warning pop-up.

- ⑤ When the dongle key is connected, execute VX3D.

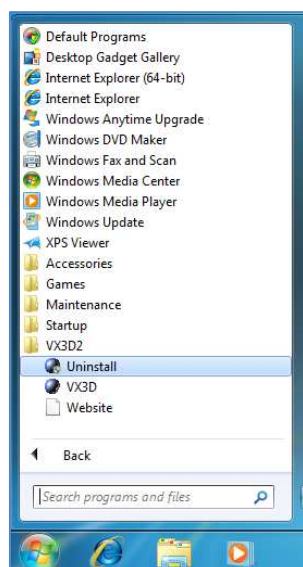
※ WARNING: If the 3DII software is already installed, users will be asked whether to install the software once again. Click 'Yes' or 'Yes to all' to proceed.

※ WARNING: This installation package does not include a graphics card driver. To use the GPU-based functions, install the latest graphics card driver by downloading files from the website of the graphics card manufacturer (ex. NVIDIA, AMD). For further information, please contact 3DII.

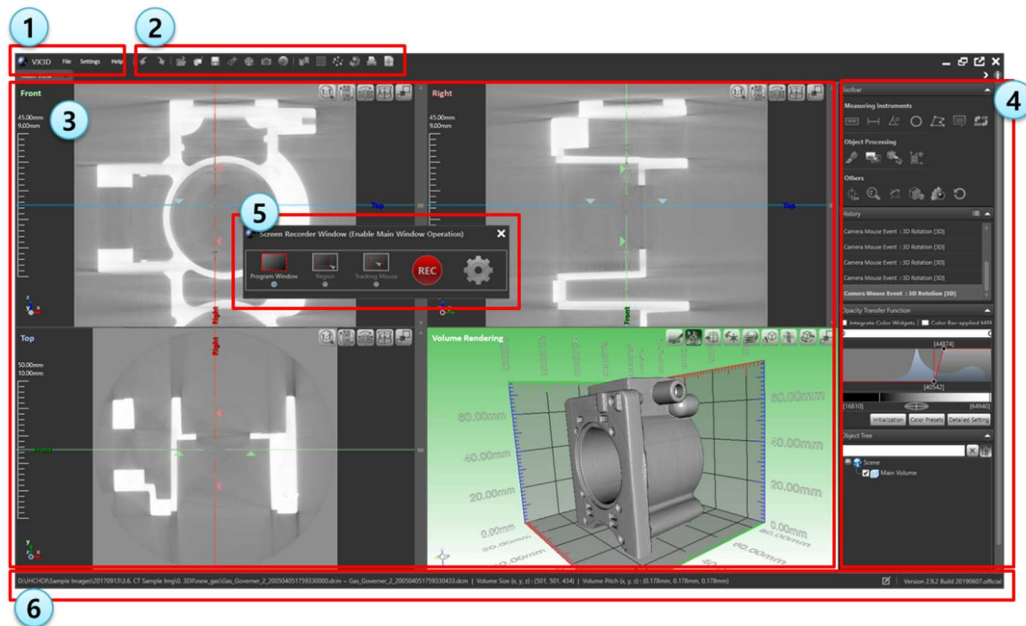
※ WARNING: The installation process of the driver can last up to several minutes. Run the program after installation.

2.3 Uninstall

- ① Click the Windows Start menu and select the VX3D folder from All Programs.
- ② Click the 'Uninstall Program' but



3. Layout



Layout	Description
① Title bar	The main menu contains File, Setting, and Help.
② Common Function Toolbar	Common Function Toolbar includes buttons to perform common functions like opening file, saving project, etc.
③ View Container	View containers include panels with MPR and 3D rendering visualization results.
④ Function Container	Function containers include function buttons, operation history, and the OTF panel.
⑤ Pop-up Window	A pop-up window shows up when additional information or options for specific functions are provided.
⑥ File Information / Help	The basic file information is shown. If a specific function is used, related details will be shown.

4. Title bar

There are several function buttons for the overall use of VX3D on the title bar.

At the upper left side:  , the upper right side: .

① File

- Open: 'Open file window' is displayed.

See the tutorial 'Basic operations: Open file' for details.

- Import/Export Configuration File:

The information such as OTF preset, Shading preset, Layout (panel location), Background color are saved.

Favorites, Monitor size and Screen record setting are not saved.

- Exit: The program will be automatically shut down.

② Settings

- Calibration: Sets Unit, Precision and Coordinate System in Calibration Window.

See [8.1.1.7 Calibration](#) of this manual for details.

- Language: Supports Chinese, English, Japanese and Korean.

- Configuration: 'Configuration Window' is displayed. See [5. Settings](#) of this manual for details.

- ③ **Help:** Supports the Manual as PDF file.

- ④ Click  button at the upper right side of the screen to fold the right tab of the screen and expand the view screen. Click  button at the upper right side of the screen to display 'DICOM Info. Window'.

5. Settings



The various settings can be set by the path Main Menu-Settings- 'Configuration Window'.

Settings for five categories and detailed settings for each category are provided. (Check each setting to activate it.)

① **Layout and GUI Option:** Settings for layout and GUI.



● **“Use the latest layout of each view container as default”:**

Sets the latest location of Sagittal, Coronal, Axial and Volume Rendering view as default. If the check box is unchecked, the default setting of the program is applied.

● **“Use the latest expander states of each function container as default”:**

There are taps   those folds or unfolds the detailed contents at the function container. If the check box is checked, the latest states of each function container as default. If the check box is unchecked, the default states are applied.

● **“Use the latest background color of each panel window as default”:**

Sets the latest background color as default. If the check box is unchecked, the default color is applied.

② **Visualization Option:** Settings for visualization option.



● **“Use the latest 3D rendering option as default”:**

Sets the latest 3D rendering option of the panel button  as default. If the check box is unchecked, the default setting of default VR and perspective projection is applied.

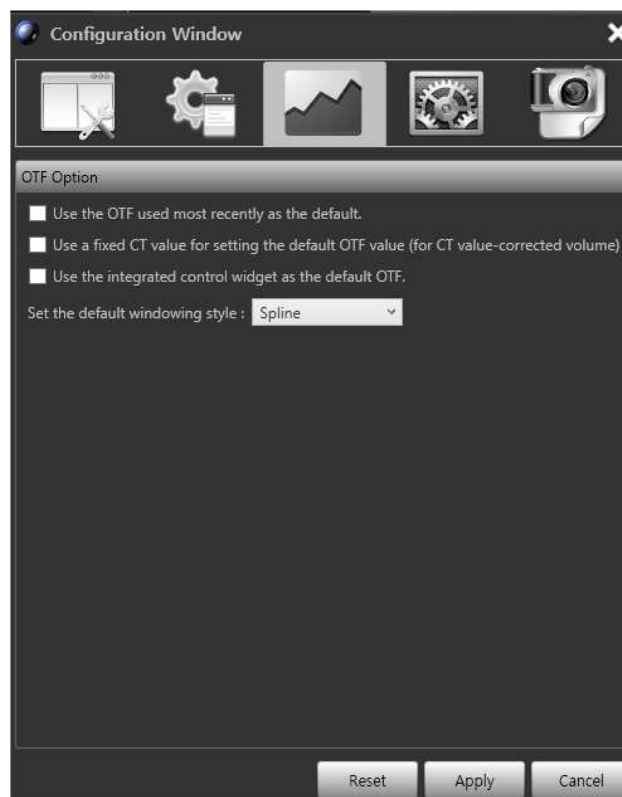
● **“Use the latest 3D superimposed plane option as default”:**

Sets the latest some 3D superimpose plane options (Clipping MPR planes with the bounding box, MPR Opacity) of the panel button  as default.

● **“Use GPU volume rendering”:**

Set whether to use the GPU volume rendering.

③ **OTF Option:** Settings for OTF option.



● **“Use the latest OTF for VR as default”:**

Uses the latest OTF as default. If the check box is unchecked, OTF that set automatically by volume information is applied.

● **“Use Absolute CT value is used for default OTF setting (For CT value-calibrated volume)”:**

Uses the OTF value that is suitable for volume data by analyzing windowing value of DICOM Tag. If the check box is unchecked, proper OTF value is applied by analyzing volume data.

● **“Use the unified OTF control widgets as default”:**

Uses the OTF that Unified Color Widget is applied as default. If the check box is unchecked, OTF that Unified Color Widget is not applied is used.

● **“Set the default windowing style”:**

Set the one style among Spline, Linear, 3 Points Linear.

④ **Others:** Other general settings.



● **“Use the latest calibration setting as default”:**

Uses the latest calibration at



● **“Use the latest actual monitor size setting as default”:**

Set the 2D image of MPR panel appropriately to the actual monitor size. (Real Size Settings)

● **“Warning message will appear when a history item is deleted”:**

If user does new working after returning to the previous working history, the existing history items are deleted. In such cases, 'Some history items will be discarded.' warning message box is appeared. If the check box is unchecked, some history items are deleted without warning message.

● **“Set mouse control events on MPR”:** (See below for How to use)

■ Click with the left mouse button,

- Drag horizontally:  Both the starting and end line of the Windowing Bar move.
- Drag vertically:  The width of the starting and end line of the Windowing Bar changes.

■ Mouse wheeling

- Wheeling: Relocate the image slice.
- Wheel-click and drag: Move the image slice.

■ Click with the right mouse button,

- Drag vertically: Zoom in/out the image.

● **“Flip the volume slice vertically when importing volume dataset”:**

The Axial view is upside down.

If the check box is unchecked, the volume slice appears intactly.

● **“Use UDP Communication”:**

Set Receive/Send Port. (See Command Tutorial for details)

● **“Keep the 'Measurement' button state”:**

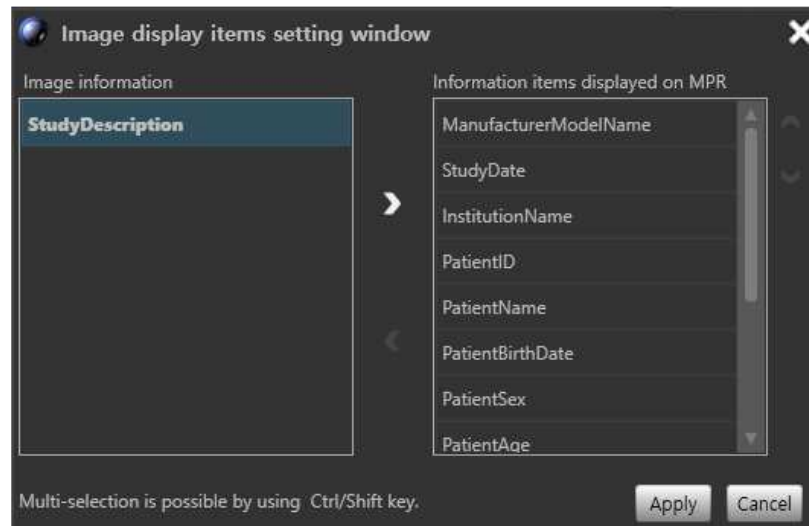
If user clicks the measurement tool button, user can use the measurement tool continuously. If the check box is unchecked, measurement tool must be selected on each time.

- **“Use the latest import file path as the default path of the file dialog”:**

If the check box is unchecked, the root path of data file is used as the default path.

- **“Display image information on MPR”:**

When loading DICOM file, image information is displayed on MPR. Using the [Settings] button, image information items that is displayed on MPR can be added or deleted.



- **“Use the latest state of MPR flip button as default”:**

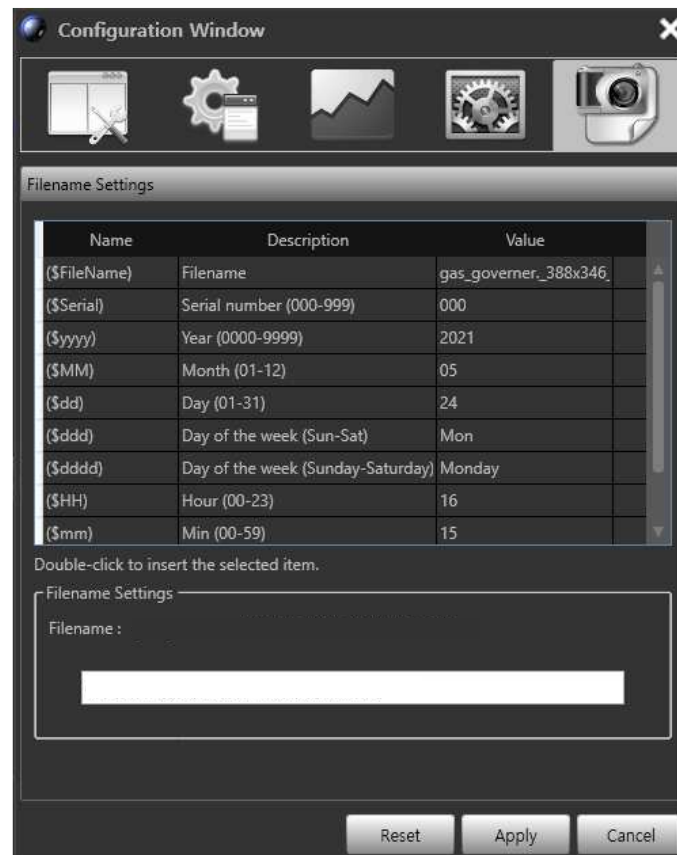
The setting of Flip MPR Image vertically/ horizontally button  can be maintained. Use the latest state of MPR flip button as default.

- **“Run multiple programs at the same time”:**

This is a function that allows user to run multiple VX3Ds at the same time.

When this function is activated, the command prompt only supports the '/import' command.

- ⑤ **Filename Settings:** Set the rules of the filename used when saving files.



- Double click to insert the selected item.
 - Click 'Apply' button to set a Filename.
 - Click 'Reset' button to reset the current saved setting.
 - Click 'Cancel' button to return to the previous setting and close the window.
- ※ Click Menu-File-Export Configuration File of main menu tab to save the configuration as a .cvx file.
- ※ Click Menu-File-Import Configuration File of main menu tab to load the saved .cvx file and set the program.

6. View Container



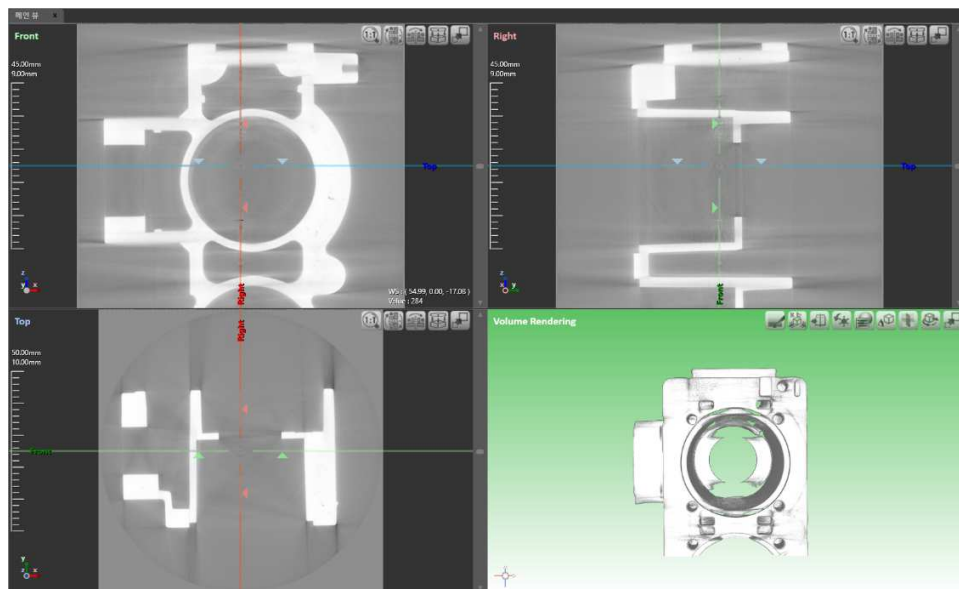
The view container contains panels which display visualization results of VX3D. VX3D supports various view containers for different purposes of use. Some view containers offering advanced features are provided in add-on modules.

6.1 Main View

The main view is the most basic view of VX3D, allowing the operation of most of the functions. It also opens and interworks with other views.

The main view includes:

- Panel buttons
- View layout
- GUI components for the interaction between MPR panels and the 3D panel.



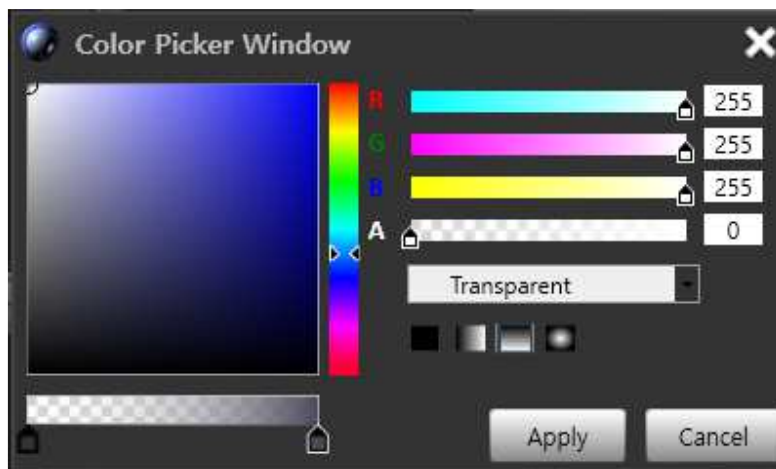
6.1.1. Panel Buttons

6.1.1.1 Changing Background Color

Click  at a panel to change the color of the background.

A pop-up window will show up to choose the background color.

Either a solid color or gradient are supported for the background.

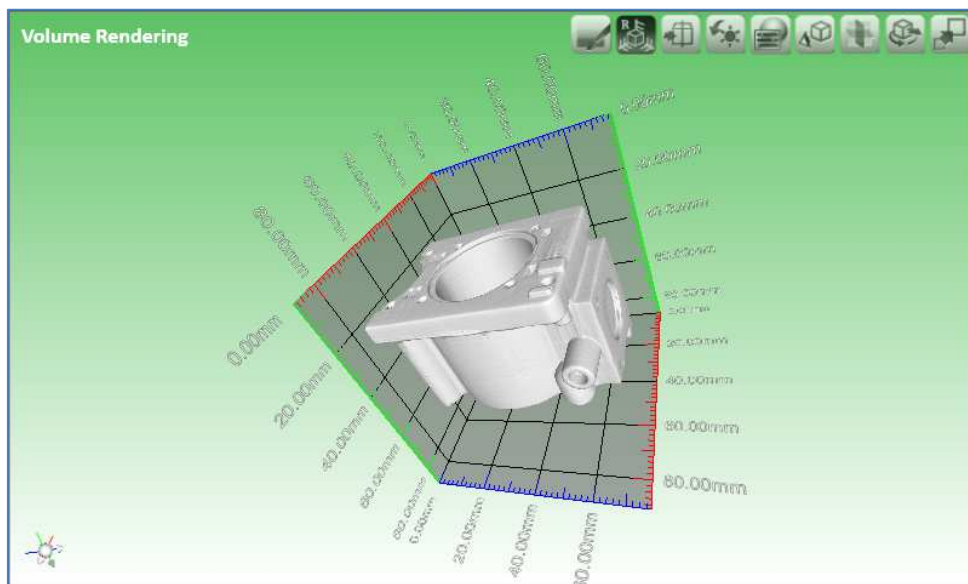


6.1.1.2 3D Ruler



Click  at a panel to utilize a 3D Ruler.

3D Ruler measures a length of the object. The location of 3D Ruler appeared on the boundary aspect is changed automatically as the object rotates. 3D Ruler button is still available while other panel buttons are used.



※Warning:

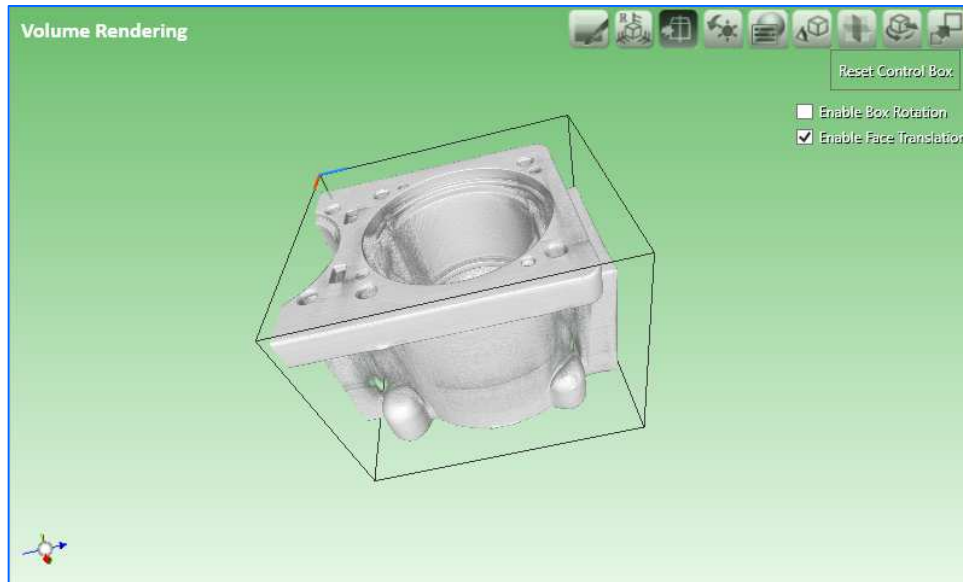
The accuracy of measurement is based on the image resolution of CT data and the accuracy may be lower than the resolution of CT data.

The measurement values are based on the location that is specified by user.

The form or boundary line of the object can be changed by the adjustment of the image brightness.

6.1.1.3 Clipping Box

Click  at a panel to utilize a clipping box.



Clipping box visualizes occluded structures of the volume by cropping the object. Rotation of the

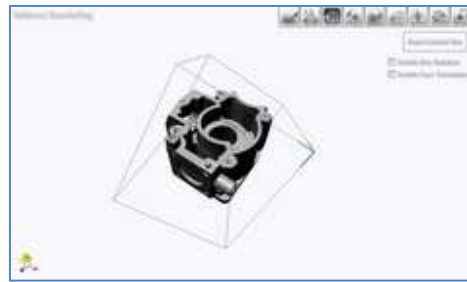
clipping box as well as the parallel movement of the plane can be controlled by mouse control.

● Drag Clipping box with the right mouse button

■ Check '**Enable Box Rotation**' to rotate only the clipping box.

