C251-E029E

SHIMADZU
Excellence in Science

Microfocus X-Ray CT System

inspeXio SMX-225CT FPD HR Plus

Advanced Operability and Excellent Image Quality That Overturns Conventional Assumptions

inspeXio SMX-225CT FPD HR Plus

Microfocus X-Ray CT System

The inspeXio SMX-225CT FPD HR Plus is a high-performance microfocus X-ray CT system equipped with a Shimadzu microfocus X-ray generator and a large high-resolution flat panel detector.
The large detection area, input resolution equivalent to 14 megapixels, and an enhanced high-output microfocus X-ray generator enable CT images with a large field-of-view, high resolution, and high contrast. In addition, the improved HPCinspeXio high-performance computing system processes images faster.

These developments make the inspeXio SMX-225CT FPD HR Plus system applicable for researching, developing, or inspecting a wide variety of samples, from composite materials, such as glass fiber reinforced plastic (GFRP) and continuous fiber reinforced thermoplastic laminate (CFRTP) materials to large aluminum die cast parts.

High-Resolution CT Imaging

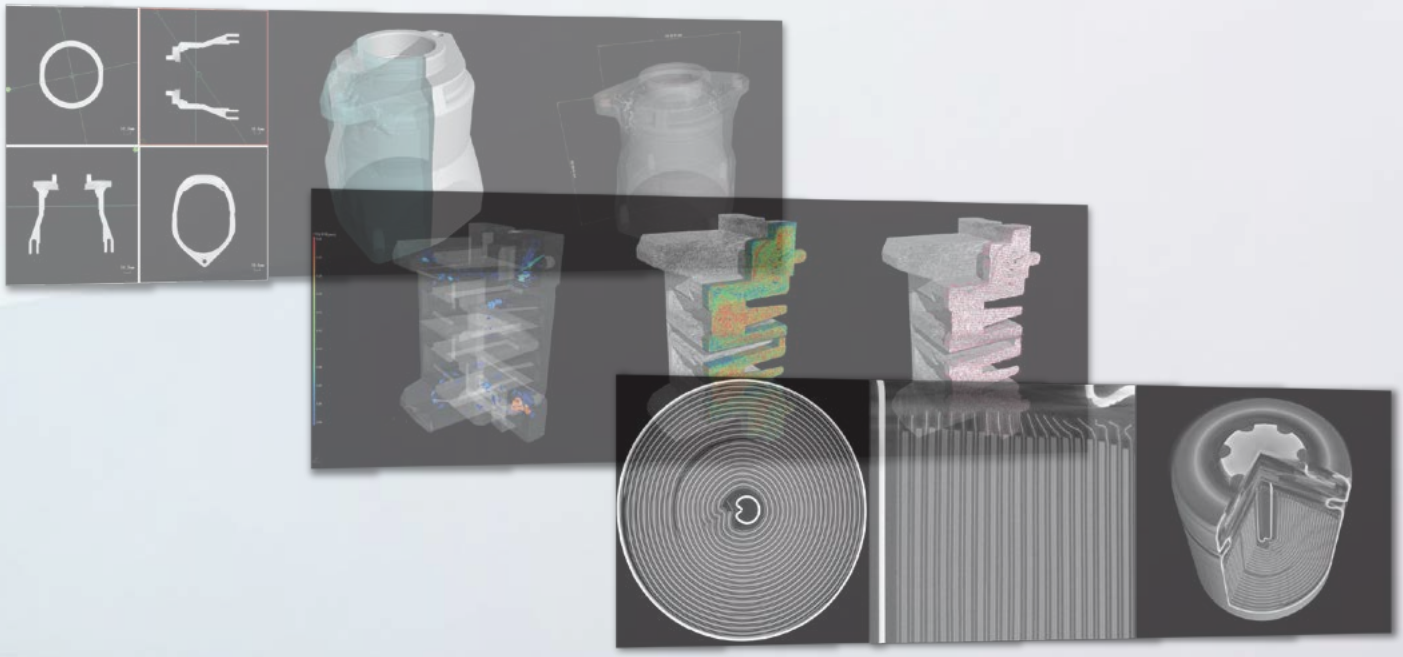
The large high-resolution flat panel detector has an input resolution equivalent to 14 megapixels, which provides a large field-of-view and high resolution.

High-Contrast CT Imaging

Improvements to the Shimadzu-made microfocus X-ray generator and the sensitivity characteristics of the state-of-the-art flat panel detector enable unprecedented high output and image contrast.

Easy and Fast CT Scanning

In addition to the automated CT scanning function, which relieves the operator from having to specify parameter settings, the system also includes an improved version of the HPCinspeXio ver. 3.0 high-performance computing system, providing 50 times faster processing speeds.