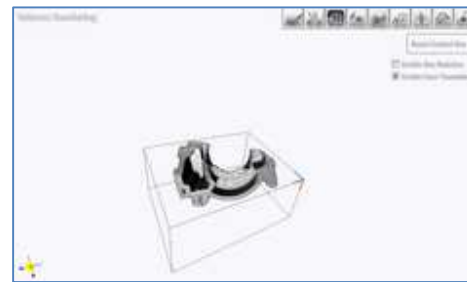


- Uncheck '**Enable Box Rotation**' to move the entire volume with the clipping box.



- Drag Clipping box with the left mouse button

- Check '**Enable Face Translation**' to clip the volume along the box plane.



- Uncheck '**Enable Face Translation**' to move the entire volume with the clipping box.



6.1.1.4 Light Source Control

Click  at a panel to control the light source. Users can control the direction of light source.

Two options for the control of the light source are supported.



● **"Light on Camera"**: Fixes the direction of the light source to the viewing direction of the user.

● **"Fixed Light"**: Drag with the left mouse button to fix the light source in the intended direction on the 3D panel. The yellow arrow () is shown at the left bottom side of panel indicates the current direction.

6.1.1.5 Rendering Options

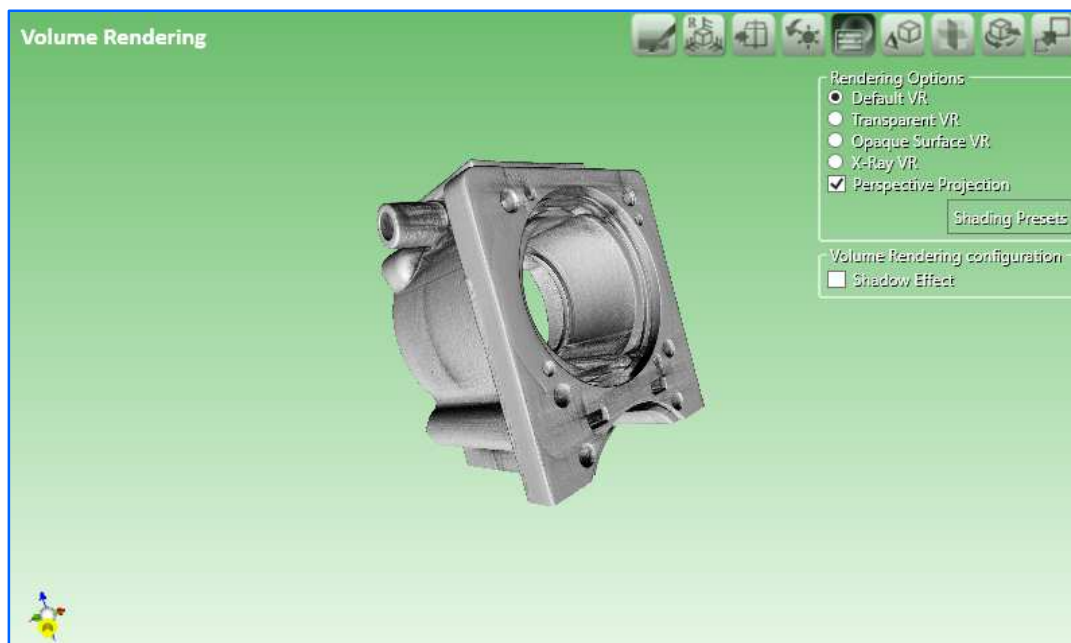
Set the 3D rendering options. VX3D visualizes the input data on a real-time basis by applying a GPU accelerating technique, presenting rendering images to users, and thereby enabling intuitive understanding of the volume structure.



Click  at a panel to apply 3D rendering options.

Volume rendering (VR) options are as follows.

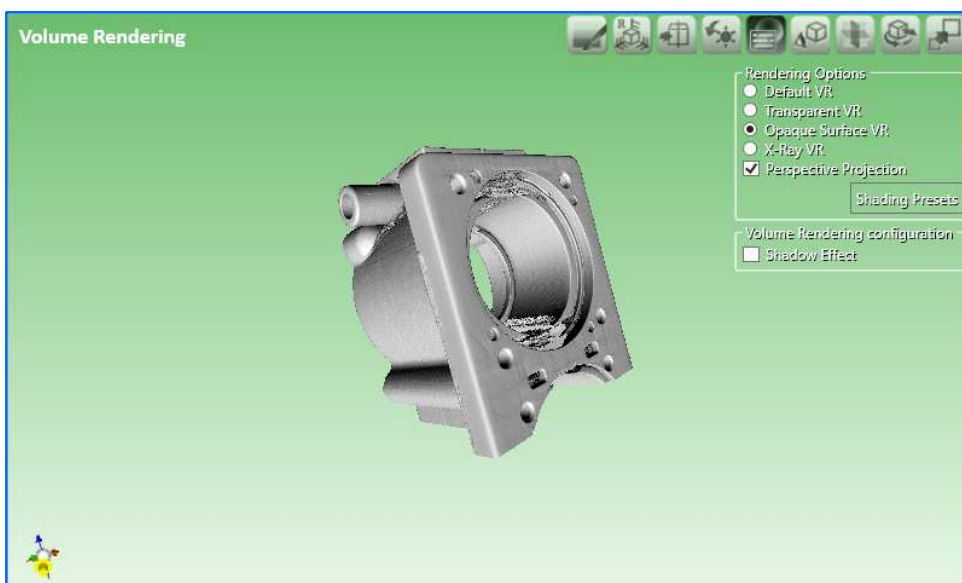
- **“Default VR”**: This option strictly applies Phong shading (interpolation technique for surface shading in 3D computer graphics) to volume rendering. If the volume is rendered transparent by OTF manipulation, it may require a longer processing time. Especially, rendering the massive volume data (i.e., several hundred MB or several GB) will require a substantial amount of time on PCs with a low-performance GPU.



- **“Transparency VR”**: Users can set several parameters for visualizing both the occluded and occluding structure. Rendering a massive volume data (i.e. several hundred MB or several GB) will require a substantial amount of time on PCs with a low-performance GPU.

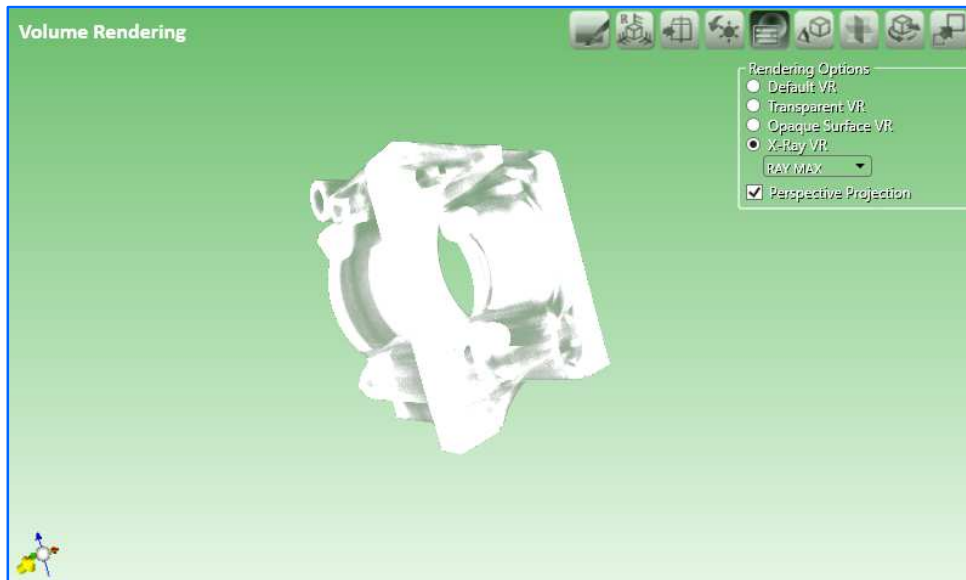


- **“Opaque surface VR”**: This option renders the surface of the object in detail by sampling more data. It can be used for a detailed depth analysis or a rapid 3D rendering.

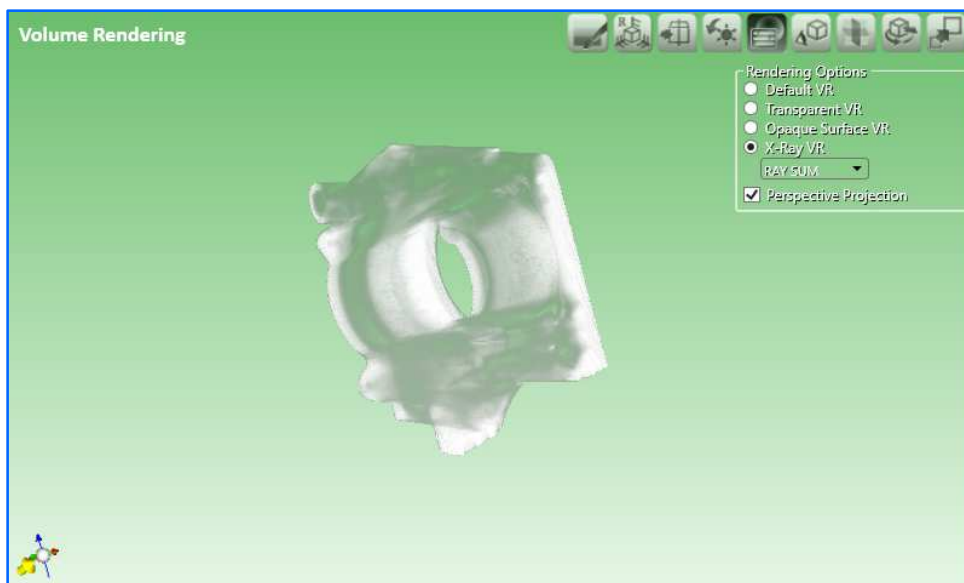


● "X-Ray VR"

- **Ray MAX:** This option displays the maximum volume value of voxels penetrated by the ray among the sampled ones.

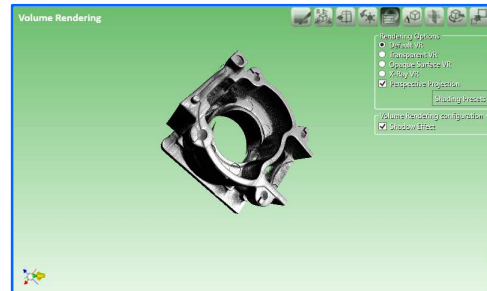
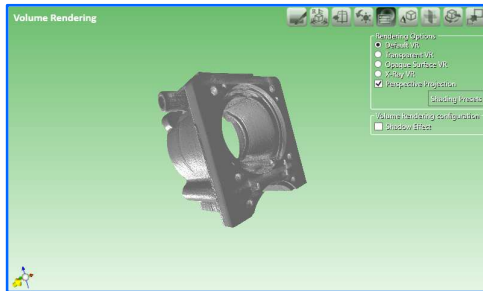


- **Ray SUM:** This option displays the mean volume value of voxels penetrated by the ray among the sampled ones.

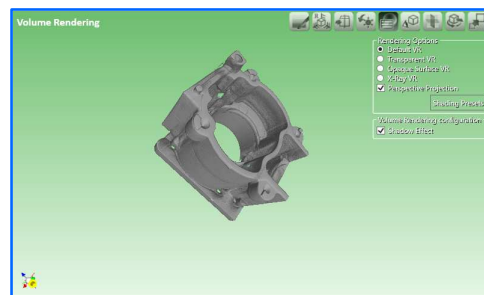
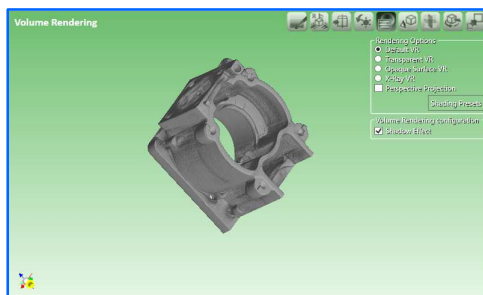


6.1.1.6 Volume Rendering Options

- **“Shadow effect”**: This effect applies shadows according to the manipulated direction of the light source.

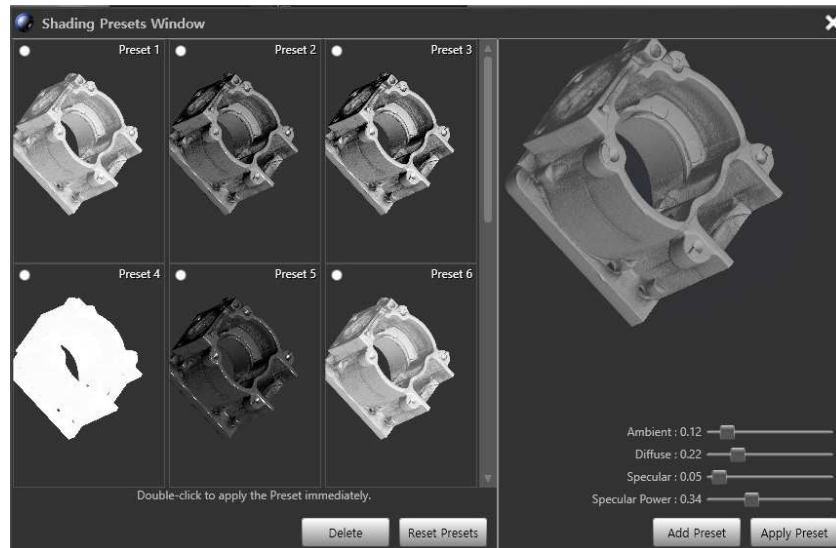


- **“Perspective Projection”**: This option affords two ways of projecting 3D-rendered objects, the perspective and orthogonal projection.



✖ **Note:** Action Items in the volume rendering settings are not saved in the History panel.
(Shadow effect)

- **"Shading Preset"**: It can be set in "Default VR" and "Opaque Surface VR" options. Click 'Shading Presets' to set parameters of Phong shading. A pop-up window with options for parameter setting will appear. Click 'add preset' to use the adjusted parameter afterwards as well.



- **"Transparency Rendering Preset"**: Click 'Transparency Rendering Presets' to set parameters of Transparent VR. A pop-up window with options for parameter setting will appear. Click 'Add Preset' to use the adjusted parameter afterwards as well.



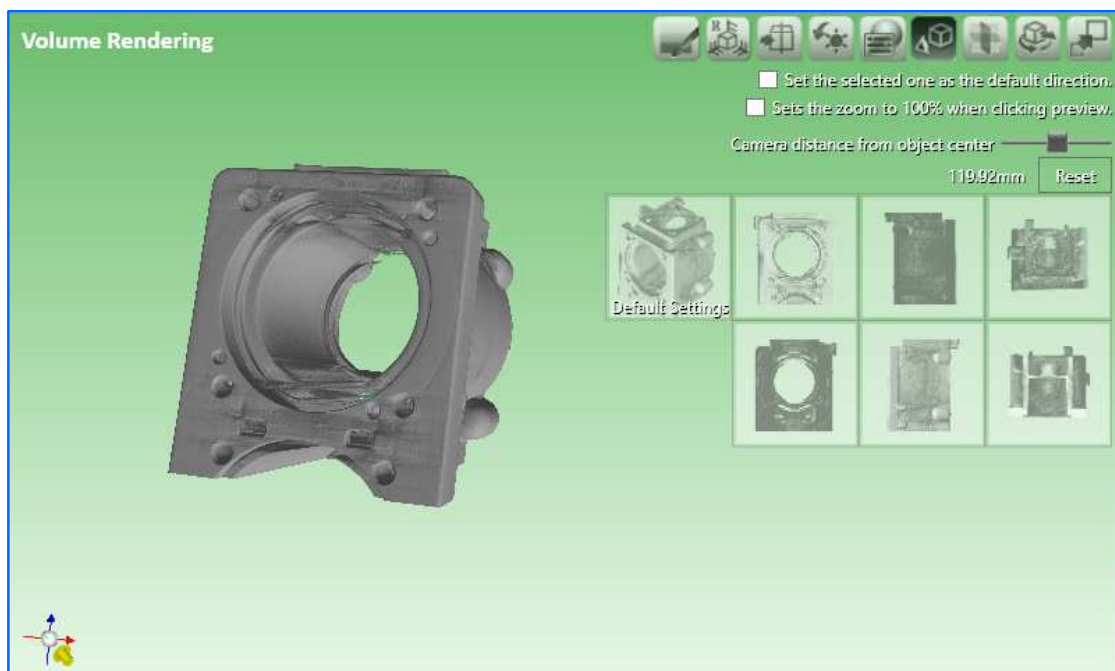
※ **Warning: It may require a significant processing time to render massive volumes with the Shadow effect and Transparency Rendering preset.**

Additional Features / VR Options	Default VR	Transparent VR	Opaque surface VR	X-Ray VR
Shadow Effect	O	X	O	X
Perspective Projection	O	O	O	O
Shading Preset	O	X	O	X
Transparency Rendering Preset	X	O	X	X

6.1.1.7 Camera Orientation Setting

Click  at a panel to set the camera orientation.

The 3D screen movement of VX3D is set by the location and orientation of camera. Camera Orientation Setting provides functions which set the location and orientation of camera easily.



- **"Set the selected orientation as a default":**

Check 'Set the selected orientation as a default' to fix the current orientation as the default orientation.

- **"Set zoom in preview to 100%":**

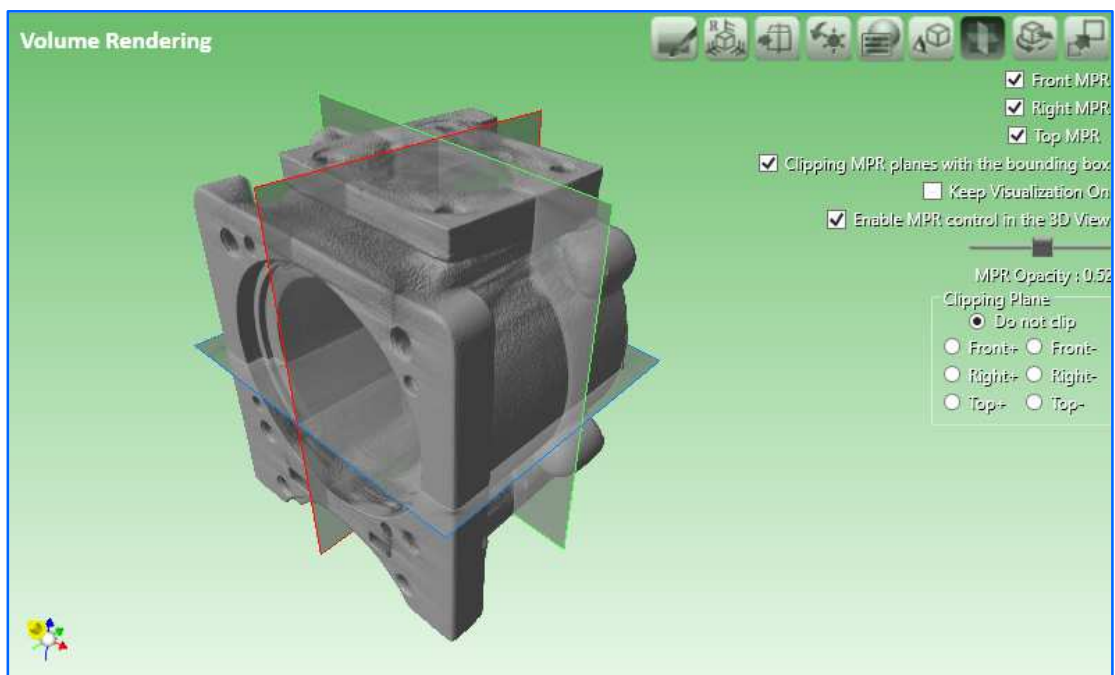
Check 'Set zoom in preview to 100%' to adjust the current zoom in ratio to the screen size.

- The radius of the 3D trace of the camera (Distance from the object center) is adjusted by the camera distance setting. Click **[Reset]** to set the camera distance as the radius of default camera trace.

- The orientation of camera is set in accordance with the x- or y- or z-axis. The preview box for the camera orientation setting will be visualized. Click the preview box with the desired camera orientation to set the orientation.

6.1.1.8 3D Plane Options

Click  at a panel to set 3D planes.



- **"Front MPR (sagittal), Right MPR (coronal), Top MPR (axial)":**

Check the MPR planes to visualize the current placement of them on each panel with different color. The border color appears in the corresponding MPR color. Each of the three MPR planes can be translated on the volume rendering panel by mouse dragging. They can also be translated on a MPR panel, the result shown on the volume rendering panel window as well.

- **" Clipping MPR planes with the bounding box":**

Click 'Clipping MPR planes with the bounding box' to visualize the plane of MPR panel on 3D depending on the bounding box of the object. Deselect it to visualize the rectangular cross-section defined on MPR panel intactly without clipping.

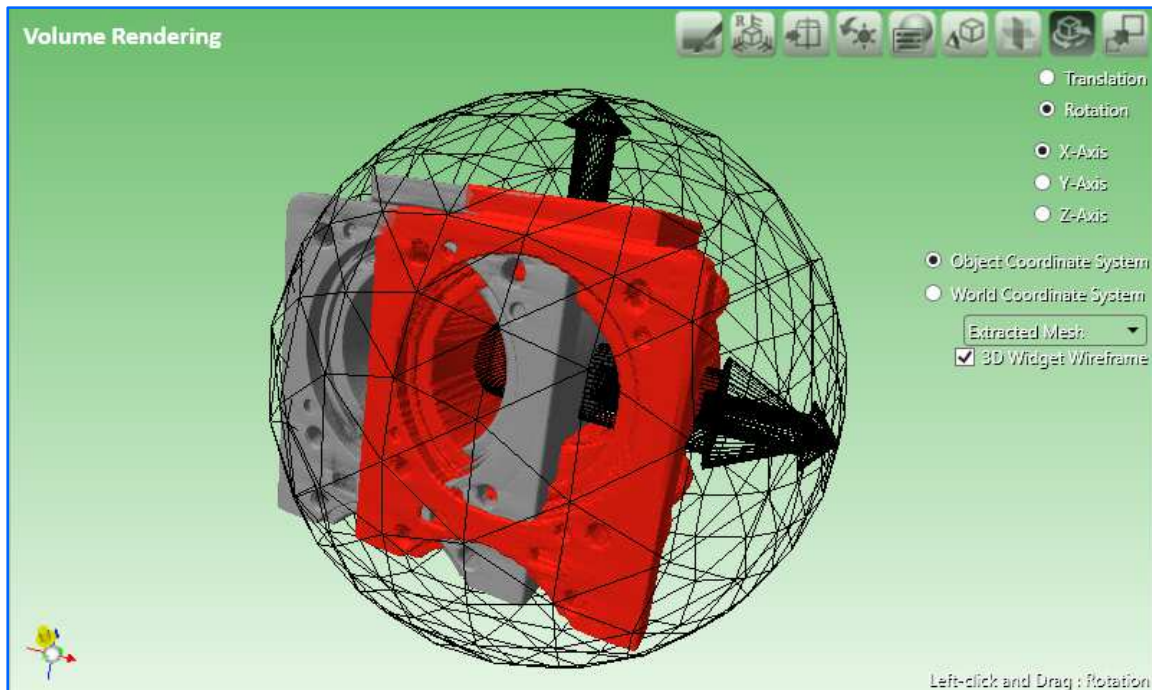
● **“Keep Visualization On”:**

Check 'Keep Visualization On' to keep the plane visible on the volume rendering panel window. MPR planes displayed on the volume rendering panel window can be operated and visualized as follows:

- Place the mouse cursor on superimposed planes (the cursor will change its form) and drag it to translate the plane in parallel.
- Use the slider to adjust the opacity of superimposed planes (0.0~1.0).
- MPR can also be used as a clipping plane.

6.1.1.9 3D Object Control

Click  at a panel to rotate or translate the object.



VX3D offers a GUI to place the loaded object in 3D space.

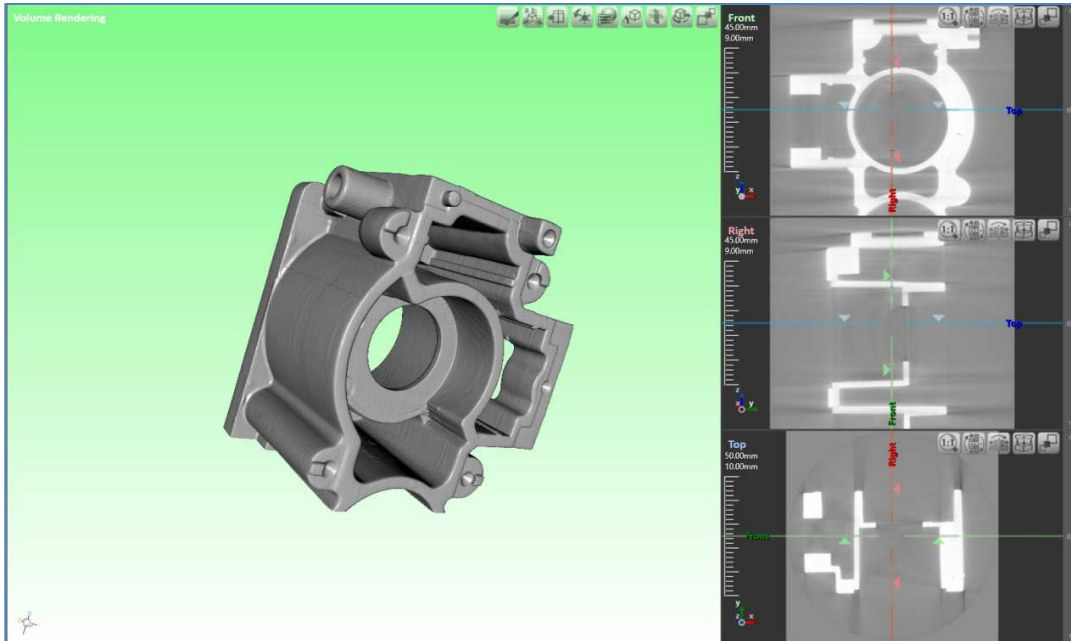
When a mesh object is added, its possible placing options will be shown. Choose an object from the combo box.

Set the standard for transformation (translation/rotation) as either the world coordinate space or the object coordinate space.

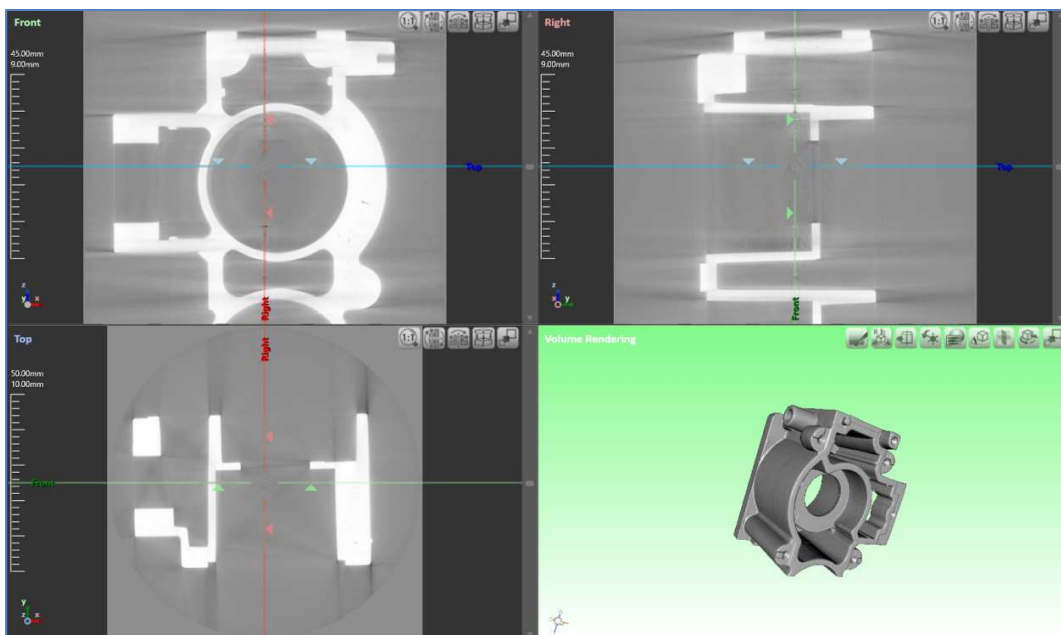
- **"Parallel translation"**: Click 'Translation'. Choose one of the axes (x,y,or z-axis). Left click and drag the object to translate it.
- **"Rotation"**: Click 'Rotation'. Choose one of the axes (x,y,or z-axis) and the panel window will show both the chosen rotation axis penetrating the center of the object and the sphere representing the radius. Left click and drag the object in the direction users want to rotate.

6.1.1.10 Panel Window Min/Maximization

Click  at a panel to maximize the panel window.



Click  at a panel to minimize the panel window.



6.1.1.11 Inverting MPR View Direction

Click  at a panel to flip the visualized image horizontally.

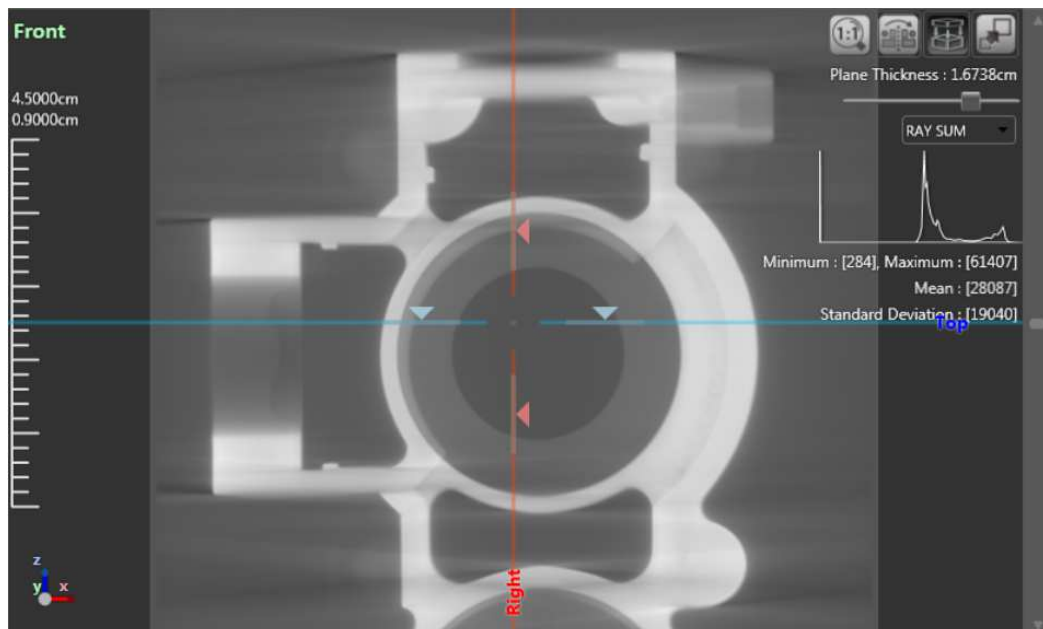
Click  at a panel to flip the visualized image vertically.

6.1.1.12 MPR Setting and Analysis

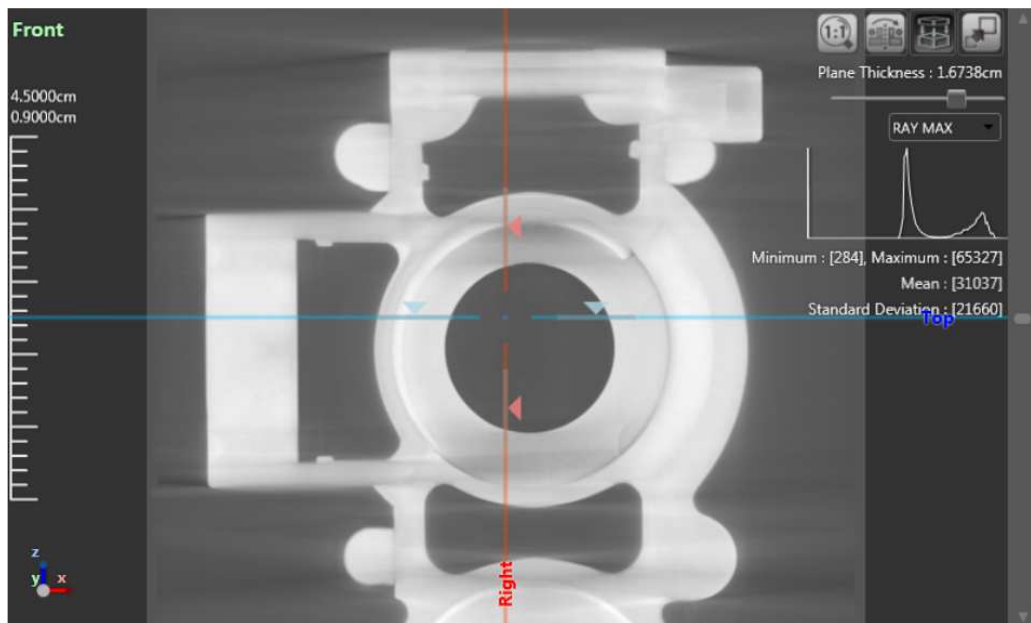
Adjust the scope of an MPR plane and use its sampled data for visualization.

Click  at a panel to observe the volume data in the adjusted range.

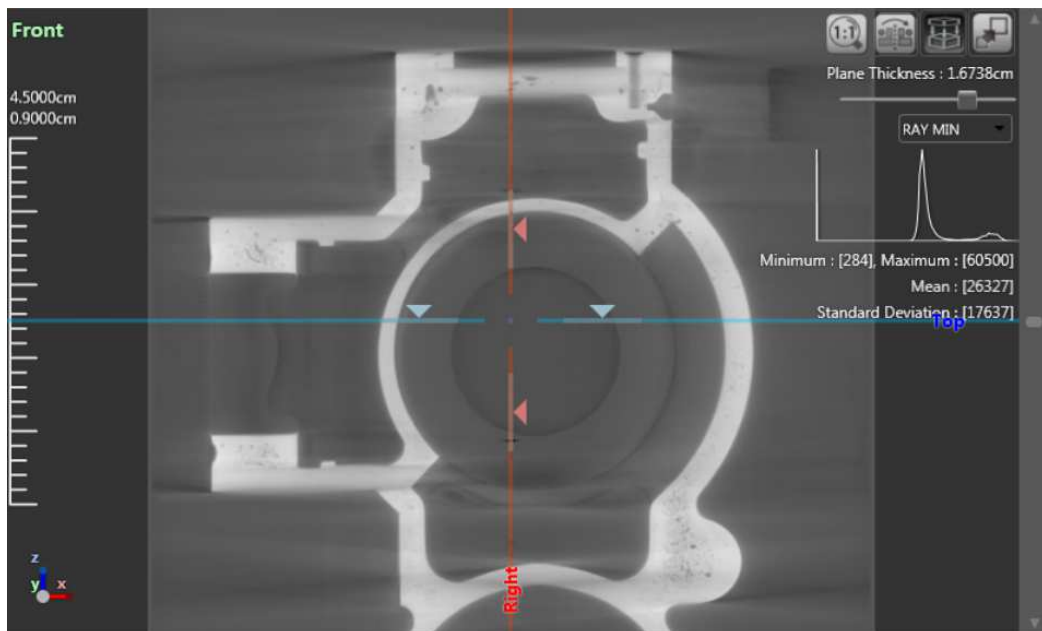
- **"Plane Thickness"**: Sets the thickness of the MPR panel. The thickness of this MPR panel is displayed as white dotted lines on other MPR panel window.
- **RAY**: Choose one among RAY SUM, RAY MAX, RAY MIN.
- **RAY SUM**: The mean values are visualized when sampling the selected area.



- **RAY MAX:** The maximum values are visualized when sampling the selected area.



- **RAY MIN:** The minimum values are visualized when sampling the selected area.

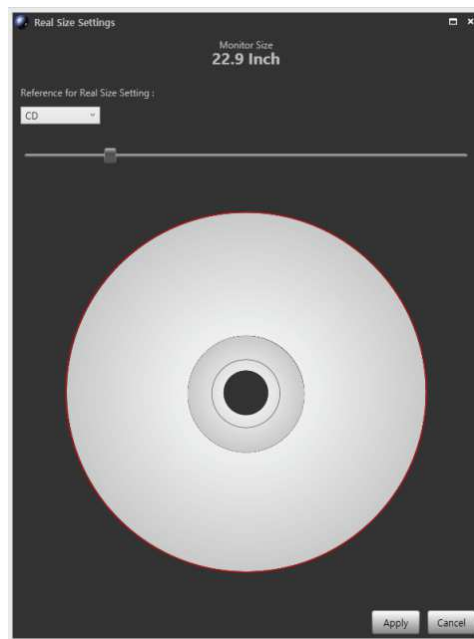


Additional information on volume values represented in pixel can be found on the MPR panel.

It provides information about histogram, min/max values, and standard deviation.

6.1.1.13 Real Size Settings

Check 'Use the latest actual monitor size setting as default' from 'Settings - Configuration – Others' and click 'Settings'.



Select an object for reference (CD, Credit Card, Ruler) from the real size settings window.

The standard size that program defines: The diameter of CD is 12cm, Credit Card width / height are 8.560cm / 5.398cm. If using the CD or Credit Card which is unsized, real size setting does not work.

The accuracy depends on the CT resolution and the accuracy is lower than the CT resolution.

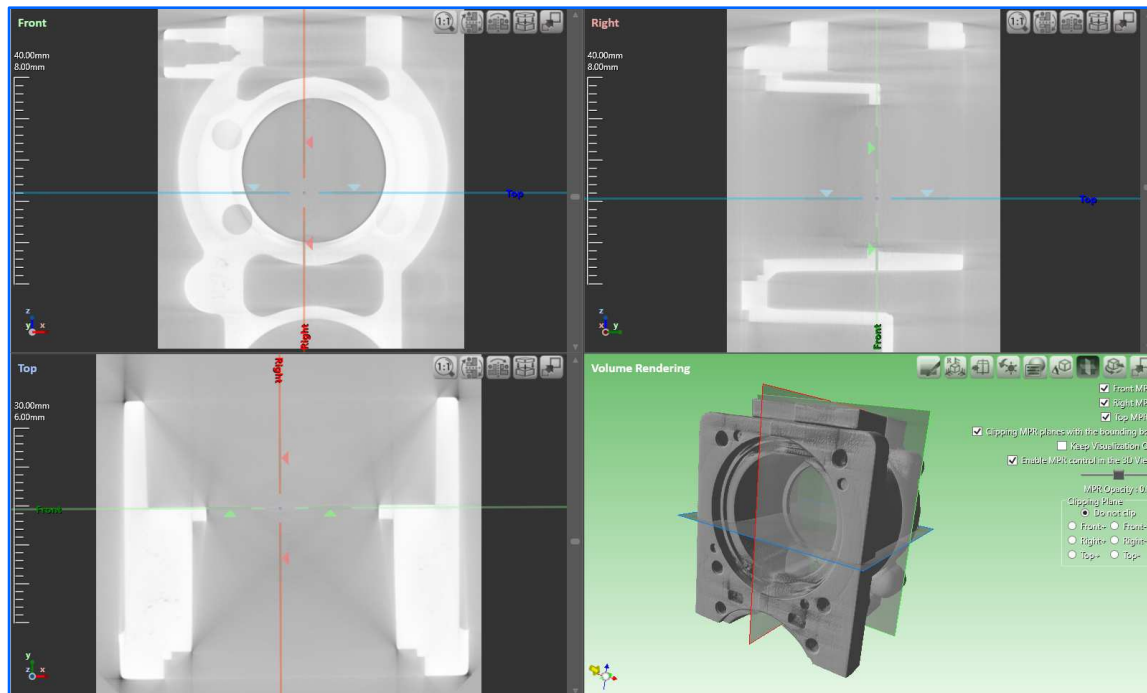
If user set the real size without an error, the length for 1 pixel is a maximum permissible error.

Place a real CD or credit card on the monitor and use the slide-bar to adjust the size. The slide-bar can be operated either with the left mouse button or mouse wheel. Click [Apply] after adjusting.

Click  at the MPR panel to set the 2D image of the MPR panel in real size.

6.1.2 View Layout

The basic view layout is like the following.



The three cross-sectional planes on the volume rendering panel indicate the MPR panels which are vertical to each other. When the data is first loaded, they penetrate the middle point of the volume and are perpendicular to x, y, and z-axis.

- The front panel (hereafter referred to as the 'panel') which is marked with green is vertical to y-axis when data is first loaded.
- The right panel which is marked with red is vertical to x-axis when data is first loaded.
- The top panel which is marked with blue is vertical to z-axis when data is first loaded.

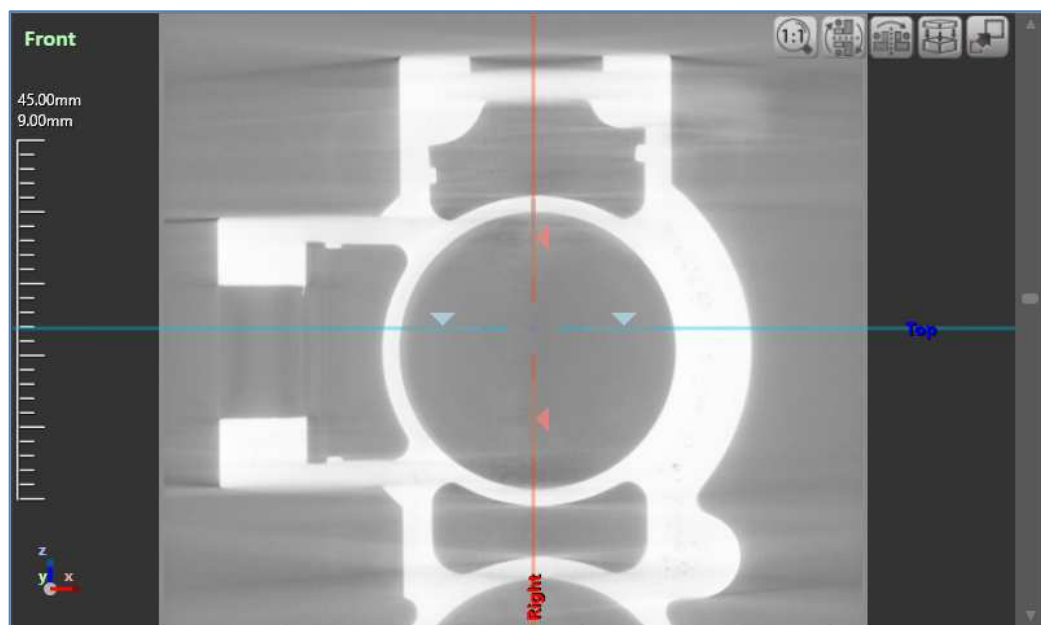
The 3D panel shows the entire volume. Click  to visualize the superimposed planes.

[\(See "6.1.1.8 3D Plane Options" for details\)](#)

6.1.3 Layout Manager

Changes the location of MPR panel and the 3D panel from the view container. Click the name of the desired panel. Drag and drop it on the target panel, which turns to blue, to exchange the location of the two panels. Change the location of the panels of the function container in the same way. ([See "Basic Operations" Tutorial for details.](#))

6.1.3.1 GUI COMPONENTS FOR MANIPULATING MPR PLANES



- All the four panels are interconnected, so any changes on one panel are applied automatically on the other panels in real time.

On the 3D panel, click  to visualize the current placement state of planes.

- Right-click on one MPR panel and drag to zoom in and zoom out.
- The two-colored lines crossing each other vertically show the current placement state of the other two planes. These are called MPR lines. In the image above, the red line indicates the right panel, and the blue line indicates the top panel.
- With mouse scrolling or by using the slider on the right side of each MPR panel, translate the corresponding panel.

- Place the mouse cursor on the crossing point of one MPR panel. A circle which has the representing color of the panel will appear. Drag the circle to translate the two other planes. In this way, users can translate two planes at the same time.
- Place the mouse cursor on one of the MPR lines which is marked in bold. Left click and drag to rotate the two crossing planes. (Then the three planes will no longer be parallel to axis.) Right click and drag to rotate only the 2D image of the plane. The placement state of planes remains the same.
- Place the mouse cursor on one of the MPR lines which is marked in bold and white, adjoining the crossing point. The white part will thicken. Left click and drag to translate the plane of that MPR line. In this way, users can translate only one plane and see at the same time its placement state on the MPR panel. ([See "Basic Operations" Tutorial for details.](#))

6.2 Panorama View

Users can visualize a 1D nonlinear curve plane of volume into a 2D image.

([See "10. Panorama View" for details.](#))

6.3 Pore Detection View (add-on module)

Users can manipulate and control the detected pores.

([See "9. Pore Detection" for details.](#))

6.4 Report View

Users can print reports in formats provided by VX3D, with additional comments if needed.