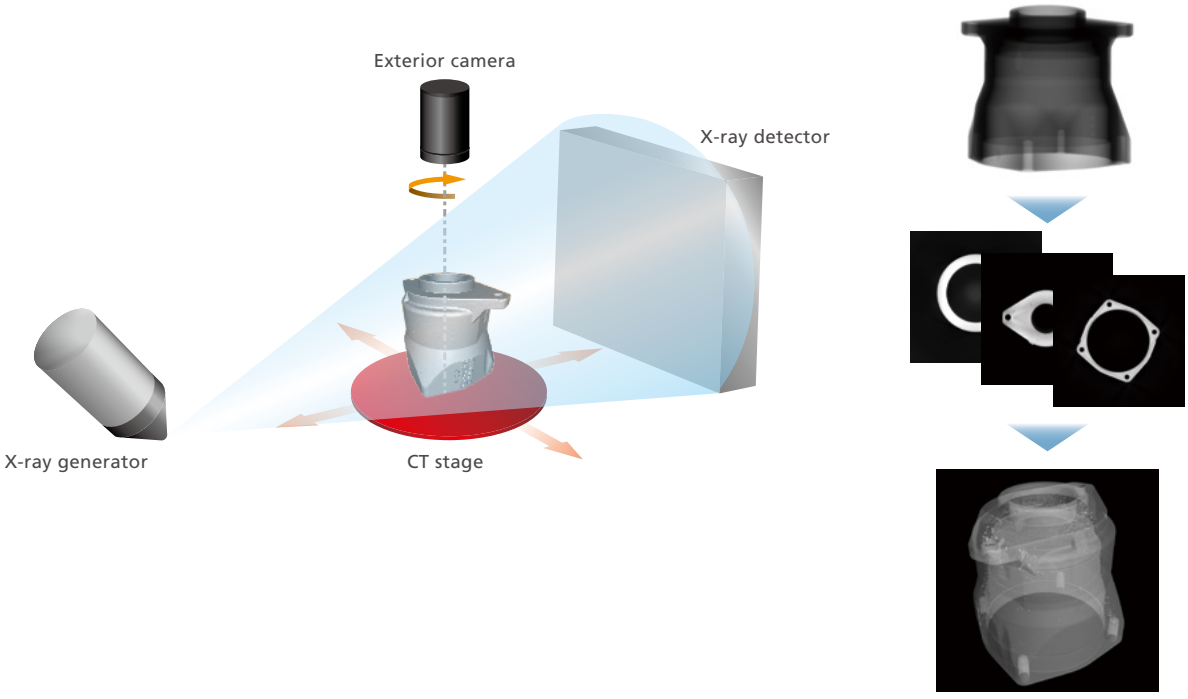


Contents

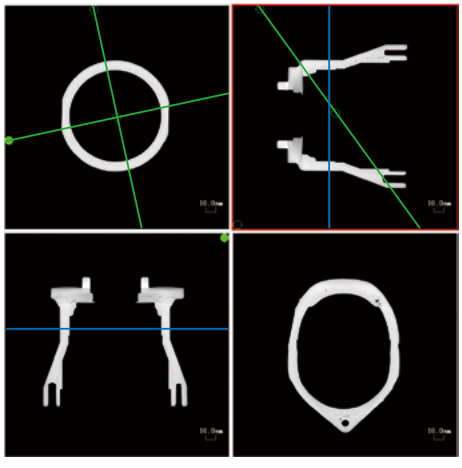
System and Principle

System Configuration and Operating Principle

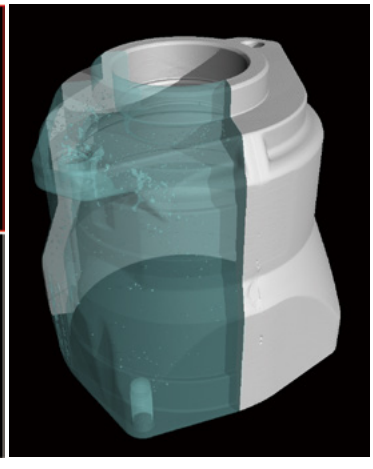
The inspection target (sample) is placed between the X-ray generator and detector, as shown below.
Then, the sample is rotated 360 degrees to collect X-ray fluoroscopic data from various angles in order to calculate cross-sectional images.



MPR



VR



MPR Display

(Displays any cross section desired)
Multi Planar Reconstruction (MPR) stacks multiple CT images in a virtual space to display four images—a CT image, mutually longitudinal section images, and a user-selected section image orthogonal to one of the longitudinal section images.

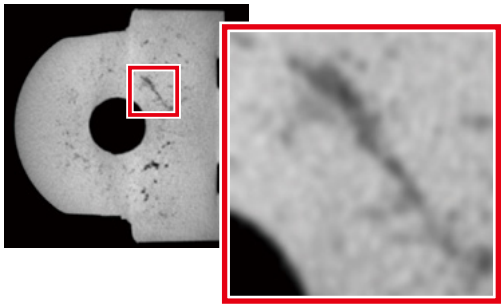
VR Display

Volume rendering (VR) stacks multiple CT images in a virtual space to display a 3D image. Separate 3D image processing software is required for VR display.

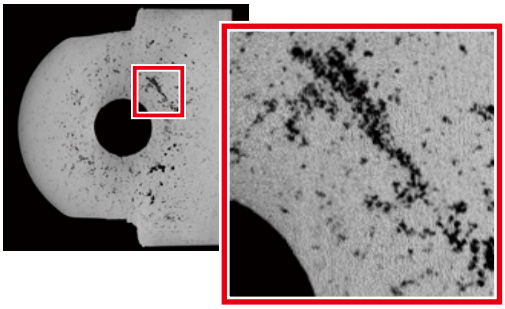
High-Resolution CT Imaging

Maximum 14 Megapixel Input Resolution

The large high-resolution flat panel detector achieves an offset scan input resolution of up to 14 megapixels.



Low-Resolution Cross-Sectional Image



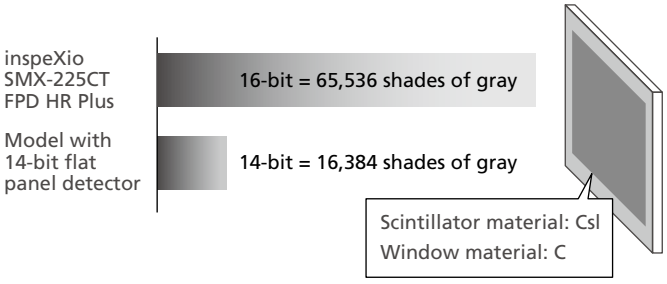
High-Resolution Cross-Sectional Image
(14 Megapixels Input Resolution)

High-Contrast CT Imaging

High-Contrast Detector with Wide Dynamic Range

Cesium iodide (CsI), which has excellent sensitivity characteristics in the long wavelength region, is employed as the scintillator material.