([See "13. Report View" for details.](#))

6.5 Tile View

Tile View arranges MPR planes as images.

[\(See "11. Tile View" for details.\)](#)

6.6 Path Animation View

Path Animation View allows to create an animation using the camera direction.

[\(See "12. Path Animation View" for details.\)](#)

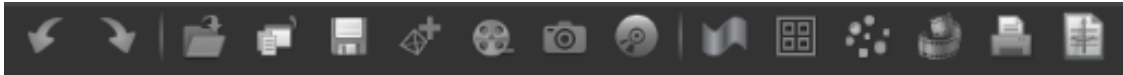
6.7 Reformat View

Exports the image that is customized by using various options.

[\(See "14. Reformat View" for details.\)](#)

7 Common Function Toolbar

Common Function Toolbar provides a list of function button commonly used in each of view containers.



Toolbar panel performs functions as follows:

- Open / Save a file
- Export/Save a movie file
- View container by function
- Others

7.1 File

Imports / exports various volume data or mesh data (STL) such as *.x3d (VX3D's own format), *.dcm (DICOM), *.raw (file without header), *.tif, *.jpeg.

If additional volume information is provided, VX3D will automatically detect it while importing the data. Otherwise, set manually the required information to import the volume data.

Volume data can be exported in several formats and new volume data can be created by setting the region of interest (ROI). ([See "File" Tutorial for details.](#))

7.1.1. Save Project (Ctrl+S)

Click  at the common function toolbar to save the current operation as a project.

Check '**save original data**' to copy original data and save it with its project file(*.vx3). Project file will not be loaded if original data is not copied and its path or the path of the project file is changed.

Storage policies for the volume data are as follows:

- Volume data: Volume data will be saved in *.x3d file format. *.x3d file format includes additional information like volume size or pitch and are used on project files (*.vx3). *.x3d files can be loaded by itself.

Following information will be saved:

- 2D Plane state: MPR Line, MPR zoom state, position, and direction of Planes, etc.
- 3D Camera state: Position and orientation of the camera, Zoom state, etc.
- 3D Rendering Options: Clipping box, Light source Control, MPR planes, etc.
- Measurement: Add, Modify, Erase, Color Change, etc.
- OTF: Alpha, Color, Windowing state change, etc.
- Mesh data loading and Surface Extraction
- Job history added to history panel
- Captured image screen, Final result of report view

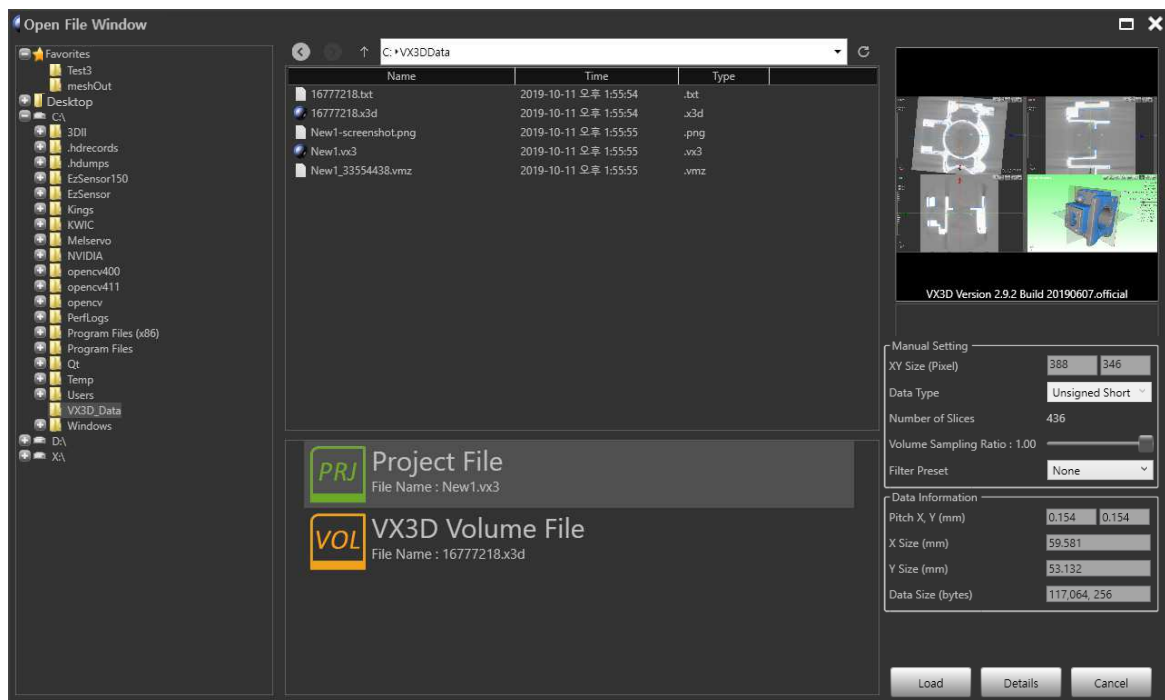
Following information will not be saved:

- Volume processing: Volume processing such as Sculpture or Filter, etc. will not be registered on the history panel. Only the final result of the volume processing is saved to the volume.
- Background Color
- Adjustment of the size of a panel.
- Unit Transformation
- MPR Overlay Visible/Hidden
- File-related operations (i.e., Export, Save as AVI)

7.1.2. Open (Ctrl+O)

Click  at the common function toolbar to appear Open File Settings Window.

(See "Open File Settings" Tutorial for details.)



Choose from the folder list a folder containing files in supported formats (*.raw, *.DICOM, *.vgi, *.x3d, *.vx3, *.stl, *.igs, *.iges, *.step) to open the file list. Add frequently used directories on the favorite tab by right-clicking a directory on the list. Added directories will be shown on the favorite list on the top left part of screen. Left-click the directory to unfold it.

The image of the file located in the center of the file list in the folder is displayed in the pre-view at the top right. Adjust the opacity using the windowing bar. (See "8.3 Opacity Transfer Function" for details.)

If a *.vx3 file is selected, the latest operation applied to it is shown on the top right part of screen.

Users cannot manually modify the volume information for *.dcm, *.x3d, and *.vx3 files, which already contain volume information. On the other hand, users can modify or input volume

information to *.raw files which contain no information in advance. For mesh data (*.stl), users can change the unit, mesh color, and choose direction.

Enter proper data format and XY dimension values to acquire the desired image. If the value is invalid, the image will be distorted.

Adjust the “**volume sampling**” ratio using slide bar for reducing volume when loading. The original volume is loaded with the value of 1.0. If the value is less than 1.0, volume is loaded with reduced ratio. In this case, less memory is needed but detailed information of the volume is lost.

In case of file formats except project files, apply **presets**. (See Filter for details.)

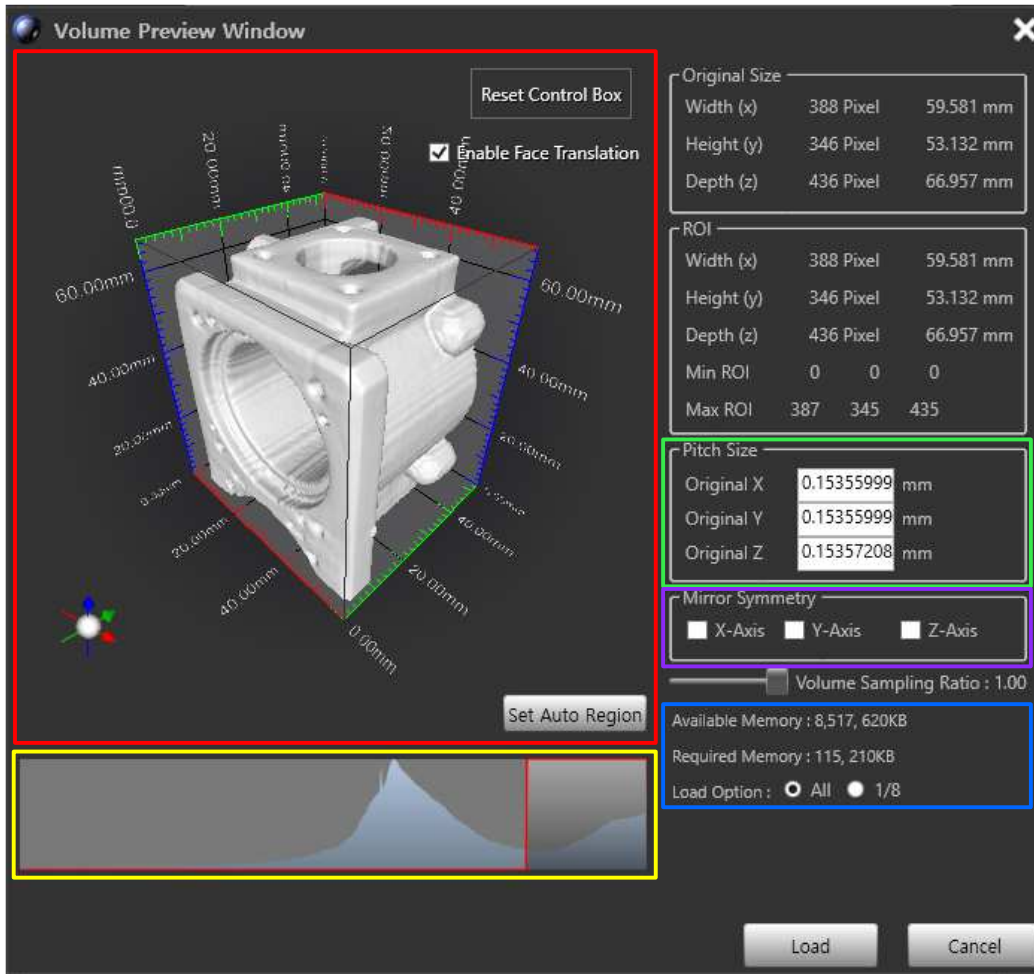
Click **[Load]** to load the volume data with current settings.

In case of volume data, **[Detail]** button will be activated.

If the chosen volume data is floating point type, click **[Load]** or **[Detail]** to show up the voxel value calibration window. After defined the calibrating function to convert floating type data to the integer type data, next operation will be performed.

Click **[Detail]** to load the volume data without air space visualization or to reduce volume data by down-sampling.

On the 'Volume Preview Window', user can set the ROI by adjusting the box plane on the x/y/z axis on the volume.



- Yellow box:** Manipulate the OTF to set the visible region of volume.
- Red box:** Manipulate ROI (Region of Interest) to remove unnecessary regions of volume. Click and drag left mouse button on the bounding box to change the ROI. Click **[Reset Control box]** button to reset ROI. Click **[Auto Crop]** to remove air region and minimize the bounding box automatically without removing any part of the object. Click and drag the right mouse button to rotate the volume. Click and hold the left mouse button on an area outside of the bounding box and drag the mouse to pan the camera. If modifying ROI is not necessary, uncheck 'Enable Plane Translation' to fix bounding box. The size and ROI of volume data is shown on the right panel.
- Green box:** Adjust pitch size on the 'pitch size' part. The default pitch of raw data is 1 mm/voxel. Edit pitch to match the size of volume to that of the real object.

- **Purple box:** Select the check box in the 'mirror' option to flip the volume in the x, y, z-axis direction.
- **Blue box:** Check the available memory space and the required one to load new volume data. If memory space is insufficient to load the volume, its file name will appear in red. Click 'All' to load the full volume of ROI. The '1/8' button will reduce the volume size by one-eighth, also down-sampling the volume.
- Click [Cancel] to go back to the former window. Click **[Load]** to load volume set as ROI.

7.1.3. Export (Ctrl+U)



Click  at the common function toolbar to export the current volume and mesh data shown in the view container as files.

Volume data which is defined as a stack of slices is exported in the following three ways:

- **"Volume applied with ROI box":**
 - Export volume data containing data size and sliced direction in accordance with the state of the clipping box. Set the file format to be output.
 - Supported exporting file formats are *.X3D, *.DCM, *.RAW, *.TIF
 - The size of volume size which is exported will be computed automatically. It can be found on the volume information section beneath.
- **"Volume determined by the Rendering Direction":**
 - Export volume data containing data size, sliced direction, and image formats in accordance with the rendering state including camera state, OTF application, etc.
 - Set one of the three MPR panels as sampling slice.
 - Either export a single slice or the whole stack of slices in rendering direction of the chosen MPR panel window.

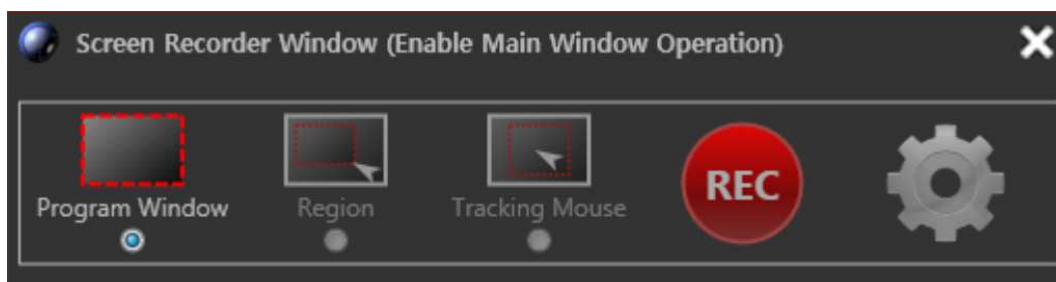
- Choose either to export slices represented with volume value or with opacity.

"Mesh objects":

- If mesh data is loaded in the object tree of the view container, the tab to save the mesh object is activated on the data output window.
- Select mesh to be exported. Selected mesh data is displayed on right preview screen.
- Select the file type to save the *.stl file (Binary/ASCII).
- Select the coordinate. If 'original coordinate' is selected, the coordinate that is set when creating mesh is exported (If mesh data is loaded as file, the coordinate of original file is exported). If 'current coordinate' is selected, the coordinate that is set by program is exported.

7.1.4. Export a movie as a file (Ctrl+M)

Click  at the common function toolbar to record VX3D window panels.



The default for saving is 30 frames/sec.

Recording may not be smooth depending on volume data size or speed of hardware.

Click  again to cancel recording.

When the recording starts, a window to pause or finish recording is activated on the bottom right part of the screen.

Click 'Stop' on the bottom right part to finish recording and open a new window to save as file.



7.1.5. Capture

Click  at common function toolbar to capture the screen.

Save as file - Front - Right - Top 3D - All - Region Add to report view - Front - Right - Top 3D - All - Region	 Save as file ⇒  Front/ Right/ Top/ 3D: Captures and saves each panel. ⇒  All: Captures and saves all panels. ⇒  Region: Sets and saves the region to capture.  Add to report view ⇒  Front/ Right/ Top/ 3D: Captures and adds each panel to report view. ⇒  All: Captures all panels and adds to report view ⇒  Region: Sets region to capture and adds to report view.
---	--

By clicking a capture option, captured image will be saved or added to the report view.

Depending on the view container, regions possible to capture may vary.

7.1.6. Add STL (Ctrl+T)

Click  to add STL file.

Choose the STL file from the file list. The preview of selected file will be visualized on the right side.

 Manual Setting

- Select the unit for the object. (micrometer, millimeter, centimeter)
- Rotate the mesh data with the right mouse button or move it with the left mouse button on the preview.
- Click '**Central Alignment**' to place the mesh data in the middle.
- Click '**Mesh Color**' to change the color of the object.

 Data Information

- Check the type of STL file (binary/ASCII), data size, and the number of polygons comprising the data.

Click **[Load]** to load the mesh object.

7.1.7. Create one-project Viewer



Click  to burn a CD of the project file with current operation history or save it in a mass storage device. A pop-up window to set the saving path of the one project viewer shows up. The one project viewer can operate without a dongle key, but certain functions are restricted. Only project files of when the one project viewer is created can be loaded.

 Minimum System Requirements:

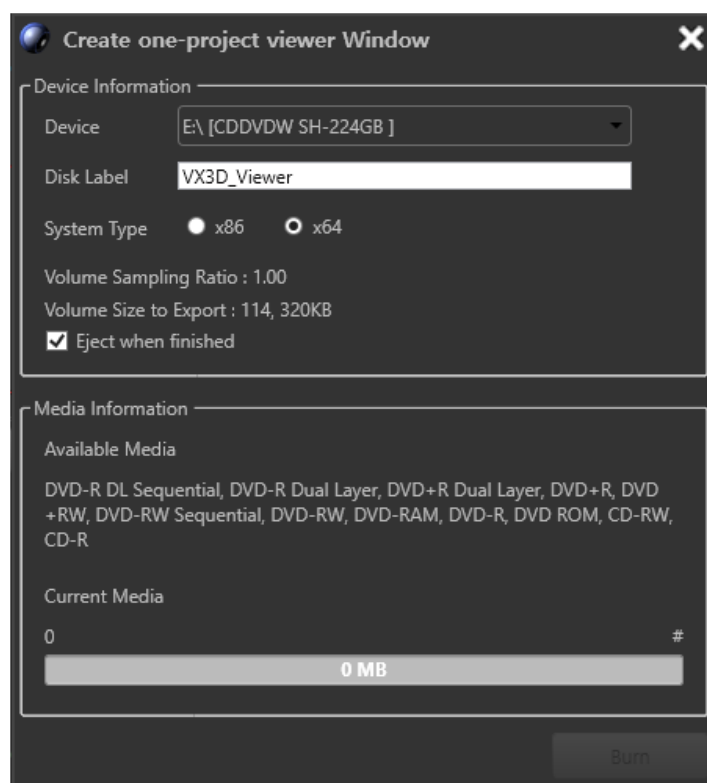
- Windows version: Windows Vista, 7, 8, 10
- System type: 32bit, 64bit Operating system
 - *Operating system must be designated according to the actual running environment for a one project viewer. The one project viewer that is created by designating 64bit cannot be run in 32bit system, it is available in 64bit system only. The one project viewer that is created by designating 32bit(x86) can be run in 32bit, 64bit system but the volume that is saved in the project has low resolution.

- Graphic card: DirectX 10 or higher

[\(See "File" Tutorial for details.\)](#)

(1) Export to CD

Click '**Export to CD**' button to display the pop-up window like the following.



Device Information

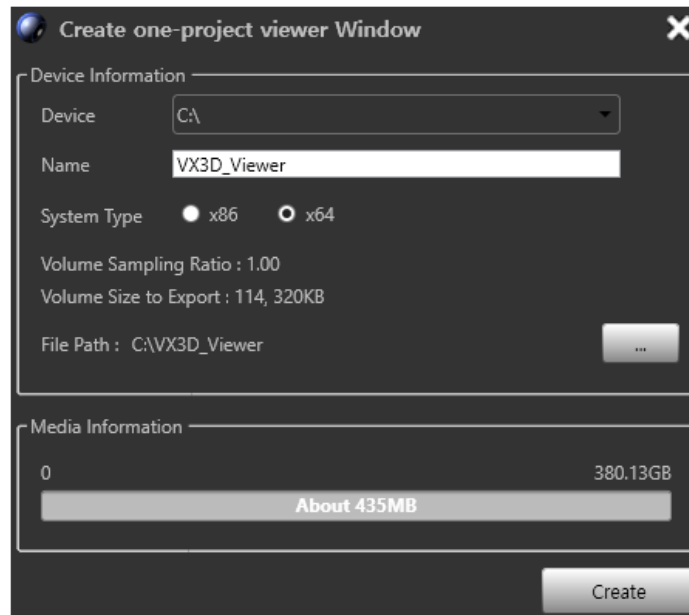
- Choose the device to create the one project viewer. Write the disk label.
- Check '**Eject when finished**' to eject the CD automatically when burning is finished.

Media Information

- The list of available media for the selected device is shown beneath. If the current media is not available, a warning message will show up. If the current media is available, the type of media will show up. Click **[Burn]** to start burning.
- The burned CD incorporates install program.

(2) Export to Mass Storage Device

Click '**Export to Mass Storage Device**' button to display the pop-up window like the following.



Device Information

- Sets the name and file path of the drive to create the one project viewer.
- Sets the name of the folder to save the one project viewer.

7.2 View

7.2.1. Pore Detection

Detects pores and shrinkage cavity.

Click  at Common Function Toolbar to detect pores. ([See "9. Pore Detection" for details.](#))

The pore detection function is an **optional product ("VXPI")**, and the button is activated **when the product is licensed**.

7.2.2 Panorama

Panorama View converts the cross-sectional images of the created curve into 2D image.

Click  at Common Function Toolbar to start Panorama View.

([See "10. Panorama View" for details.](#))

7.2.3. Tile

MPR planes are arranged as images.

Click  at Common Function Toolbar to use it. ([See "11. Tile View" for details.](#))

7.2.4. Report

User create a report based on template provided by VX3D.

Click  at Common Function Toolbar to use report view. ([See "13. Report View" for details.](#))

7.2.5. Path Animation

Path Animation View allows to create an animation using all the functions applied on the 3D panel.

Click  at the Common Function Toolbar to use path animation view.
([See "12. Path Animation View" for details.](#))

7.2.6. Reformat

Exports the images or videos that customized by using various options.

Click  at the Common Function Toolbar to use reformat view.
([See "14. Reformat View" for details.](#))

7.3 Others

7.3.1. Undo/ Redo

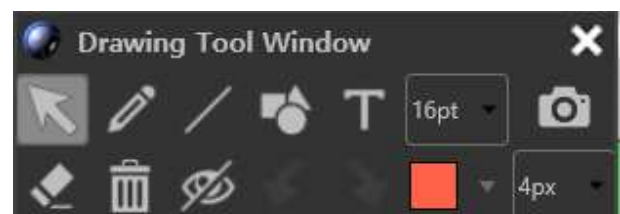
Click  to undo the current work and click  to redo the previous work.

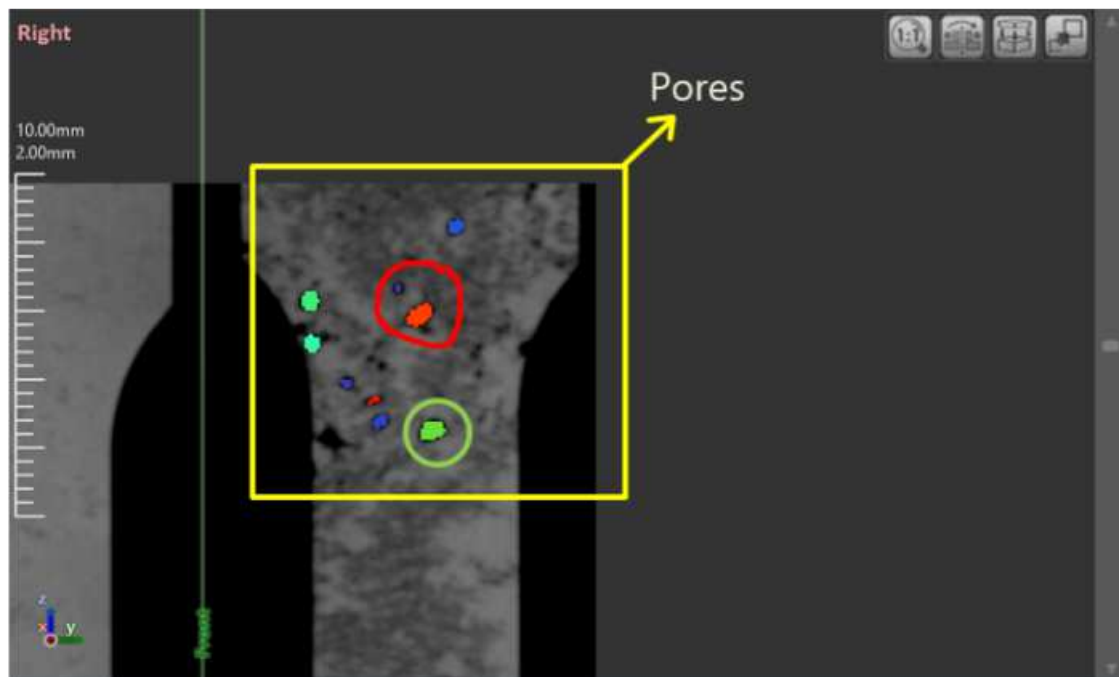
7.3.2. Drawing Tool

Click  to open Drawing Tool Window.

It is possible to draw or erase lines, figures, and text by using Drawing Tool on each of views.

The drawn images can be saved and loaded.





How to use

■ Drawing object selection mode:

It will be a selection mode if all buttons are deactivated. Movement, control of size, change of color and thickness are available on drawn objects.

■ Drawing Mode:

Activate the button to use functions of shortcut key of VX3D or functions of each view. If the button is deactivated, the drawing mode is available. In this state, the functions of shortcut key of drawing tool and relevant functions with drawing tool are only available.

■ Pen: Draws various curves.

■ Line: Draws straight lines.

■ Figure: Draws quadrangles, circles, and polygons. Double click to finish drawing polygon.

■ Text: Inserts text box and writes text.

■ Capture: Saves the drawn screen on each view and captured images are saved at report view.

-  Eraser: Erases the objects by clicking or dragging after click.
-  Delete: Deletes all drawn objects.
-  Hide: Hides the drawn objects if buttons are activated. Deactivate buttons to show up the hidden objects.
-  Undo & Redo: Undoes or redoes operations.
- Changes the  (Font size),  (Color), and  (Brush size).
- Push the [Alt] key to read the tool tip of shortcut key of each function.
- Push the [Ctrl]+[C] (copy), [Ctrl]+[V] (paste) key to copy and paste the object at the same view or among other views.

8. Function Container

It is a window on the right side of the screen that contains buttons to perform various functions, work history, and OTF (transparency transfer function) panel.

8.1 Toolbar Panel

Toolbar Panel includes multiple icons for controlling various functions provided by VX3D.

Such functions are as follows:

- Measurement tool: Measuring length, angle, radius, area, etc.
- Processing Volume data: Filtering, Sculpting, Mesh Extraction, Axis alignment etc.
- Others: Magnifier, section setting, zoom cube, camera preset, full reset, etc.

8.1.1 Measuring Instruments

[\(See "Measuring Instruments" for details.\)](#)

8.1.1.1. Line/ Distance(L)

Click  at the toolbar panel to measure the distance between two points by drawing a line. Lines can be drawn on MPR panels only, but they are visualized on MPR panels and on 3D panel as well.

● How to use

- Click  and left-click the starting and end point at the MPR panel.
- Right-click to cancel any drawing.
- Place the mouse cursor on a line and drag it with the left mouse to move the line.

- Click a line to see control points. Click and drag control points with the left mouse to modify the line.
- Drag the annotation with the left mouse button to move it.

Pop-up menu

- Place the mouse cursor on a line of an MPR panel and right-click to open the pop-up menu. (The pop-up menu will not appear on 3D panel.)
- Profile: See the density graph by sampling the value from the starting to the end point. (See "8.1.1.9 Profile" for details.)
- Property: Changes the color and the font size of each line. (See "8.1.1.8 Measurement Instrument Properties" for details.)
- Unit: Transforms units. (See "8.1.1.7 Calibration" for details.)
- Delete: Deletes a line.

※ **Warning:**

The accuracy of measurement is based on the image resolution of CT data and the accuracy may be lower than the resolution of CT data.

The measurement values are based on the location that is specified by user.

The form or boundary line of the object can be changed by the adjustment of the image brightness.

8.1.1.2 Boundary-Fitting Line

Click  to draw a line to measure the distance between two edges of which the intensity value change rapidly. When user has drawn line, both end points are placed automatically on the spot that has biggest intensity value gap by calculating intensity value. (Both end points depend on the windowing value because the intensity value of the image depends on the windowing value. Be sure to draw the line where the boundary line is clear.) Lines can be drawn on MPR panels only, but they are displayed on MPR panels and on 3D panel as well.

※ Caution:

- (1) When there are many points where the brightness value of image changes between two points that user sets, the boundary-fitting line can be set unintentionally.
- (2) Even if user set same point, the result may differ because the brightness value of image changes depending on the window setting value.
- (3) User can still adjust the end points for the line if the line drawn by the function is not what the user intends to measure, and the measured value will be adjusted right away. This function is just a user convenience feature and the user still need to check the drawn line and adjust when necessary, especially when there are multiple spots nearby where the intensity changes drastically.

- How to use [\(See "8.1.1.1 Line" for details\)](#)
- Pop-up menu [\(See "8.1.1.1 Line" for details\)](#)

※ Warning:

The accuracy of measurement is based on the image resolution of CT data and the accuracy may be lower than the resolution of CT data.

The measurement values are based on the location that is specified by user. The form or boundary line of the object can be changed by the adjustment of the image brightness.

8.1.1.3 Angle (A)

Click  at the toolbar panel to measure an angle in volume. Angles can be drawn on MPR panels only, but they are visualized on MPR panels and on 3D panel as well.

- How to use

- Click  and set three points defining the angle on a MPR Panel.
- Right-click to cancel any drawings.
- Place the mouse cursor on an angle and drag it with the left mouse to move the angle.
- Click an angle to see control points. Click and drag control points with the left mouse to modify the angle.
- Drag the annotation with the left mouse button to move it.

 Pop-up menu

- Place the mouse cursor on an angle of an MPR panel and right-click to open the pop-up menu. (The pop-up menu will not appear on 3D panel.)
- Property: Changes the color and the font size of the angle. (See "8.1.1.8 Measurement Instrument Properties" for details)
- Delete: Deletes the angle.

※ **Warning:**

The accuracy of measurement is based on the image resolution of CT data and the accuracy may be lower than the resolution of CT data.

The measurement values are based on the location that is specified by user. The form or boundary line of the object can be changed by the adjustment of the image brightness.

8.1.1.4. Circle/ Radius (C)

Click  at the toolbar panel to draw a circle and measure its radius. Circles can be drawn on MPR panels only, but they are visualized on MPR panels and on 3D panel as well.

How to use

- Click  and set the starting point and the end point on the MPR Panel, which will define the bounding box of a circle.
- Right-click to cancel any drawings.
- Place the mouse cursor on a circle and drag it with the left mouse to move the line.
- Click a circle to see control points. Click and drag control points with the left mouse to modify the circle.
- Drag the radius text with the left mouse to move it.

Pop-up menu

- Place the mouse cursor on a circle of an MPR panel and right-click to open the pop-up menu. (The pop-up menu will not appear on 3D panel.)
- Histogram: Checks the density graph in pixel by sampling the value of the volume. (See "8.1.1.10 Histogram" for details)
- Property: Changes the color and size and the font size of the circle. (See "8.1.1.8 Measurement Instrument Properties" for details)
- Unit: Transforms units. (See "8.1.1.7 Calibration" for details)
- Delete: Deletes the circle.

⌘ Warning:

The accuracy of measurement is based on the image resolution of CT data and the accuracy may be lower than the resolution of CT data.

The measurement values are based on the location that is specified by user. The form or boundary line of the object can be changed by the adjustment of the image brightness.

8.1.1.5. Polygon/ Area (R)

Click  at toolbar panel to draw a polygon to measure its area. Polygons can be only drawn on MPR panels, but they are visualized on MPR panels and on 3D panel as well.

How to use

- Click  and left-click on an MPR panel to add an apex. Double-click to finish adding.
- Right-click to cancel any drawings.
- Place the mouse cursor on a polygon and drag it with the left mouse to move the polygon.
- Click a polygon to see control points. Click and drag control points with the left mouse to modify the polygon.
- Drag the area text with the left mouse to move it.

Pop-up menu

- Place the mouse cursor on a polygon of an MPR panel and right-click to open the pop-up menu. (The pop-up menu will not appear on 3D rendering panel.)
- Histogram: Checks the density graph in pixel by sampling the value of the volume. (See "8.1.1.10 Histogram" for details)
- Property: Change the color and the font size of the polygon. (See "8.1.1.8 Measurement Instrument Properties" for details)
- Unit: Transforms units. (See "8.1.1.7 Calibration" for details)
- Delete: Delete the polygon.

※ Warning:

The accuracy of measurement is based on the image resolution of CT data and the accuracy may be lower than the resolution of CT data. The measurement values are based on the location that is specified by user. The form or boundary line of the object can be changed by the adjustment of the image brightness.

8.1.1.6. Note (N)

Click  at the toolbar panel to add a note. Notes can be added on MPR panels only and will be shown as a sphere on 3D panel.

 How to use

- Click  on the desired MPR panel and double-click to take notes.



- Click **[OK]** button after taking notes to adjust notes to MPR screen as below.



- A note consists of an annotation part and a control point. Place the mouse cursor on a control point and drag with the left mouse to move the note. Place the mouse cursor on the annotation part and drag with the left mouse to move it without relocating the control point.
- Place the mouse cursor on a note on an MPR panel and double click to open a pop-up window. Edit the content of the note.

● Pop-up menu

- Place the mouse cursor on a note of an MPR panel and right-click to open the pop-up menu. (The pop-up menu will not appear on 3D panel.)
- Property: Change the color and font size of the note.
(See "8.1.1.8 Measurement Instrument Properties" for details)
- Delete: Delete the note.

8.1.1.7. Calibration (U)



Click  at the toolbar panel to adjust units of length, area, and volume.

- Unit: Transforms units.
- Precision: Changes places of decimals. Length, area, and volume may have different places of decimals.
- Coordinate System: Chooses among Cartesian or Cylindrical coordinate system. Sets either as World Space (coordinate system with pitch information applied to voxel) or Object Space (coordinate system with voxel as standard).

8.1.1.8. Property

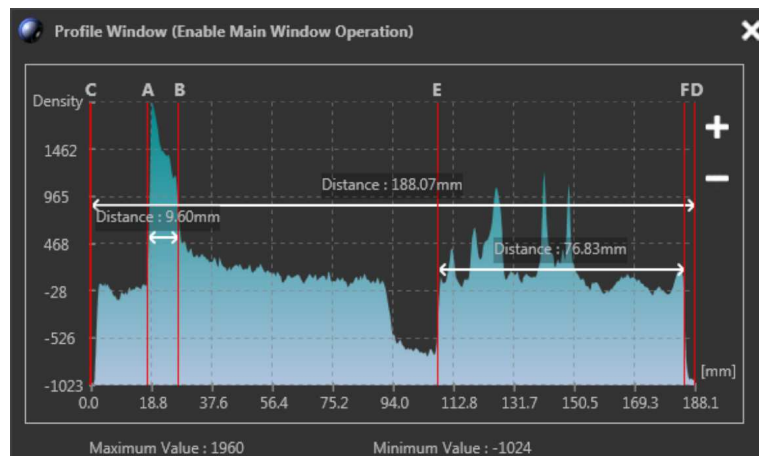
Place the mouse cursor on a measurement tool, right-click and click **'Property'** to open **'Measurement Instruments Properties'**. Set the color and font size of measurement tools.

- **[Apply]**: Applies selected color and font size to the measurement tool.
- **[Apply All]**: Applies selected color and font size to all measurement tools.
- **[Set as default]**: Applies selected color and font size to all measurement tools and defines them as default for upcoming tools.

8.1.1.9. Profile

Profile displays a density graph with length(x-axis) and density(y-axis) in a pop-up window. It samples the volume value of a line from the starting to the end point without any OTF application.

To measure the distance by section of a profile, move the vertically marked profile line (in red) and display the section distance between the two lines created. The starting and end points of the line is marked with alphabets on MPR panel.



How to use

- Click  to add profile lines at both ends.
- Five pairs of profile lines can be added maximally, enabling an exact measurement.
- Click  to delete the lastly added pair of profile lines.

※ Density:

CT is based on the fundamental principle that the density of the object passed by the X-ray beam can be measured from the calculation of the attenuation coefficient. The measured density is normally expressed in Hounsfield unit (HU). The HU scale is a linear transformation of the original linear attenuation coefficient measurement into one in which the radiodensity of distilled water at standard pressure and temperature (STP) is defined as zero Hounsfield units (HU), while the radiodensity of air at STP is defined as -1000 HU.

※ Intensity:

Intensity is brightness value that is adjusted by windowing while density is unique value of the image. When the specific area of the image brightens by adjusting windowing, the brightness value changes but the density does not change.

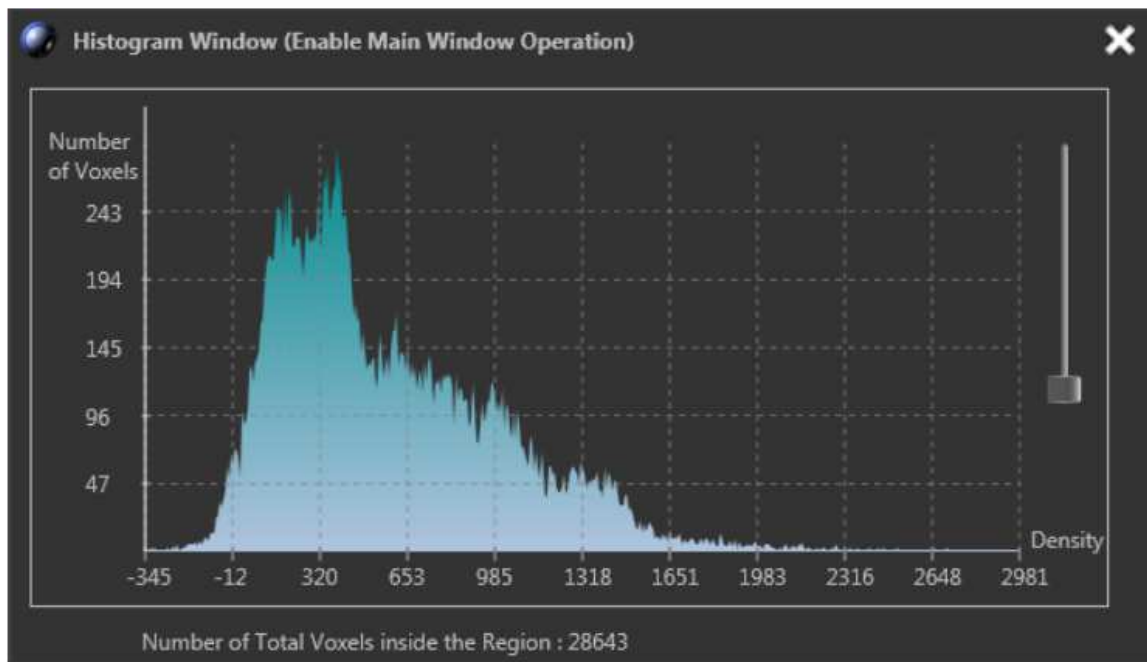
※ DICOM file has PixelData tag that is used as Density value in this value is used as Density within the program. Intensity is comprised of Window Center, Window Width and PixelData of

DICOM tag.

8.1.1.10. Histogram

Histogram shows the number of voxels(y-axis) to density (HU)(x-axis) as a graph. Histogram can

help user to check the entire density distribution of the selected area briefly. Use the slider on the right side to adjust the height of a histogram (Zoom in the graph by scaling down the y-axis, without changing the real value.)



8.1.2 Object Processing

(See "[Object Processing](#)" Tutorial for details.)

8.1.2.1 Sculpting

Click  at the toolbar panel to sculpt volume. Sculpting refers to cleaving volume data by drawing polygons on 3D panel, which helps users to remove unnecessary parts or analyze the inner structure of the volume.

 How to use

- Click **[Polygon]** in Sculpting Window.
- Left-click the 3D rendering panel to draw a polygon. Double click to finish drawing.
- Left-click inner/outer region after drawing polygons to cut off volume data.
- Right-click to cancel any drawings.
- Use the **[Plane]** button to remove the area above or below the center line.
- Use **[Remain region]** , **[Remove region]** button to remain or remove the volume area that is connected to the selected area.
- Click **[Finish]** button to apply the result to each panel and appear 'Original'/'Sculpted Volume' on 3D Volume Rendering panel.

8.1.2.2 Filter

Click  at the toolbar panel to use filter. It assists users to edit the volume data to their needs.

 How to use

- Click a preview image in Filter 2D window to choose filter type to apply.

- Use the sliders on 'Parameters' to adjust filtered image and click **[Next]** to proceed. The filter will be applied to the whole volume data, and the result is shown in the 'Filter 3D pop-up' window for volume rendering.
- Compare the original and filtered volume in the 'Filter 3D' pop-up window and click **[Finish]** to confirm. The filter will be applied to the view container.
- The adjusted filter preset can be used afterwards as well.

Filter Types

- Gaussian:

Applies a Blur effect.

- Median:

Applies a median volume value of voxels in the mask. Used to remove Salt & Pepper noise.

- Mean:

Applies a mean volume value of voxels in the mask. It is effective in removing noises, but visualized data including its boundary lines may appear blurred.

- Adaptive Gaussian:

Applies Gaussian adaptively to reduce distortion and remove noise.

- Erosion:

Erodes boundaries of the object away (one of the basic morphological operations).

- Dilation:

Enlarges boundaries of the object (one of the basic morphological operations).

- Sharpness:

Makes boundary lines clear by increasing the sharpness of the volume.

8.1.2.3 Mesh Extraction

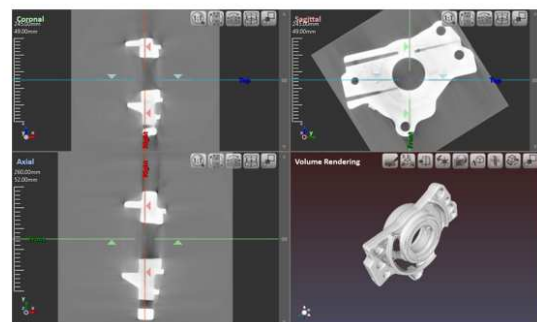
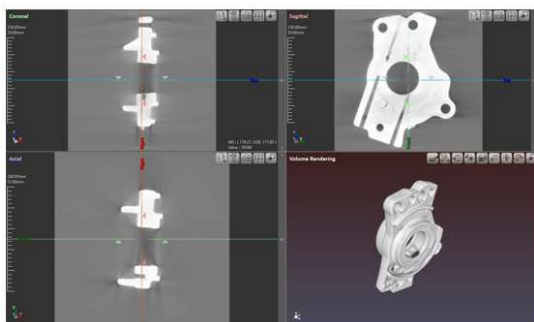
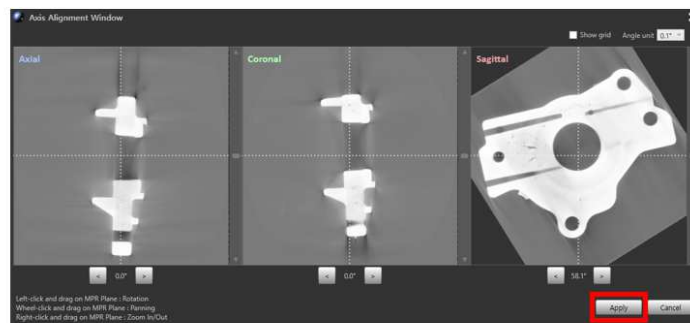
Click  at the toolbar panel to extract mesh data from volume data.

● How to use

- Select an area of volume data where you want to extract mesh data by using OTF control.
- Set an interval for mesh sampling at 'options' to determine its precision level.
- Click **[Extraction]** to extract the mesh data.
- Click **[Apply]** to apply the result to the view container.

8.1.2.4 Axis Alignment

Click  at the toolbar panel to modify the axis of the volume.



 How to use

- Align the MPR panel in the Axis Alignment Window.
- Drag and rotate the MPR section to be aligned with the left mouse button.
- Click and drag the mouse wheel button to move the MPR section to be aligned.
- Drag the MPR section to be aligned with the right mouse button to zoom in/out.
- Select the "Show grid lines" option allows you to display grid lines on the MPR section.
- When rotating the axis of the MPR section, user can select the unit of angle change (0.1° or 1.0°).
- Click **[Apply]** to apply the result to the view container.
- Click **[Apply]** button, all views other than the main view are closed and all history details are initialized (a pop-up window for confirmation appears).

8.1.3 Others

(See "[Toolbar Others](#)" Tutorial for details.)

8.1.3.1. Show/ Hide MPR Overlay



Click  at toolbar panel to hide MPR overlay like lines or ruler of whole panel.

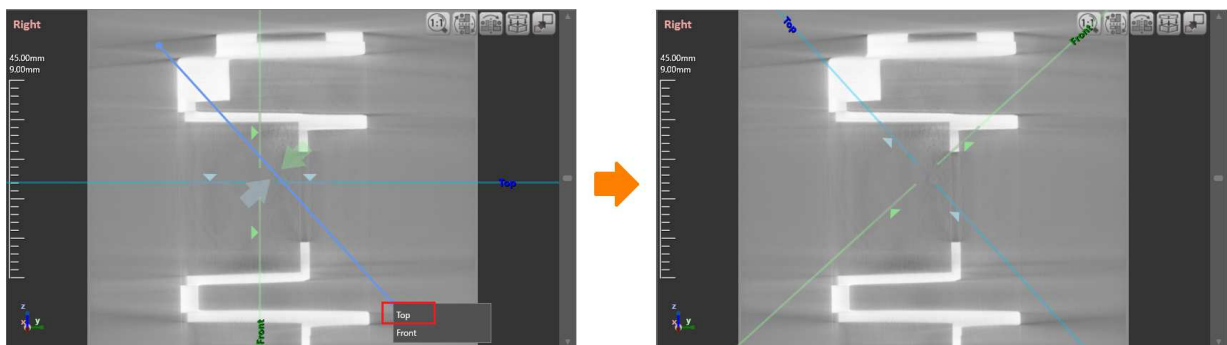
Click it again to show. Use [Enter] key as a shortcut key.