The use of carbon (C) for the detector window material enables imaging on low-density materials. Furthermore, the wide dynamic range (16-bits) enables small contrast differences to be displayed.

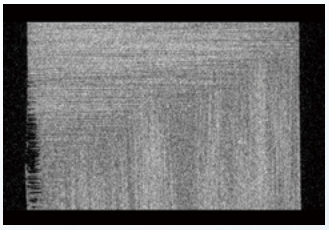


Improved X-Ray Generator

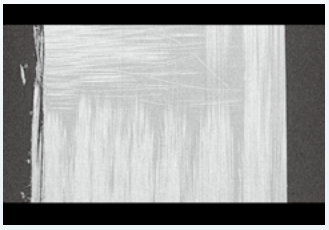
The Shimadzu-made microfocus X-ray generator unit now includes a newly developed irradiation window. Due to the larger proportion of soft X-rays in the X-ray output, it offers significantly improved contrast when scanning low-density materials that easily transmit X-rays.

In addition, the irradiation angle has been optimized for the wide field flat panel detector.

Cross-Sectional Images from Non-Woven Fabric



Previous Cross-Sectional Image



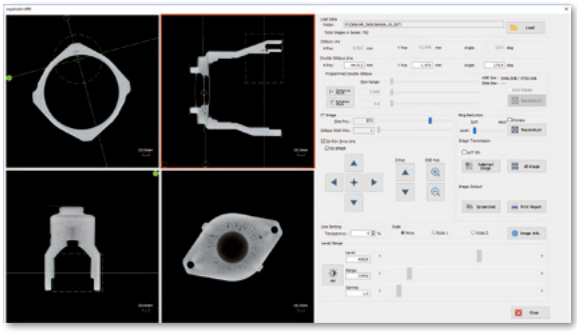
New System Cross-Sectional Image

Easy and Fast CT Scanning

Intuitive User Interface

The new user interface features a simpler arrangement for intuitive operation.

Main System Window	Displays the stage position, scan field of view, equivalent voxel length, and other information in real time (the yellow box), making it easy to scan images with the specified resolution and field-of-view size.
MPR Window	Displays slice, oblique, and double-oblique images, enabling the easy observation of cross-sections.



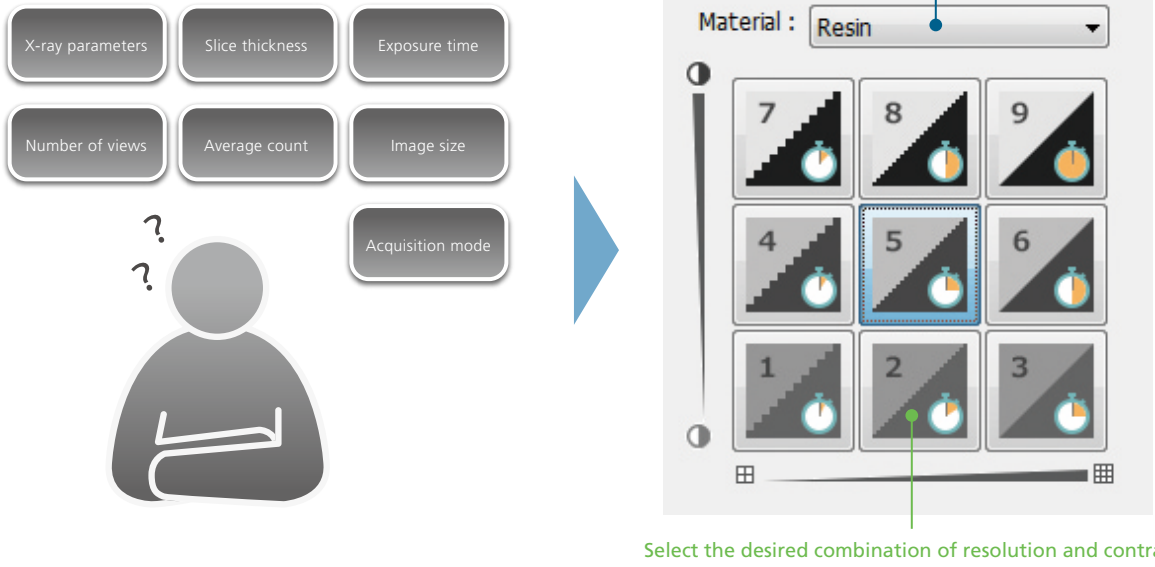
MPR Window

System Window

Recommend Scanning Function

ANALYTICAL INTELLIGENCE

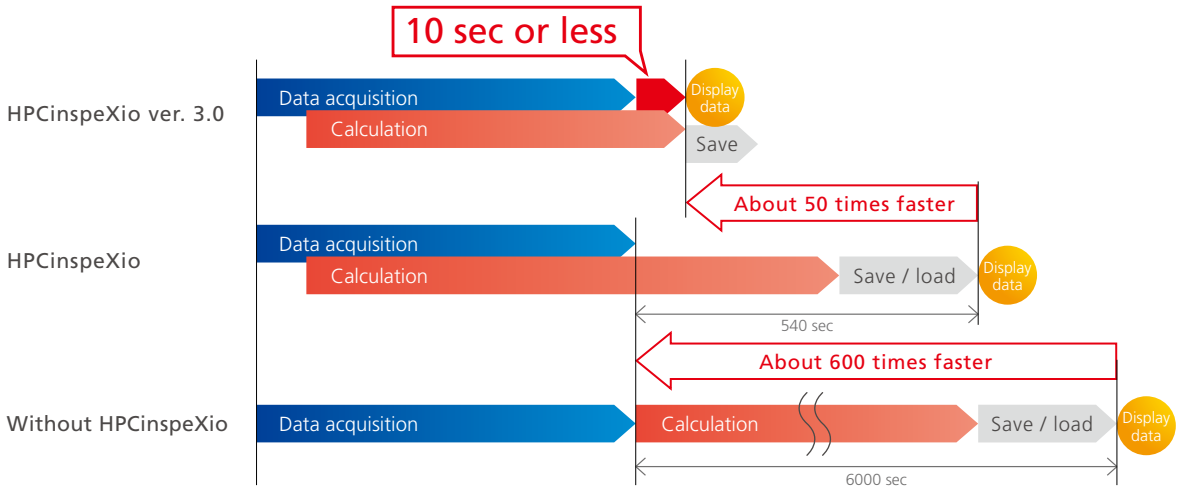
The new recommend scanning function enables scan parameters to be specified easily.
Simply select the material, the desired CT image resolution, and the contrast level, and the system automatically optimizes the CT scanning parameter settings accordingly.



HPCinspeXio High-Performance Computing System ver. 3.0

The HPCinspeXio high-performance computing system is around 50 times faster* than the previous version.

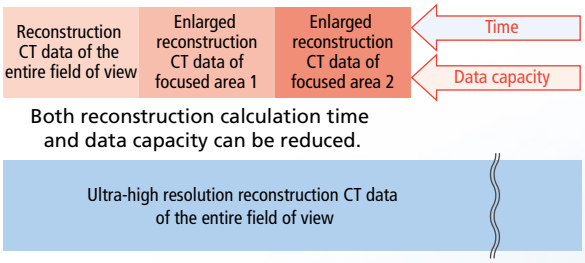
* When the fast acquisition mode is configured and the CT slice size is set to 1,024 × 1,024 pixels

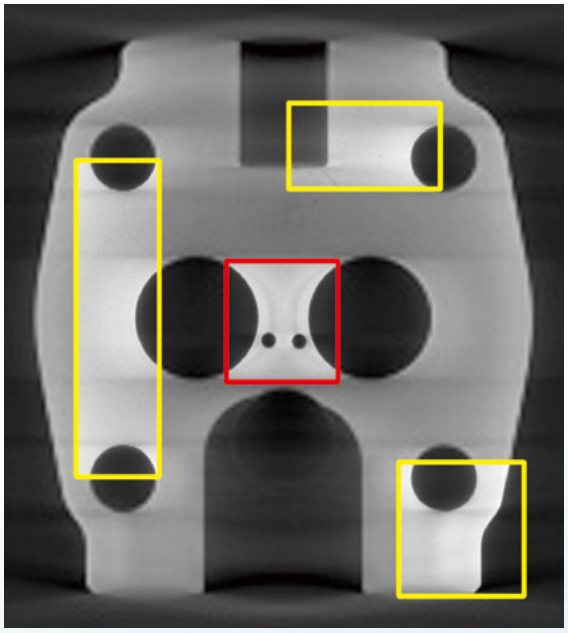


Advanced 3D Image Reconstruction

It is possible to enlarge only the focused areas in images once acquired and perform the reconstruction calculation. High-magnification cross-sectional images can be obtained even in the works that enlargement ratio is difficult to be improved.

Equipped with a high-resolution at panel detector, clear cross-sectional images can be obtained even when performing reconstruction. It is not necessary to perform the CT scanning once again when performing reconstruction only.





: Selectable area with traditional software

: Selectable area with new software

Easy and Fast CT Scanning

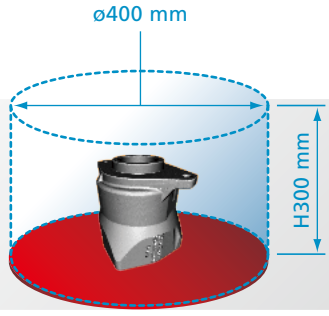
Obtain CT Images in Three Easy Steps

No calibration process is necessary before scanning. Scans can be started immediately after sample placement.

step 1

Place the sample.

Maximum sample and CT scan size are 400 mm in diameter and 300 mm in height.



step 2

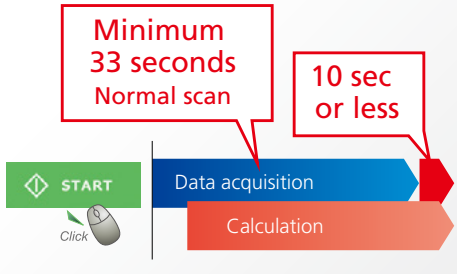
Determine the scan position.

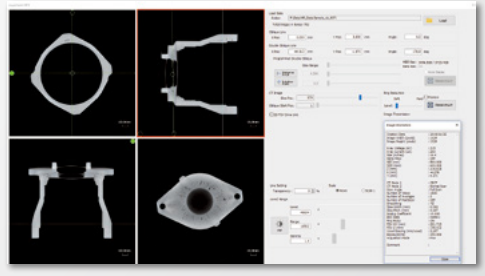
Samples are positioned using the camera mounted on the rotation axis.

step 3

Start the scan.