Click a mouse on the panel and press the 'Space Bar' to show / hide the MPR line of the corresponding panel.

8.1.3.2. Oblique MPR Setting (O)



Click  at toolbar to set oblique planes on a MPR panel and visualize the plane on other MPR panels.



After  clicking the button, draw the desired MPR line by dragging with the left mouse on the MPR section panel to set the section line.

After drawing the line, select the direction (Top, Front, Right) to apply the drawn line.

The MPR line in the selected direction is redefined and reflected on all MPR panels.

8.1.3.3. Zoom Cube

Click  at toolbar panel to use the zoom cube. Left-click and drag the area users want to zoom

on one of the panel windows of view layout. (The area is marked with a circle)

A zoom cube window will show up.

It is still possible to use the main window after the pop-up.

Following functions are provided:

- **Sculpt volume:**

Sculpt volume using **[Polygon]**, **[Remain]**, and **[Remove]** buttons.

- **Export zoom cube as file:**

Click **[Export]** to export the current zoom cube as a file.

- **Export to View:**

Exports the sculpted volume to the current activated view. OTF can be adjusted by choosing the exported volume on Object Tree.

- **Extract Mesh:**

Extracts the mesh from the segmented data.

8.1.3.4. Camera Preset

Click  at toolbar to create or delete the camera locations of 2D and 3D panels and the locations and orientations of MPR line as each of presets.

Click the button to show up 'camera preset window'.

The main window is still available, while the camera preset is shown up.

The functions that camera preset window provides are as follows:

- **[Create], [Delete], [Modify]:**

Creates, deletes, and modifies the camera locations of 2D and 3D panel and the locations and orientations of MPR line of the current view container.

- **[Rename]:**

Changes the name of selected preset.

- **Save and Load preset file:**

Saves the setting of camera presets as a file (*.vxcp) and loads the file.

8.1.3.5 Magnifier

Click  at toolbar panel to magnify the image that mouse pointer points on 2D panel.

- Enlarged image is displayed on thumbnail window on the right side of the mouse pointer.

- Center of the image is the current position of mouse pointer, and image is enlarged by around the mouse pointer.

- In case of using other mouse-operating functions, magnifier can be used also.

8.1.3.6. Reset all (Ctrl+R)

Click  at toolbar panel to reset volume and mesh data. Operation history will be also deleted. User can reset only the MPR panel or reset all.

8.2 History Panel

History Panel shows the list of operations and allows to undo (ctrl+z) / redo (ctrl+y) operations.

Operations are registered to the history automatically. Click a specific operation process from the history panel to restore the data to that state. Reload the volume data to clear operation history.

See ["7.1.1 Save Project"](#) to check which operations are registered or not.

8.3 Opacity Transfer Function

(See ["OTF" Tutorial for details](#))

Opacity Transfer Function consists of Color Bar, Alpha Bar, Unified Color and Alpha Bar, Windowing Bar.



 Color Bar:

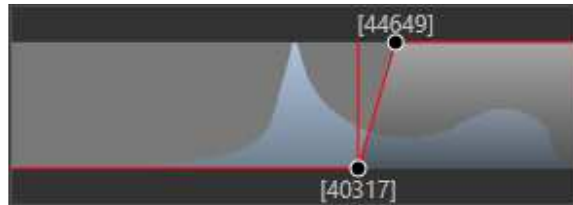


Manipulates color control widgets (the small circle of color bar), which applies color to volume value, often referred as density. Double-click the color bar or right-click to add the widget. Left-click and drag the widget to move it horizontally. Drag it vertically or right-click to delete the widget. ('X' will appear on color control widget if dragged

vertically excessively.)

Click **[Color Presets]** to utilize color presets provided by VX3D.

Alpha Bar:

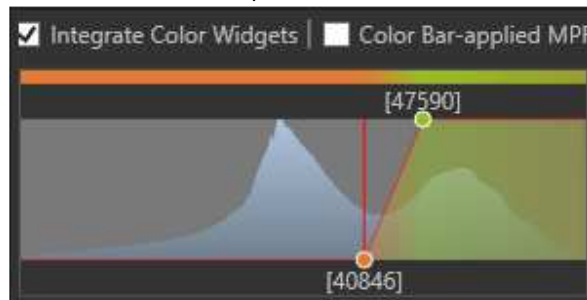


Manipulates the opacity unit, which applies opacity (Alpha) to volume value. The x-axis of alpha bar refers to density, while its y-axis refers to opacity. Place the mouse cursor on a specific point of alpha bar to check its volume value, the histogram of which is shown in background in blue. Each figure written with a **control point**(●) refers to its volume value.

Following functions are operated through mouse events:

- Left-click and drag control points to relocate them and thereby change the OTF unit shape.
- Left-click and drag inside the OTF unit to translate it.
- Left-click and drag outside the unit to move the OTF display horizontally.
- Right-click on outside of the OTF panel within alpha bar to add or delete a unit. To delete a unit, right-click where OTF unit is already defined.
- Right-click to add/delete control points in polygon-typed OTF units.

● Unified Color and Alpha Bar:



Unified Color Widgets of the Color Bar are combined to the control points of Alpha Bar. Check '**Integrate Color Widgets**' to unify.

Following functions are operated through mouse events:

- Double-click or right-click a control point(●) to apply color to its volume value.

● "Color Bar-applied MPR":

Check this option to apply the color defined in the color bar to the MPR section panel.

● Windowing Bar:

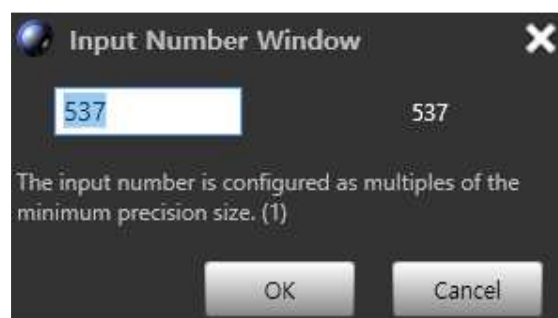


The windowing bar provides the ability to adjust the brightness and contrast of the image on the MPR section panel.

A vertical bar line showing the windowing range is displayed left/right on the windowing bar.



The maximum/minimum value of the windowing range can be changed directly by moving the bar line or by left-clicking the value displayed below the bar line. By changing the max/min value, user can adjust the contrast of the MPR section image.

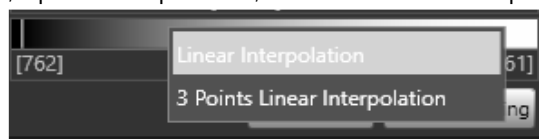


Drag with the left mouse button on the bar area within the windowing range to move the windowing range itself, and through this, user can adjust the brightness of the MPR section image.



Click right within the windowing range area to change the way the windowing range is interpolated. The following 3 types are supported.

-. Linear Interpolation, Spline Interpolation, 3 Points Linear Interpolation



Place the mouse cursor  in the area below the windowing bar and click the left mouse button.

-. Drag horizontally:

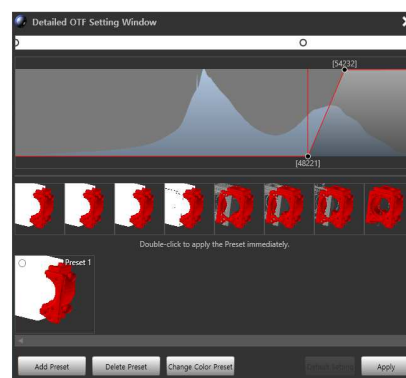
The windowing range itself can be moved, and the brightness of the MPR section image can be adjusted.

-. Drag vertically:

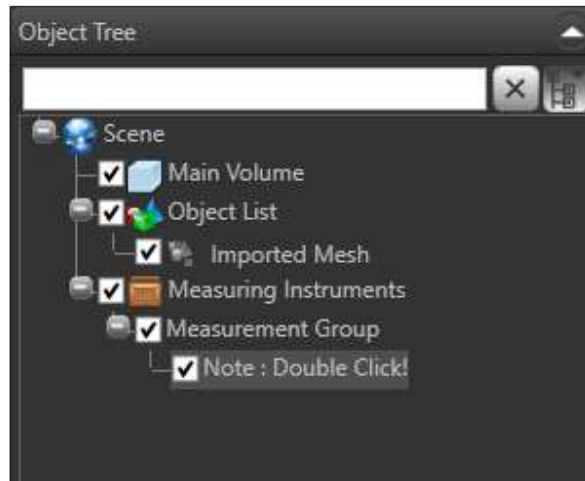
Increase/decrease the maximum/minimum value of the windowing range.

[Detailed Setting]:

Click 'Detail Setting' to open a window to save and load OTF. Move Color Bar and Alpha Bar or move the Unified Color and Alpha Bar to apply the result to 3D panel. Preview images of volume object represented with volume values are in the center of the detailed setting window. Inside the box beneath are OTF presets, along with their preview rendering images. It also provides the ability to export or import OTF settings as presets.



8.4 Object Tree



Object List and Measuring Instruments are shown as tree diagram.

Input the item to search in the text box, corresponding item is shown as tree diagram only.

[Cancel]  to undo search history. Use toggle button  (Expand all),  (Collapse all) on the top right side to expand/collapse the tree.

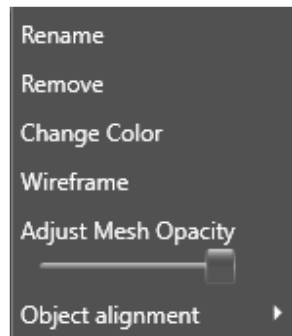
Check / Uncheck the check box to show / hide corresponding item. If the check box of any item is

unchecked, its child items are hidden.

Object List:

'Object list' lists added or created mesh data.

Right-click on each item of 'object list' to display the pop-up menu.



- **Rename:** Changes the name of object.
- **Remove:** Removes the object.
- **Change Color:** Changes the color of object.
- **Wire frame / Solid Filling:**
 - Wire frame: Displays mesh with wire frame.
 - Solid Filing: Displays mesh with solid filling.
- **Set Opacity of Mesh:** Sets the opacity of mesh.
- **Object alignment:** Aligns mesh data and volume data. (See 'Alignment' Tutorial for details.)

Measurement Group

Measurement tools in the same 'measurement group' are classified according to their located MPR panel and the camera state.

Those which are drawn on the same panel but vary in camera state will be registered in different measurement groups. Click measurement group or measurement tools in the tree diagram to restore the initial camera state.

Right click on the measurement group to display pop up window for changing group name.

9 Pore detection (add-on module)

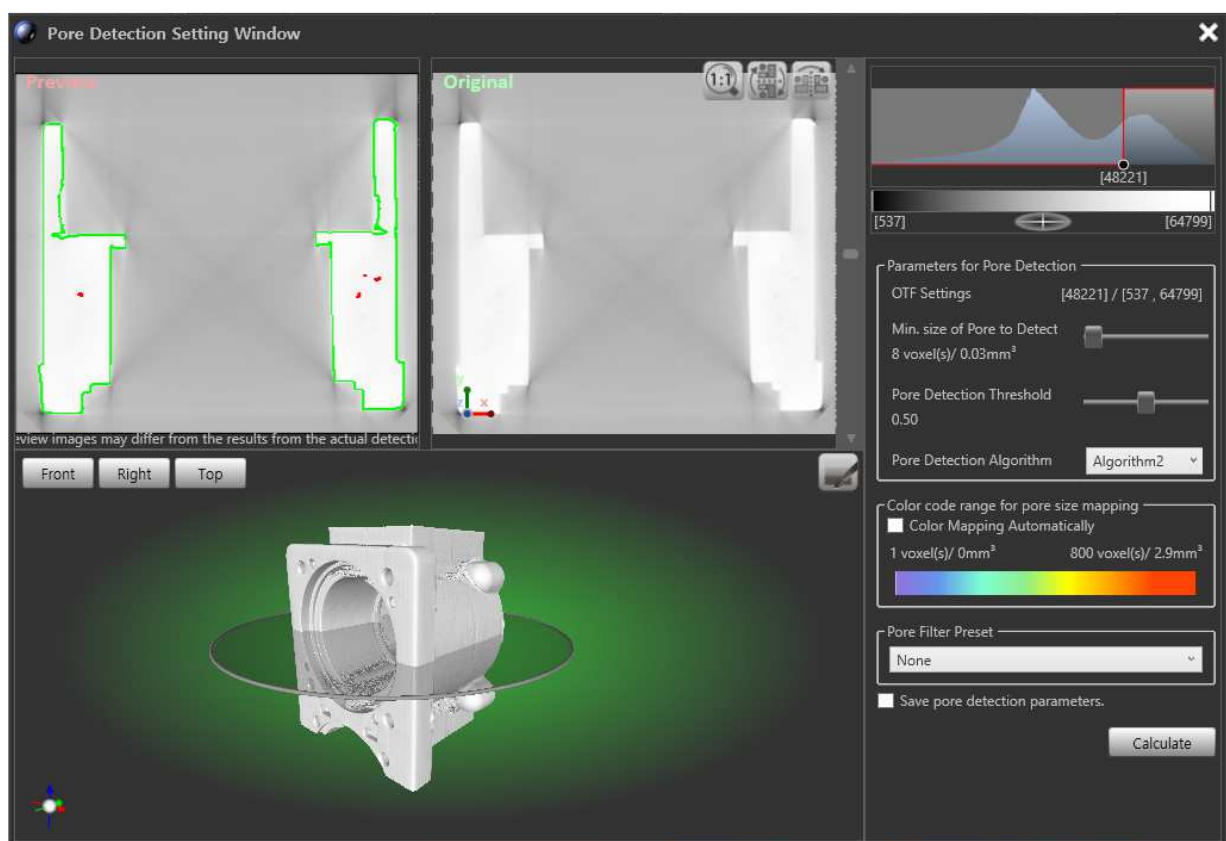
Detects pores from volume data and analyzes results as an add-on module.

The pore detection function is an **optional product ("VXPI")**, and the button is activated **when the product is licensed**.

Click  from the main view or pore detection view to open a window for pore detection. Set parameters for pore detection and analysis. (See ["VXPI" Tutorial for details](#))

9.1 Pore Detection Setting Window

Sets the various parameters for pore detection in Pore Detection Setting Window.

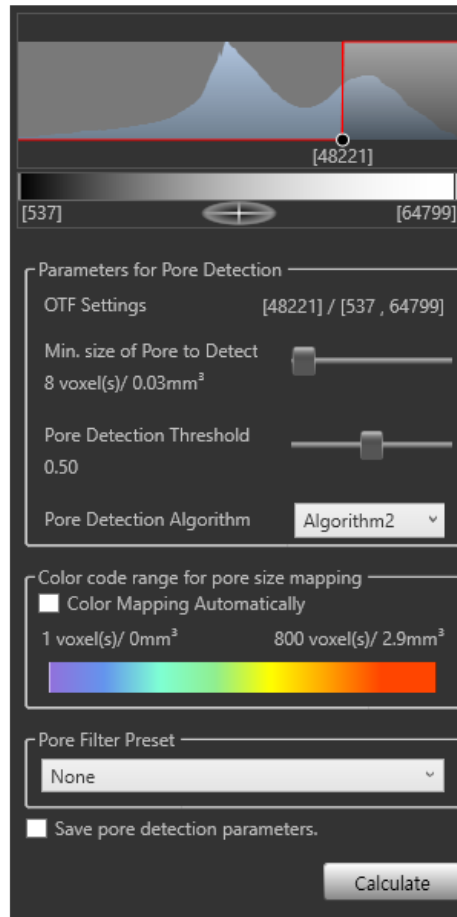


- Set the OTF and the parameters for pore detection on the pore detection parameter panel.

- The pore-detected 'preview result' of MPR image is shown at the top of the window through the current parameters.
 - Through the preview, the result of the pore detection by the change of parameter is predictable.
 - The color of the object contour is green, and the detected pore is red in color.
 - The result of the pore detection for the current MPR image is shown as a preview. It could be different from a result of the pore detection for a whole volume data.
- Use **[Front]**, **[Right]**, **[Top]** buttons of the bottom of 3D panel to switch to the desired section.
- Drag the border of the circle with the left mouse in the 3D panel at the bottom of the window to rotate and translate the section inside the circle.
- Click **[Calculate]** to start pore detection. After detection, a pore detection view is created, or the new detection result is applied to the 'pore detection view'.

9.1.1 Pore Detection Parameter Panel

Sets the parameters for pore detection.



Parameters for Pore Detection

- OTF Settings:
It shows the value that is set in OTF.
- Minimum size of Pore to Detect:
Detects the bigger pore than the setting value.
Adjust slider bar  or click then enter the value to set the minimum size of pore to detect.
The set value is displayed in units of voxel or mm3.
- Pore Detection Threshold:
Sets the sensitivity of pore detection.

※ As the Pore Detection Threshold gets closer to 1, many pores as possible are detected. The noise region, not the real pore, are more likely to be detected.

※ As the Pore Detection Threshold gets closer to 0, pores are detected strictly. Things unseen in the real pore would not be detected.

■ Pore Detection Algorithm:

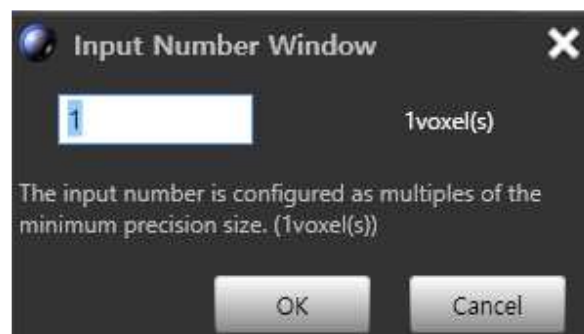
Choose the algorithm for pore detection.

'Algorithm 1' detects the pores by brightness value. 'Algorithm 2' detects the pores by voxel value of the volume data.

■ Color code range for pore size mapping:

The detected pores are displayed with different colors according to pore size in 'pore detection view'.

Adjust slider bar () or click  and then enter the value to set the range.



Check 'Color Mapping Automatically' and calculate to adjust the range for color mapping by the max/min size of detected pore.

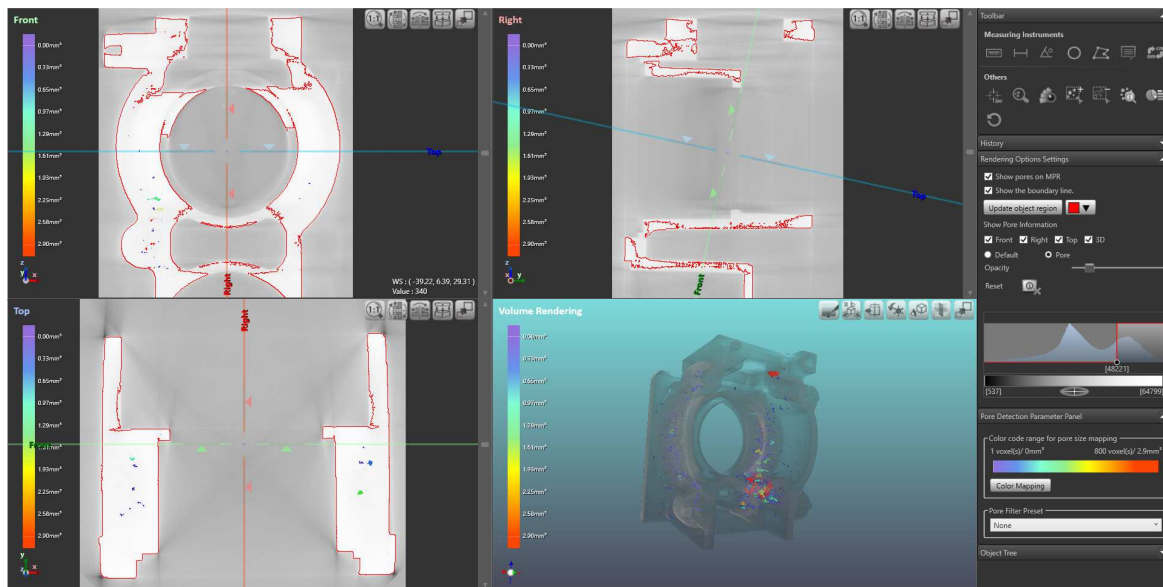
Color mapping and the minimum size of pore are not applied to the preview result.

■ Save pore detection parameters:

Saves the pore detection parameters.

9.2 Pore Detection View

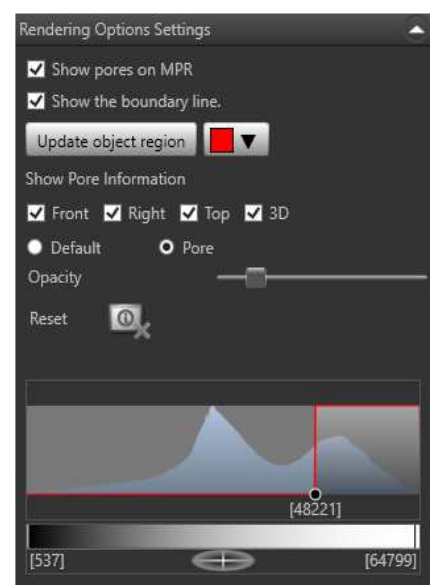
After pore detection calculation, detected pores and original volume are visualized on each panel.



9.2.1. Pore Detection Rendering Option

Changes the rendering options of pore detection view.

- Show pores in MPR:
Check to show pores in MPR panel.
- Show the boundary:
Check to display the boundary in MPR panel.
- Update object region:
Sets the object region to detect pore accurately.
Sets the color of the boundary.
- Default:
Default rendering option.
- Pore:
Rendering option to see pores.



- **Opacity:**
Sets the opacity of the volume data.
- **Reset:**
Delete all pore information displayed on the screen through [Pore Information]  tool.
- **OTF:**
Adjusts the area of voxel values to be visible on the 3D panel and the brightness/contrast of the MPR panel.

9.2.2 Pore Detection Report

The result of pore detection is summarized in a report window, including detailed information of detected pores and of detection parameters.

Click  at toolbar to generate the report window.