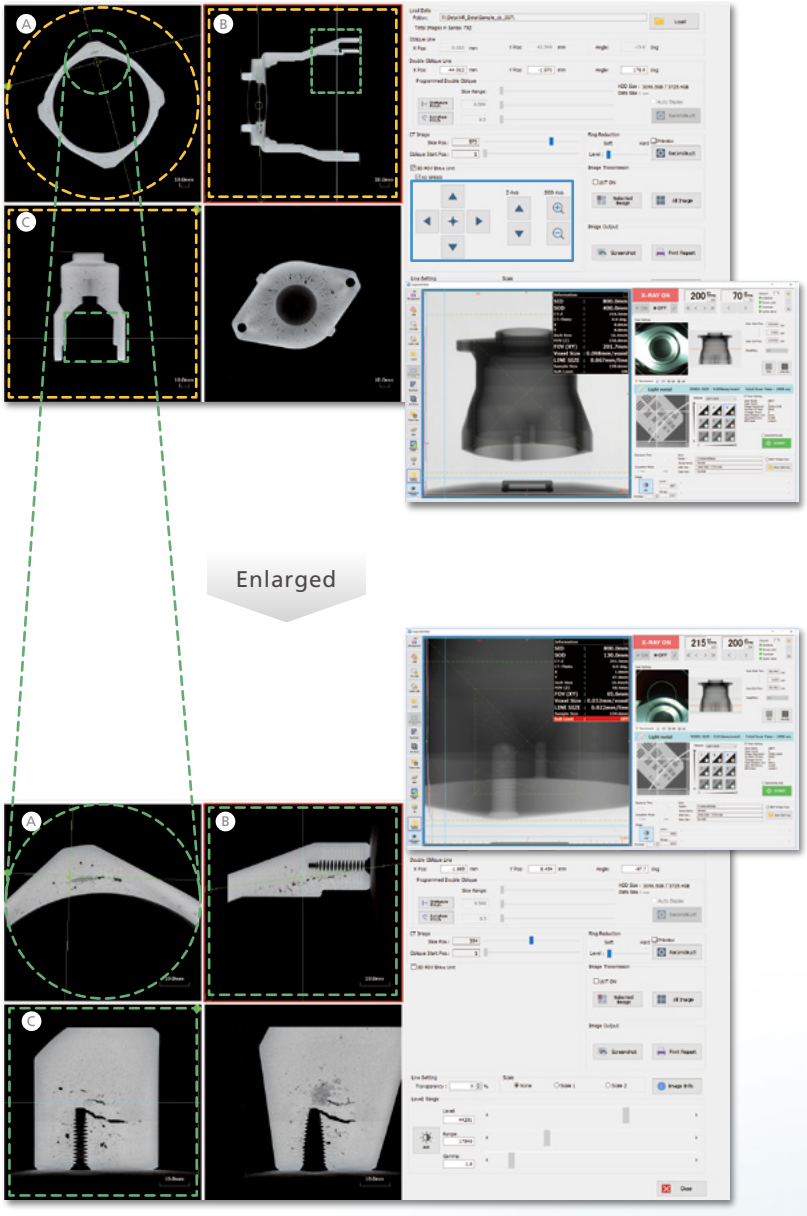
Scans can be started immediately without prior calibration.
In normal scan (600 view), data acquisition can be done in as short as 33 seconds.
Due to the high-performance computing system, MPR images are displayed 10 seconds or less after scanning is finished.

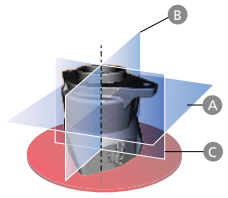




3D CT Scan Region Display Function

As the CT stage moves, the corresponding CT scan region is displayed and overlaid in real-time on the MPR display. Based on the previous CT scan image, additional CT scans for areas of interest can be obtained.

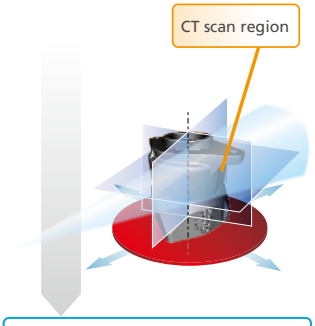




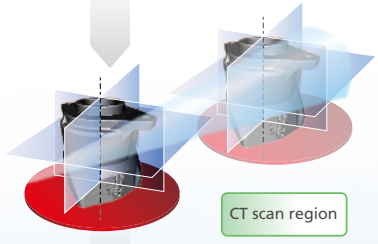
A —— Cross-Sectional Image
B C — Oblique Image

To magnify this area

Click in the 3D FOV control buttons.



The scan region is updated as the CT stage moves.



Start the scan.
The magnified scan image is obtained.

Function

Unique Functions

Extended Filament Lifetime

The expected lifetime of filament is extended by 2.5 times by automatically adjusting the current value.

Acquisition Mode Switching Function

Long or short scan times can be specified by combining acquisition mode and exposure time settings.

Anti-Pinch Prevention Mechanism

A finger-pinch prevention mechanism is provided to prevent accidents when closing the sliding door.

Door Interlock Mechanisms

The sliding door is equipped with redundant interlock circuits. These ensure X-rays are never emitted when the sliding door is open. In addition, these stop the CT stage from moving when the sliding door is open.

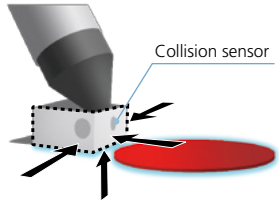
DICOM Conversion Function

CT Image data can be converted to the DICOM format, which is the world standard for medical imaging. Consequently, this function is essential for analyzing data with medical image analysis software.

- This feature is not guaranteed to function properly with all DICOM compatible software.
- CT image brightness values are indicated in 16-bit grayscale, which do not match Hounsfield values. A function is provided for converting CT image brightness values via manual input.

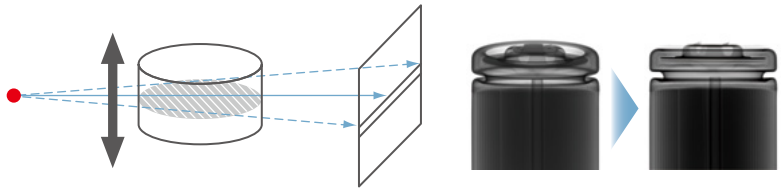
Collision Sensor

Collision sensors are provided around the X-ray tube to stop the CT stage in the event of an emergency (a collision with the sample). The collision sensor window can be opened or closed depending on the magnification rate.