Pore Detection Report (Enable Main Window Operation)

Summary Image Settings Export Excel

Number of Pores	Total Volume of Pores	Total Visualized Volume	Porosity (%)	Mean Volume of Pores	Mean Pore Voxel Value	Mean Roundness	Mean Diameter
102	21.66mm ³	79731.52mm ³	0.027169%	0.21mm ³	48082.000	0.1915	1.24mm

Parameters

OTF Settings	Pore Detection Threshold	Min. size of Pore to Detect	Color code range for pore size mapping	Pore Detection Algorithm
42857 / 31990, 58823	0.5	8 voxel(s) / 0.05mm ³	9 voxel(s) / 0.05mm ³ - 1241 voxel(s) / 7.01mm ³	Algorithm2

Pore Information Preset: None Update

Pore ID	Pore Volume	Surface Area	Number of Voxels	Mean Position	Mean Voxel Value	Roundness	Max Diameter	Defect
1	0.05mm ³	1.11mm ²	9	WS : (17.41, -12.37, -32.67)	45565.000	0.2581	0.7mm	
2	0.09mm ³	1.52mm ²	16	WS : (19.85, -14.53, -32.30)	46532.000	0.2224	1.02mm	
3	0.08mm ³	1.49mm ²	15	WS : (19.54, -13.62, -31.81)	45308.000	0.3346	0.83mm	
4	0.05mm ³	1.2mm ²	9	WS : (19.43, 9.06, -31.59)	46408.000	0.1982	0.88mm	
5	0.11mm ³	1.74mm ²	19	WS : (24.15, -2.38, -31.25)	45563.000	0.3283	0.88mm	
6	0.06mm ³	1.43mm ²	11	WS : (21.74, -2.96, -30.83)	45840.000	0.1497	1.1mm	
7	0.1mm ³	2.09mm ²	17	WS : (-15.59, 12.64, -29.17)	49955.000	0.0495	1.56mm	
8	0.06mm ³	1.27mm ²	11	WS : (20.74, -14.36, -29.08)	49012.000	0.2604	0.93mm	
9	0.26mm ³	4.47mm ²	46	WS : (21.38, -12.63, -27.82)	49400.000	0.1117	1.69mm	
10	0.11mm ³	1.78mm ²	20	WS : (22.31, 2.00, -27.78)	45924.000	0.2371	0.93mm	
11	0.06mm ³	1.3mm ²	10	WS : (20.96, -12.00, -26.92)	48509.000	0.1759	0.86mm	
12	0.05mm ³	1.01mm ²	9	WS : (23.76, -17.37, -26.42)	50207.000	0.2535	0.7mm	
13	0.11mm ³	1.74mm ²	19	WS : (21.82, -15.24, -25.68)	48380.000	0.2390	0.93mm	
14	0.11mm ³	1.71mm ²	19	WS : (25.30, -18.75, -25.39)	47893.000	0.3063	0.91mm	
15	0.19mm ³	2.89mm ²	33	WS : (21.09, -11.12, -24.94)	47459.000	0.2165	1.24mm	
16	0.07mm ³	1.33mm ²	12	WS : (20.46, 3.89, -24.48)	47020.000	0.2303	0.8mm	
17	0.36mm ³	3.87mm ²	63	WS : (23.05, -17.70, -23.66)	44330.000	0.3749	1.36mm	
18	0.19mm ³	2.73mm ²	34	WS : (19.78, -10.12, -22.85)	48072.000	0.1018	1.42mm	
19	0.08mm ³	1.81mm ²	15	WS : (19.98, -9.19, -22.50)	49211.000	0.0837	1.36mm	
20	0.18mm ³	2.57mm ²	31	WS : (21.81, -12.59, -21.37)	47228.000	0.1702	1.24mm	

 Pore Detection Report Window

- When the pore information item is selected in [Pore Information], the camera position moves to the center of the selected pore and a bounding box is shown up in 3D Panel.
- Click the column header of each item of [Pore Information] to rank them in descending/ascending order.
- Use the [Ctrl] or [Shift] key in [Pore Information] to select multiple items.
- Use 'defect' column on the right of the title [Pore Information] to set defect size ('Number of voxels').
- Click [Delete] key after selecting pore item to delete pore.
- Click an item and then click right button to show the menu which is for deleting pore and showing pore information.
- [Parameters] represents the pore detection parameter which is used in the pore detection.
- Click **[Image Settings]** button to add images at the top of the excel file which will be exported.
- Click **[Export Excel]** to export the result to Excel if the operation system supports MS Excel.
- Click  at the top of each column to set Min/Max value for each item to update report according to setting.
- Click  at the top of each column to save filter value for each item as preset to use.

9.2.3 Pore Information

Checks the pore information on MPR panel.



- Click  at the toolbar panel.
- Place the mouse cursor on a specific pore to see its information.
- Click pore to open a pop-up box with the pore information.
- Click right button to appear the menu that transfer MPR to selected pore and menu to remove pore.

● Pore Information Pop-up Box

- Pore ID:
Number of the pore.
- Pore Volume:
Volume of the pore.
- Number of Voxels:
Number of voxels of the pore.

- **Mean Position:**
Mean position of the pore in volume.
- **Mean Voxel Value:**
Mean voxel value of the pore.
- **Roundness:**
Roundness of the pore. The closer the value is to 1, the rounder is the pore (resembles a sphere).
- **Max Diameter:**
Diameter of the circumscribed sphere of the pore.

※ Click () at 'pore detection rendering option' panel to hide all the pore information pop-up boxes. .

9.2.4 Add Pores

Sets ROI to add pores on MPR panel.



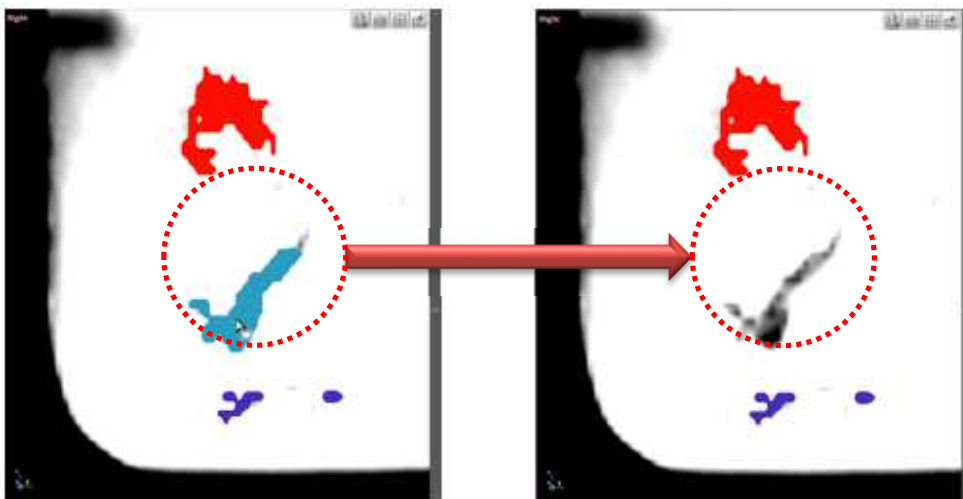
- Click  at the toolbar panel.
- The "Parameters for Pore Addition" panel appears. Set the parameter values (minimum size of pores, threshold values) for the pores to add.
- Place the mouse cursor on a specific area of MPR panel to add a pore.
- Left-click to detect pore at the target spot.
- In case of failing to detect pores at the target spot, following message appears.
 - The outside of object (air region) is set as the starting point of detection.

- The detected region is connected to the outside of object (air region).
 - The size of detected pore is smaller than minimum size set in parameter.
 - Pores come together when the detected pores are in contiguity with existing pores.
- ※ Adjust OTF and the detection parameter to set to distinguish pores clearly and improve accuracy when adding pores, if the target pore is not detected in initial detection result.

9.2.5 Remove Pores

Removes pores on MPR panel.

- Click  at the toolbar panel.
- Place the mouse cursor on a specific area of MPR panel to remove a pore.
- In case of no pores, error message appears.



10 Panorama view



Click  at toolbar of main view to use panorama view. The cross-sectional images of the created curve at 'Generate Panorama Curve Window' are sampled and converted into 2D image.

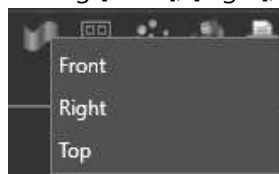
The accuracy depends on the CT resolution and the accuracy is lower than the CT resolution.

(See ["Panorama View" Tutorial for details](#))

10.1 Panorama Curve Generation Window

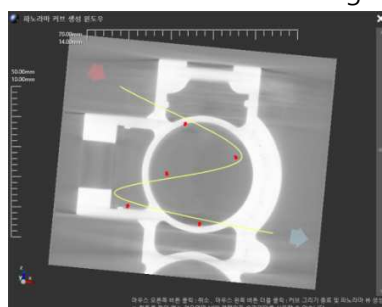
 How to use

- Click  and from the pop-up menu, select the MPR panel to create a panorama among [Front], [Right], and [Top].



Then, 'Panorama Curve Generation Window' pop-up window shows up.

- Click with the left mouse button to create control points. At least two control points must be chosen to use panorama view.
Delete control points with the right mouse button.
Double click to finish drawing a curve.

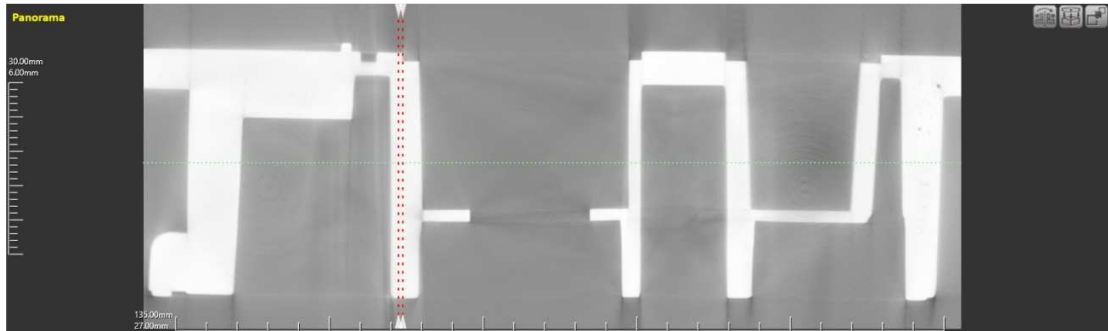


It will create a panorama view of the cross section corresponding to that curve.

- Red arrows along the curved line identify the direction of the section of user's point of view on the panorama panel.

10.2 Panorama panel

On 'Panorama Panel' at the top of the panorama view, the 2D image corresponding to the area of the generated curve is visualized.



Drag with the right mouse button on panorama panel to zoom in or zoom out.

Move the curve line itself by moving the mouse wheel button in the Panorama panel. The red dotted line drawn vertically shows the location of the cross-sectional image that intersects at right angles to the direction of the curve line. 1, 2 or 4 cross-section slices can be set and If two or more cross-sectional images are created, the two dotted lines indicate the location of the first and last cross-sectional image. ([See "10.3 Cross-sectional image Panel" for details](#))

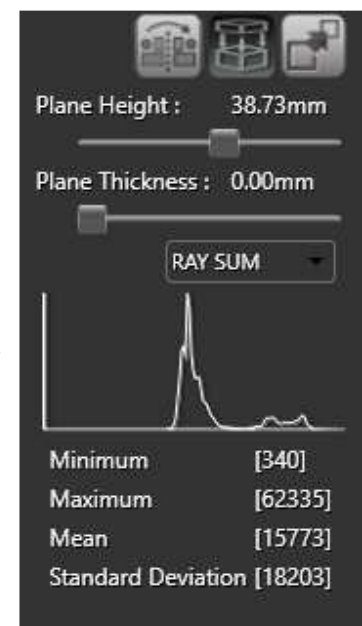
Click  to flip the image horizontally.

Click  to adjust the height and thickness of the plane.

If the height of the plane is adjusted the result will be shown on the cross-sectional slices panel and on the 3D panel.

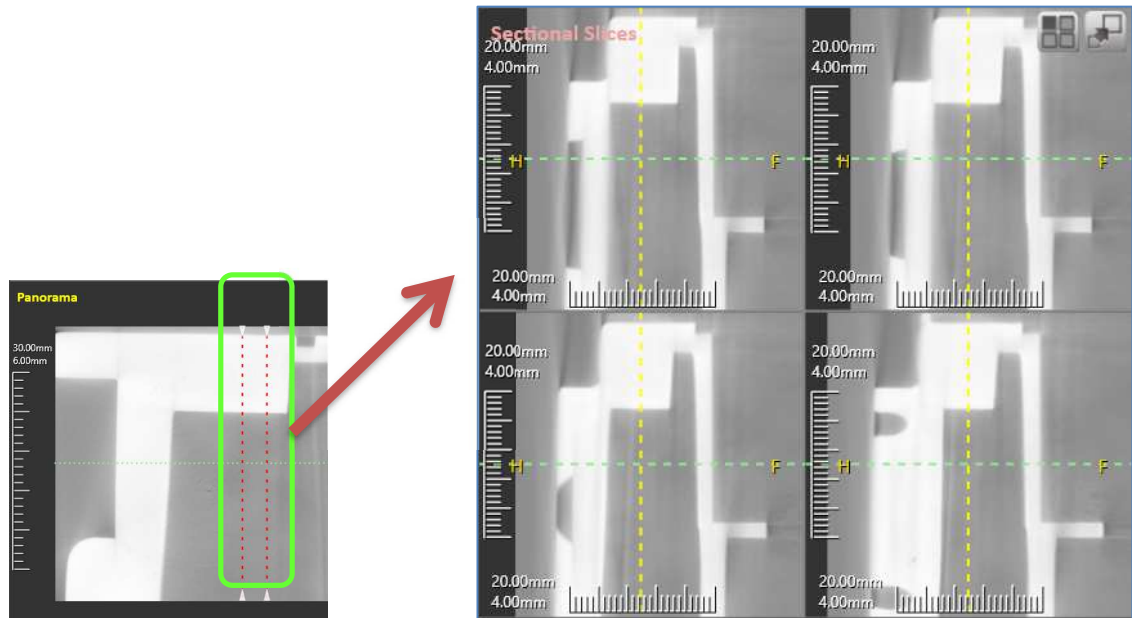
If the thickness of the plane is adjusted, the result will be shown on the cross-sectional slices panel and MPR panel, as a semitransparent white area.

Histogram, minimum/maximum, average, and standard deviation information for the panoramic image are displayed, and select the method (RAY SUM, RAY MAX, RAY MIN) to show the pixel values of the panoramic image over the specified thickness.

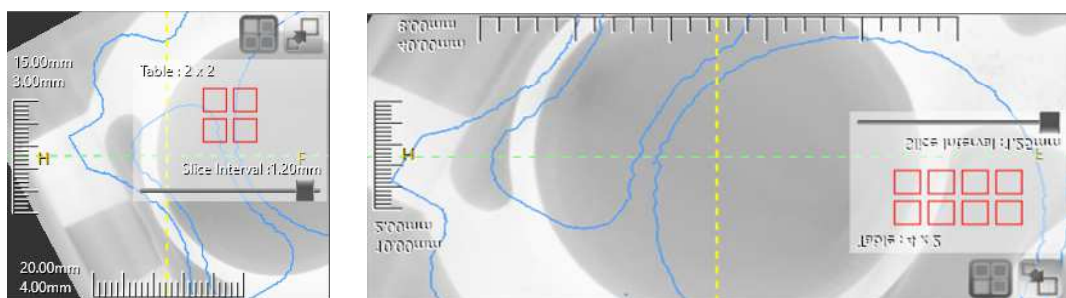


10.3 Cross-sectional Slices Panel

Cross-sectional image panel visualizes an image of a cross-sectional slice that intersects at right angles to the direction of the curve line.



Click  to adjust the interval and number of slices. The number of cross-sectional slice images depend on the current size of cross-sectional panel window. Set slice interval with the slider.



Within the cross-sectional slice panel,

- With the scroll bar on the right side or mouse wheeling:

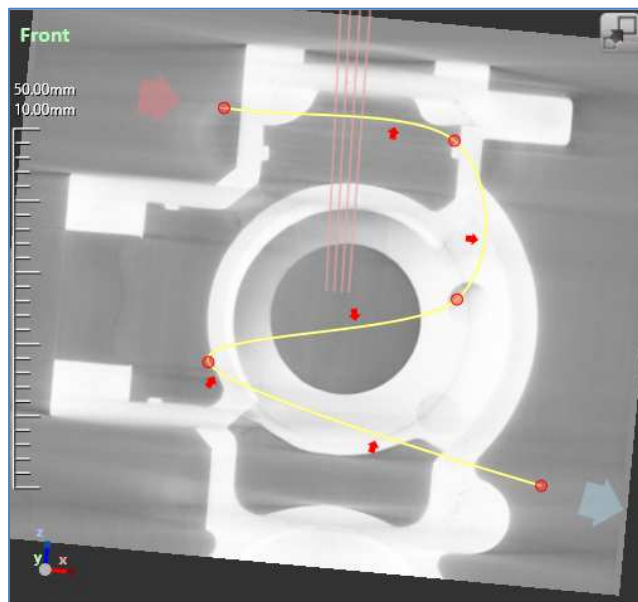
Rearrange the location of the slices.

The change in location is visualized on panorama panel as well as on MPR panel.

- With the mouse cursor is placed on one of the cross-sectional slices:
Its location will be shown on the other interworking panels.
- Drag with the right mouse button:
zoom in or zoom out.
The height of the curve will change according to the current zoom in/zoom out state.
- Drag with the left mouse button:
Translate the cross-sectional slice image by moving the curve.

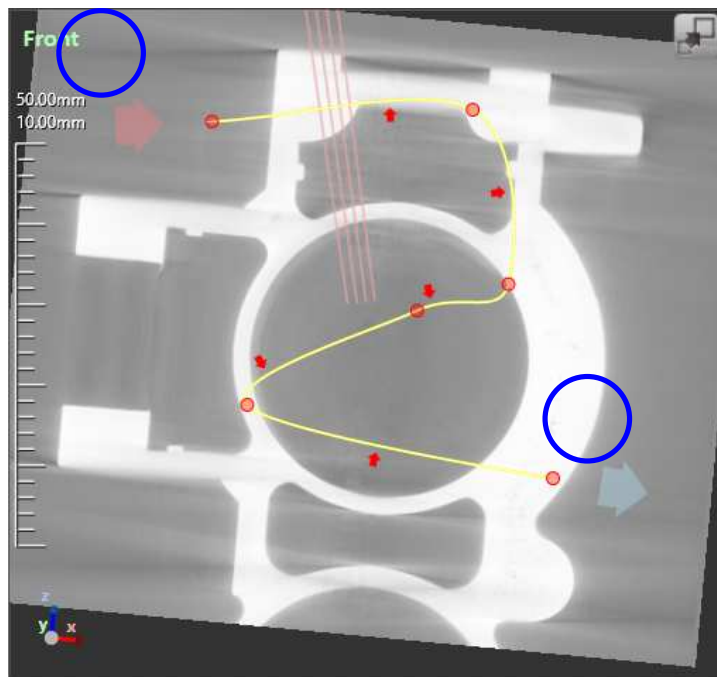
10.4 MPR Panel

MPR panel shows the control points and the possible movement area of the curve which users have adjusted on 'panorama curve generation window'.



- Add control points:
After moving the mouse cursor to the yellow curve (the line where the control points are connected), click the right mouse button to display a pop-up menu to add a new control point.

- Delete control points:
Place the mouse cursor on a control point and right-click to display a pop-up menu to delete it.
- Move control points:
Left-click and drag an existing control point to rearrange it.
- Move curve line:
Left-click inside the curve and drag to move the whole curve on MPR panel.
- By using the scroll bar or mouse wheeling on the MPR panel, move the plane to be visualized along the view direction. The yellow curve also moves along the translation direction.
- Drag either the red arrow on the starting point of the curve or the blue arrow on the end point of the curve to rotate the curve. The new location of the plane will be visualized on all the other interworking panels.



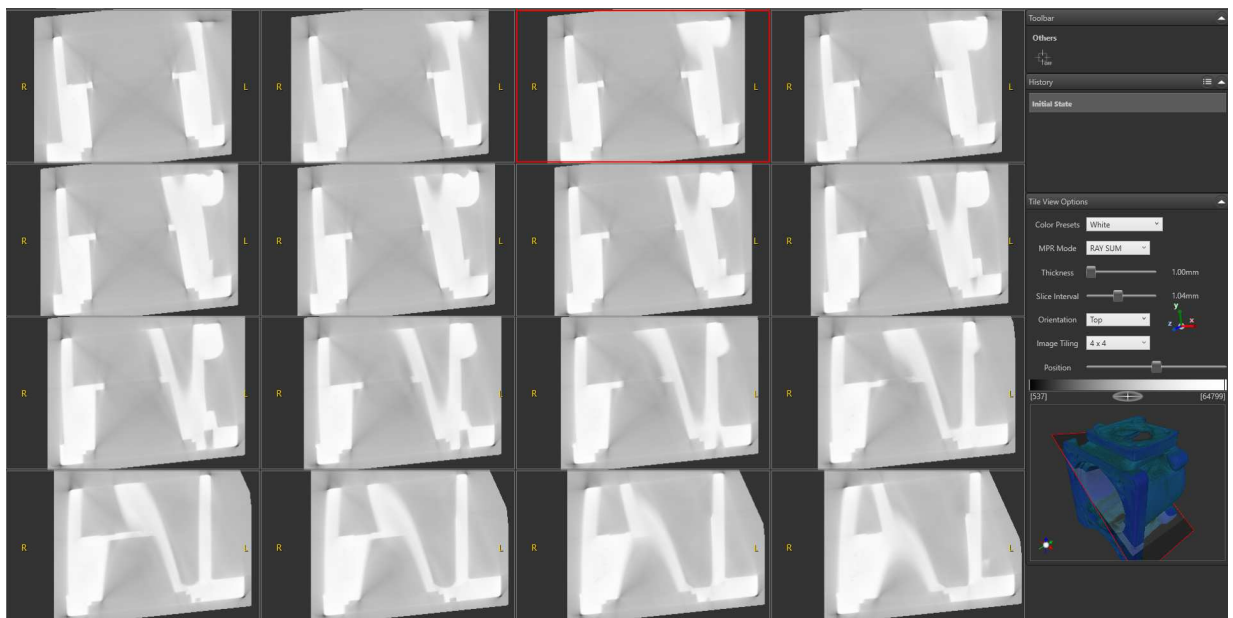
11. Tile View

Click  to use tile view.

MPR planes are arranged as images. (See ["Tile View" Tutorial for details](#))

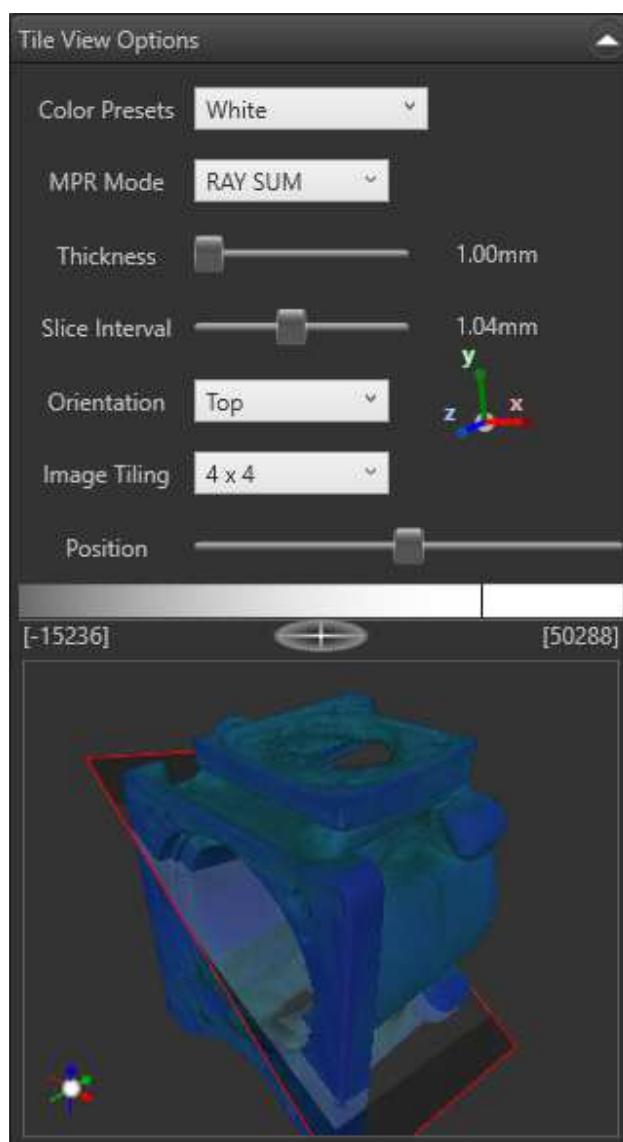
11.1 Tile View Panel

Double-click a MPR plane to open a new 'MPR window' and zoom in.



- Color Presets:
Apply the default color preset to the MPR panel.
- MPR Mode:
Check the maximum, minimum, and the mean value of the volume values.
(See '6.1.1.12 MPR Setting and Analysis' for details)
- Thickness:
Adjust the thickness of MPR planes.(See '6.1.1.12 MPR Setting and Analysis' for details)
- Slice Interval:
Set the slice interval of the image tiling.

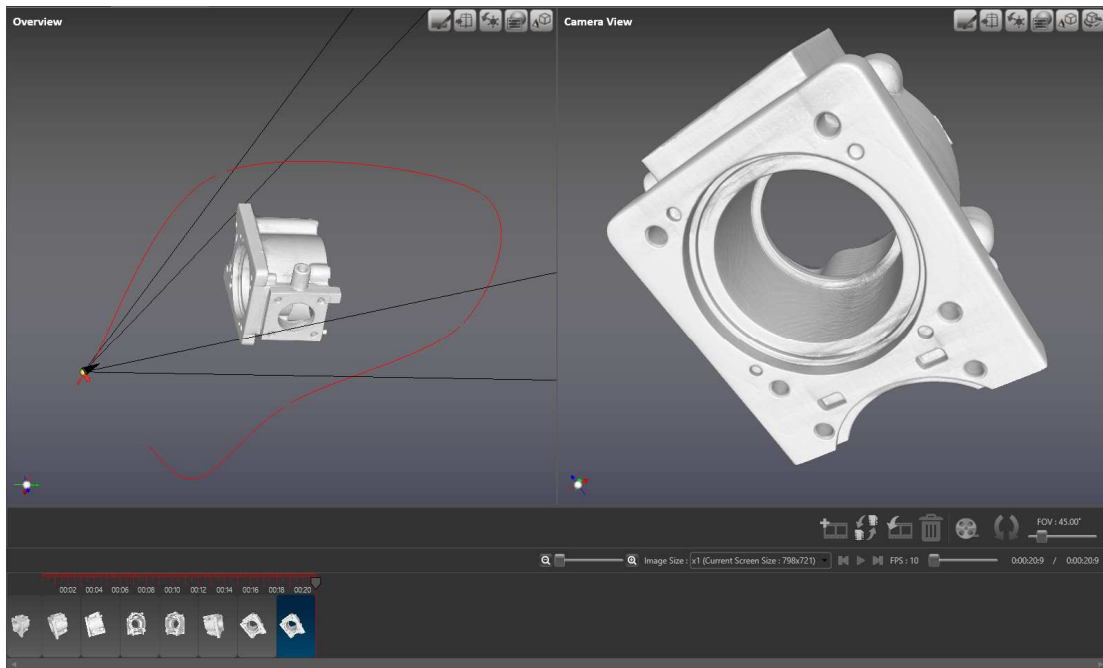
- Orientation:
Select the initial direction of the MPR plane (Top, Front, Right) for the tile view.
- Image Tiling:
Adjust the tiling of displayed images.
- Position:
Set the location of the MPR on volume.



12. Path Animation View



Click  at the toolbar panel to use path animation view. It allows to create an animation using all the functions applied on the 3D panel.



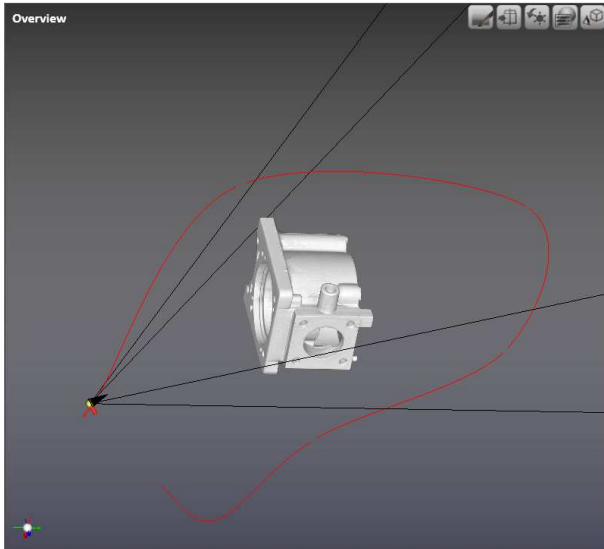
Create keyframes for every move and play the animation or save it as a video file.

After setting the desired scene in the 'Camera View' panel, click the add button () in the Key Frame panel to create a key frame. Play or save the animation after adding all the keyframes by repeating the same process (See ["Path Animation View" Tutorial for details](#))

The path of the camera(red line on "Overview" panel) is calculated automatically through quaternion interpolation and cannot be edited manually.

12.1 Overview Panel

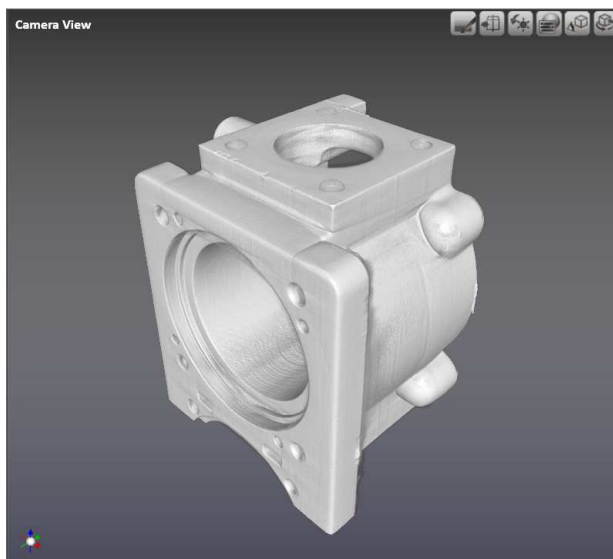
The 'Overview' panel shows the location and state (Field of View (FOV)) of the camera, which visualizes the volume data displayed on the 'Camera view', in 3D space.



12.2 Camera View Panel

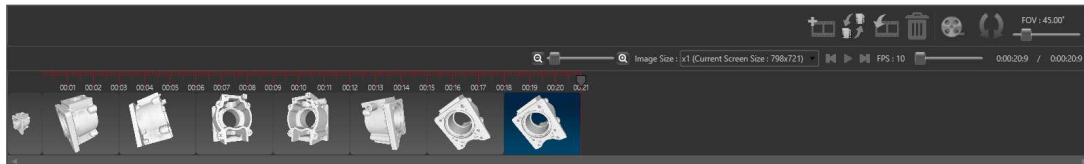
The 'Camera view' panel allows to capture key frame images to create an animation.

The same functions as the 3D panel from the main view are supported.



12.3 Timeline Panel

Timeline panel supports various functions for creating and operating path animation and offers information related to keyframes.



Supported functions of the timeline panel are as follows.

- Add/ replace/ insert/ delete keyframes
- Adjust the FOV of the camera view and rotate
- Create Video Files
- Operate and play animation

12.3.1 Keyframe

A keyframe shows the camera view state in a 2D image when the keyframe is created.

Adjust the key frame time by moving the mouse cursor to the right end of the key frame and clicking and dragging the left mouse button.



12.3.2 Timeline

The timeline includes the created keyframes.

Zoom in / out the timeline through mouse wheeling.



12.3.3 Panel Buttons

12.3.3.1 Add Keyframes

Click  at the panel window to add a new keyframe with the current camera view saved.

12.3.3.2 Replace Keyframes

Select a keyframe from the timeline and click  at the panel window to replace the selected keyframe with the current camera view.

12.3.3.3 Insert Keyframes

Select a keyframe from the timeline and click  at the panel window to insert a new keyframe with the current camera view saved after the selected keyframe.

12.3.3.4 Create Video Files

Click  at the panel window to save the created animation as a video file.

12.3.3.5 Delete Keyframes

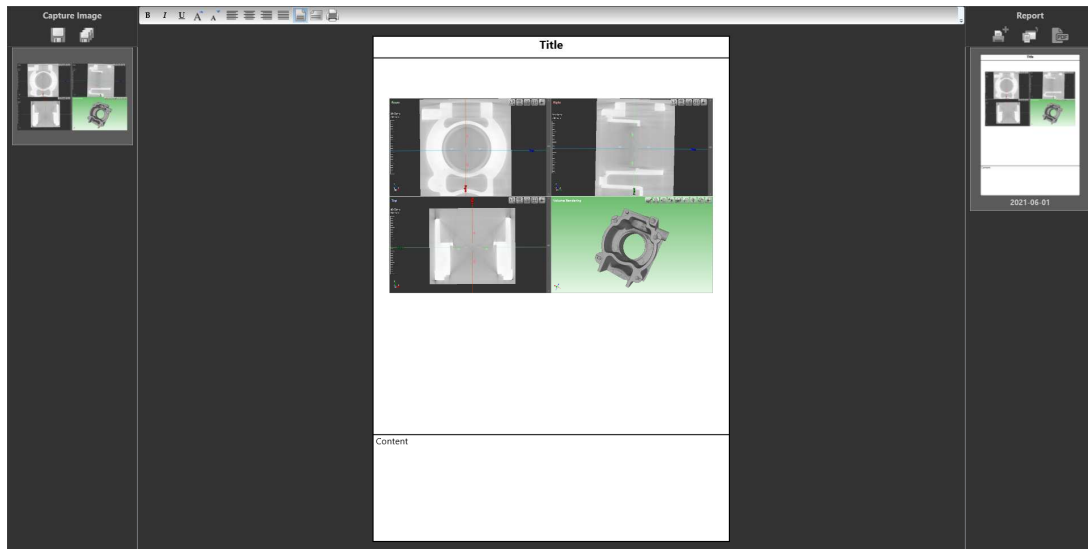
Select a keyframe from the timeline and click  at the panel window to delete it.

12.3.3.6 Play Animation

Click  at the panel window to play the animation.

13 Report view

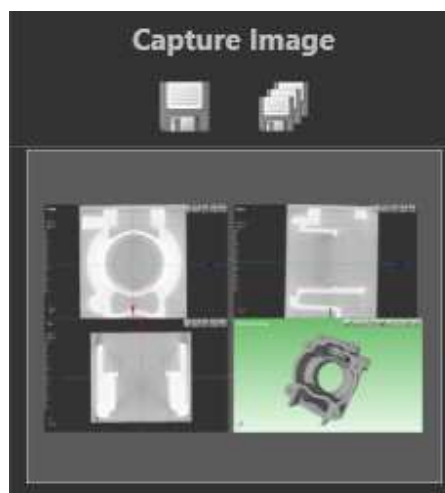
Click  at Common Function Toolbar to use report view.



Click  to add captured image to the capture list. (See ["Report View" Tutorial for details](#))

13.1 Capture Image Panel

Click  on Capture Image panel to export the selected image as a file and click  to export all capture images as files.



13.2 Edit Report Panel

It is possible to adjust the location or size of an image in a printout.

Multiple images can be printed out on a single screen. Register multiple reports to use and modify style of the text using the toolbar if needed. Change the title or content size using the size control line of the report view if needed.

Use the left mouse button to drag images from capture image list and drop them onto the edit panel to make images appear on the image panel.

Use the left mouse button to drag and move an image. It is possible to adjust the size of the inserted image with left mouse button.

13.3 Report View Panel

Click on  Report panel to add a new report and click  to export all reports as a PDF file.



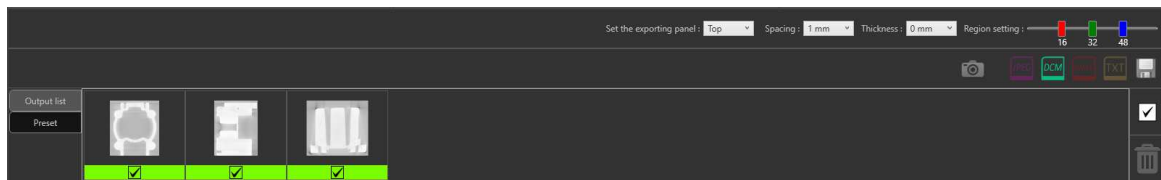
14 Reformat View



Click  button to use reformat view. Export the volume data of a user-specified section as a 2D slice image. Adjust spacing and thickness of slice to export 2D image.

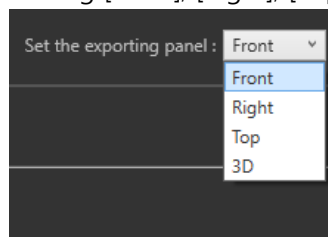
For exporting 3D image, adjust degree and direction of rotation. It is possible to export as JPG, DCM (dicom), WMV (video) file. (See ["Reformat View" Tutorial for details](#))

14.1 Reformat manager

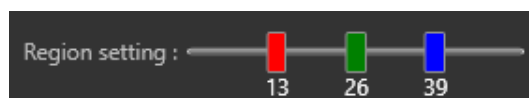


- Set export panel:

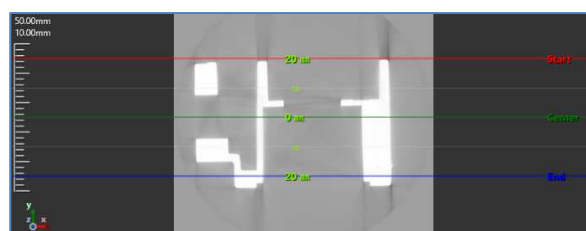
Choose panel to export among [Front], [Right], [Top] and [3D].



- Set region:

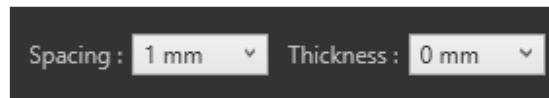


Adjust slider bar to set region for exporting (available on MPR panels), red slider bar represents start point, blue is end point and green slider bar represents center point.



- Spacing, thickness (when the panel to export is [Front], [Right], [Top])

If target to export is one of the MPR panels ([Front], [Right], [Top]), user can set the spacing and thickness of each slice section.



- Set the spacing, direction, and camera direction of the VR panel (when the panel to export is [3D])

If target to export is the [3D] panel, user can set the angle and direction between the slices to output.

The rotation direction can be selected from "vertical" or "horizontal" direction.

Click  set the camera orientation of the start, center, and end points to the camera orientation of the VR panel.



- Exporting file format

It supports JPG, DCM (dicom), WMV file format.



- Preset

Click Preset panel,  to save current reformat option and camera setting as one preset. If user clicks saved preset, current reformat option and camera setting are applied to screen.



To delete a preset, select the preset and click (, ).

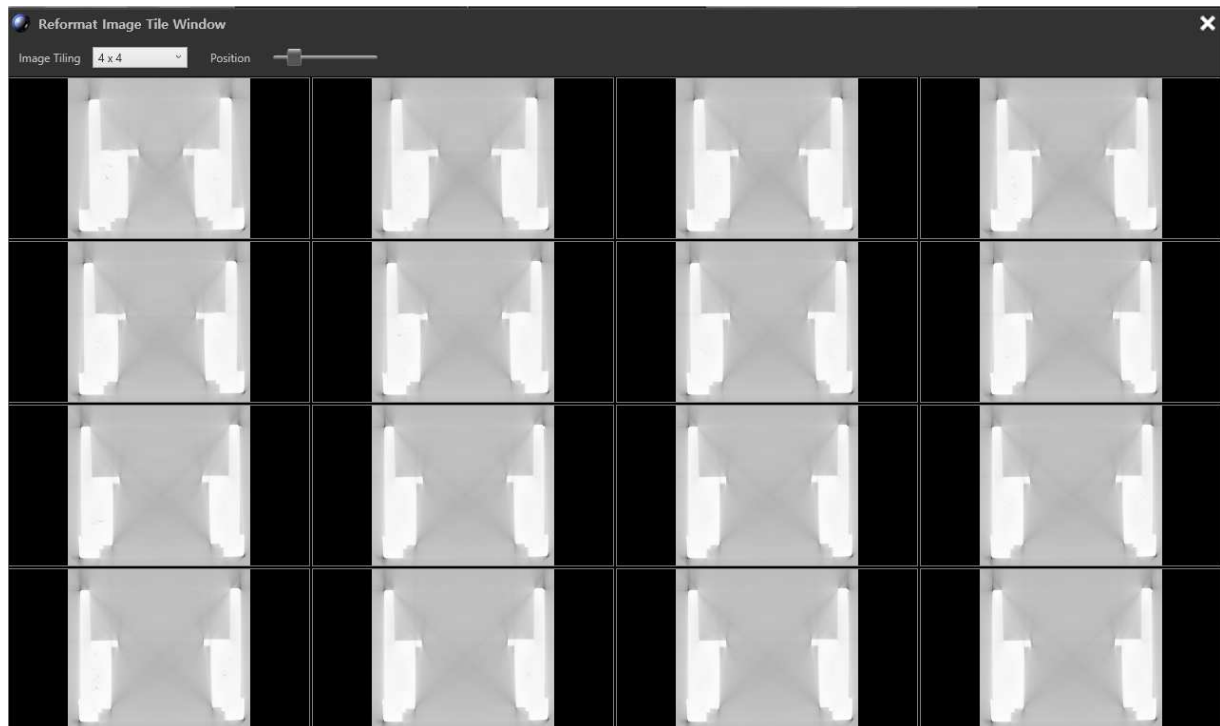
Capture

Click  in the output list panel, the content to be output according to the currently set reformat option is added to the output list panel and displayed in the form of thumbnails. Activate the check box at the bottom of thumbnail to export all at once.

Click  to save output in the specified file format.

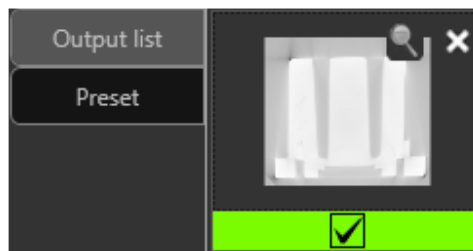


14.2 Reformat image tile window

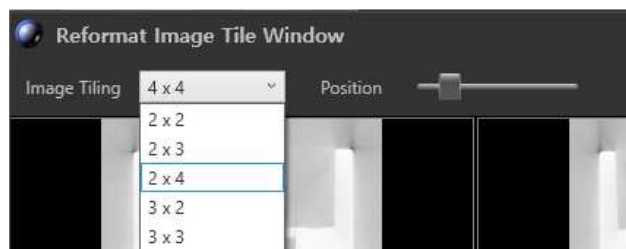


appears when place the mouse cursor on the thumbnail of an item added to the output list.

Click this button and the 'Reformat image tile window' appears to see the image to be exported in detail for each slice.



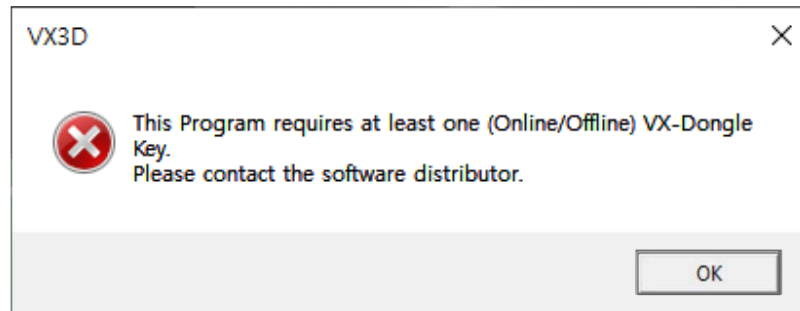
The arrangement of the displayed images can be changed, the position of the displayed slice image can be changed by adjusting the slider bar.



15. FAQ

● Dongle Key Problems

- The following message appears when the dongle key is disconnected.



- After inserting dongle key and run again to operate normally.

● Out of memory

- An error message is appeared if the system is out of memory.
- If other programs are closed and VX3D is restarted, an error message is disappeared.

● Program Crash Problems

- If VX3D or Viewer is running, other Viewers or VX3D cannot be reopened.

● Required Program

- To run VX3D, following programs are required.
 - ① .net framework 4.5
 - ② Visual studio 2013 redistributable packages
 - ③ DirectX 2010 June
- The VX3D installation file includes installation files of these programs. Those programs are installed together with VX3DC installation.