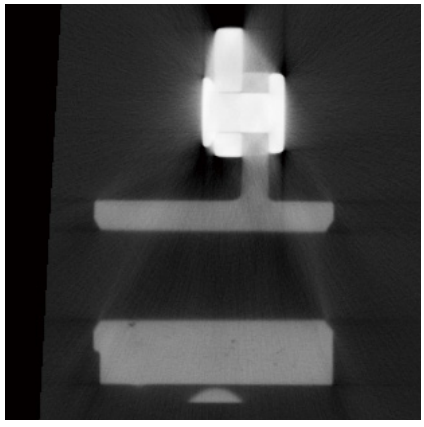
CR Scan

Computed radiography (CR) can be used to obtain transmission images without distortion in the CT-Z direction by acquiring data only along the vertical center line of the X-ray detector while moving the CT-Z axis vertically.

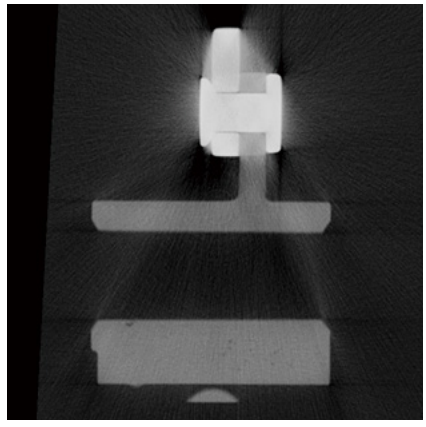


Improved sharpness with Edge Emaphasis Filters

Added an image filter that makes it sharper. Since it can be selected by Post Reconstruction, it can also be applied to collected data.



Edge Emaphasis OFF



Edge Emaphasis ON

Optional Module

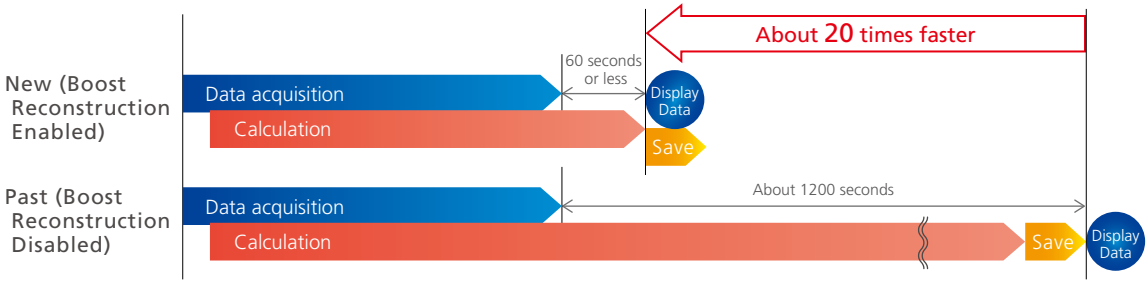
Optional Module "CORE Boost™" *New!!*

"CORE Boost" is an optional module that extends the 2 functions, "Boost Reconstruction" and "ROI Reconstruction", to the control software for the inspeXio SMX-225 CT FPD HR, inspecXio64.

Boost Reconstruction *New!!*

Boost Reconstruction Function is an image reconstruction calculation process that uses our proprietary high-speed calculation technology for image reconstruction calculation processing of high-pixel CT images to achieve even higher speed.

Faster image reconstruction at 2048 × 2048 pixels or 4096 × 4096 pixels.



* The above shooting conditions are as follows: clear mode, full scan, 2400 View, 1500 slices, image reconstruction size 2048 × 2048.
* Since Boost Reconstruction Function is a speed-specific image computation technology, it may affect the quality of cross-section images.

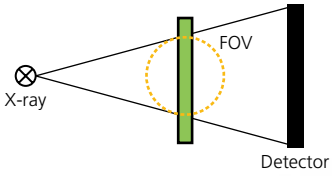
ROI Reconstruction *New!!*

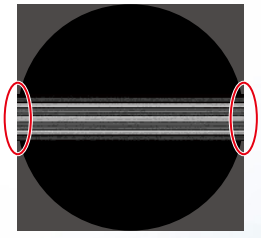
ROI Reconstruction Function is an image reconstruction calculation process that uses our unique ROI reconstruction technology to improve the image quality of data taken when a part of a workpiece protrudes (truncates) from the left and right sides of an X-ray fluoroscopic image during CT imaging.

This reduces shading artifacts that traditionally occur from the truncation to the entire image, making it easier to analyze with image processing software.

What's "Truncation"…?

A part of a workpiece protrudes from the left and right sides of a fluoroscopic image during a CT scan.

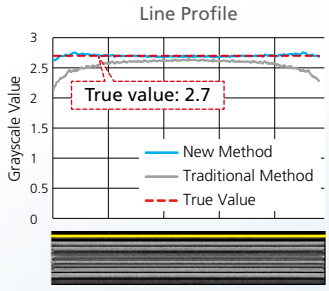




Transected CT Image

Image Comparison

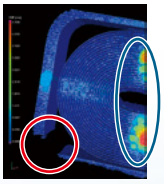
ROI image reconstruction reduces shading artifacts more than traditional methods, so grayscale values are close to true value and uniform.



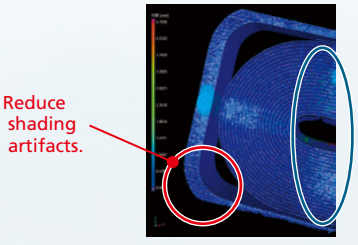
* Comparison of conventional and new line profiles.

Advantage

The reduced shading artifacts make thresholding easier.



Traditional Method

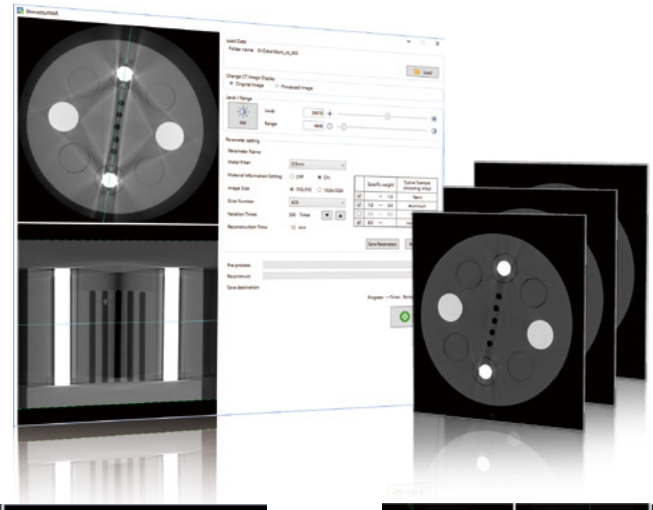


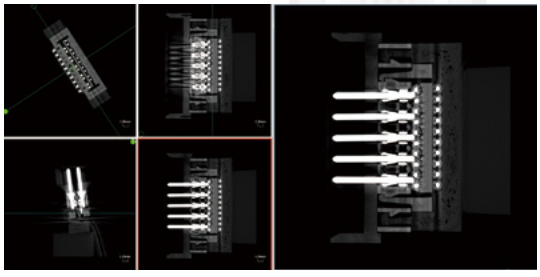
ROI Reconstruction

Optional Software

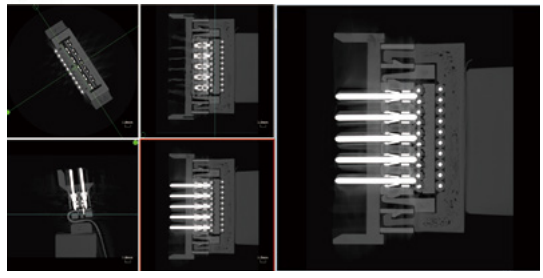
Metal Artifact Reduction Software

This is a reconstruction software program used to reduce metal artifacts in the cross-sectional images acquired using the Shimadzu's microfocus X-ray computed tomography system of the inspeXio SMX-225CT FPD HR Plus. This software allows for easier and more accurate analyses of the cross-sectional images.

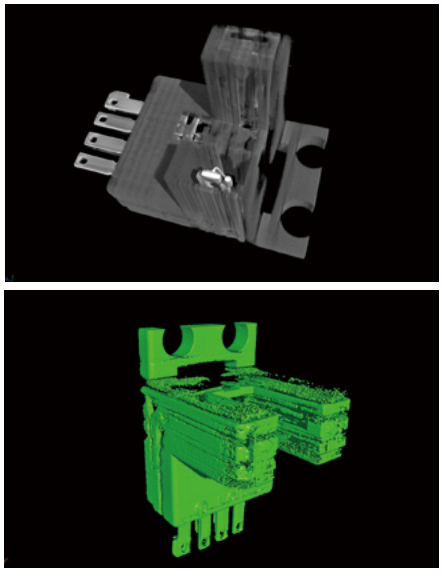




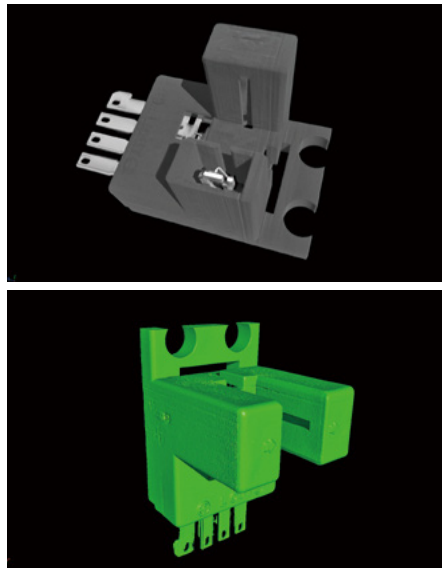
10-pin connector before processing



10-pin connector after processing



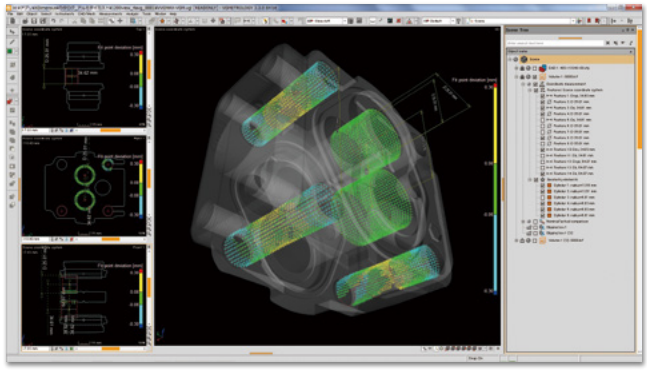
Photosensor before processing
(Top: VR image, bottom: STL)



Photosensor after processing
(Top: VR image, bottom: STL)

VGMetrology
3D Measurement Software

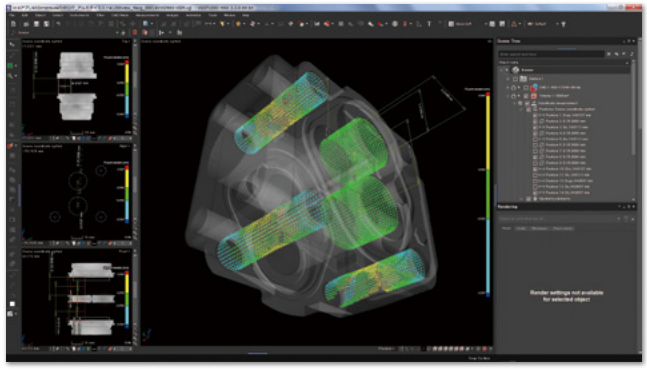
This 3D image processing software performs coordinate measurements using voxel data obtained with CT scans. The package can perform measurements not only with voxel data, but with collections of points, meshes, and CAD data. Specially designed for coordinate measurements, the package is easier to use than general-purpose 3D image processing software.



(Volume Graphics GmbH)

VGSTUDIO MAX
+ Coordinate Measurement Module
3D Image Processing Software

This software uses volume rendering to display 3D images from voxel data obtained using CT imaging. Adding the coordinate measurement module enables coordinate measurements in the same way as with VGMetrology.

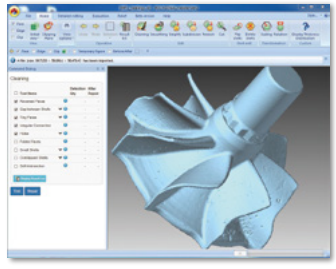


(Volume Graphics GmbH)

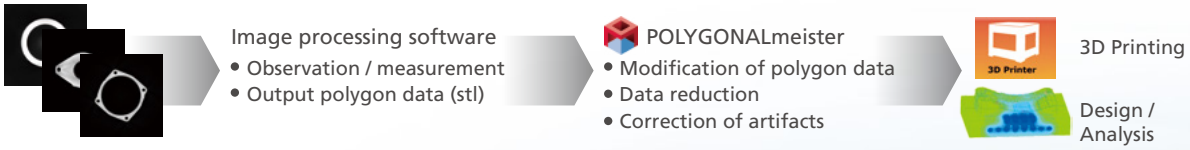
POLYGONALmeister

Polygon editing software

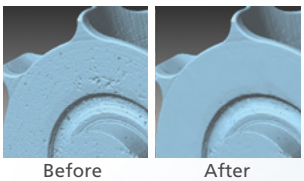
POLYGONALmeister is a polygon editing software for editing surface measurement data. It solves issues such as noise and artifacts as well as reducing data size. It is especially suitable when using measurement data in design, analysis, 3D printing, etc.



(UEL Corporation)

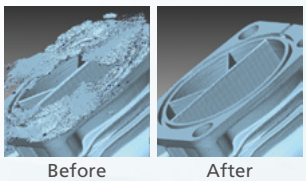


● Fix dents etc.



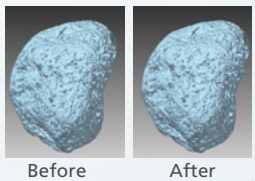
Before After

● Extract necessary parts



Before After

● Simplify porous material within tolerance



Before 1.4 GB After 51 MB (3.67%)

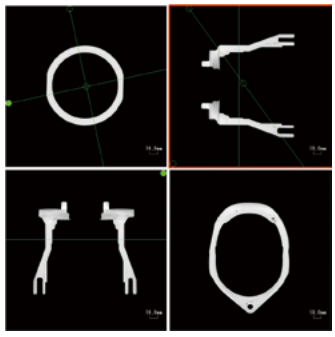
RIKEN

This software makes use of the results of an integrated research program with RIKEN

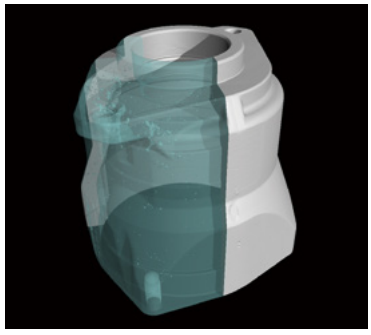
Applications

Visit our website to see enlarged application data.

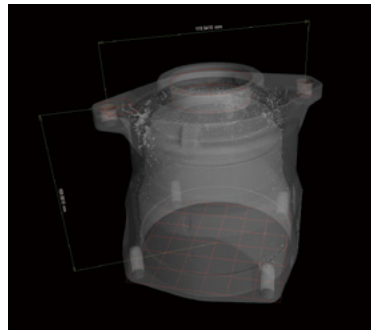
Aluminum Die Castings



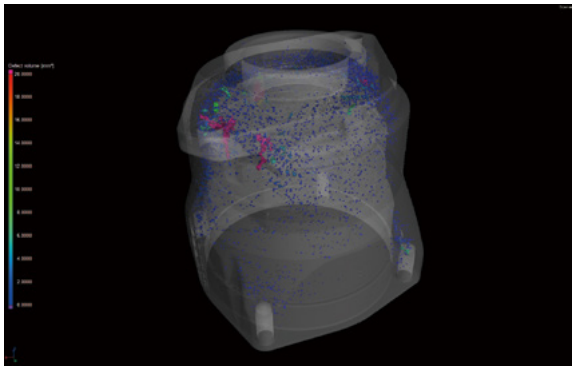
MPR Image FOV = ø207.6 mm



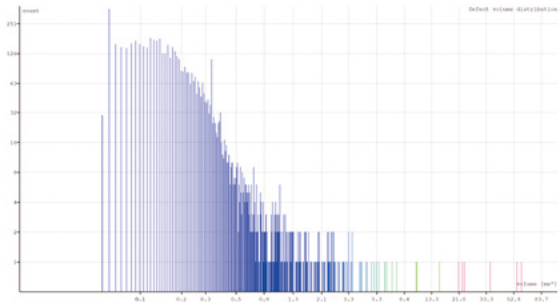
VR Image



3D Measurement

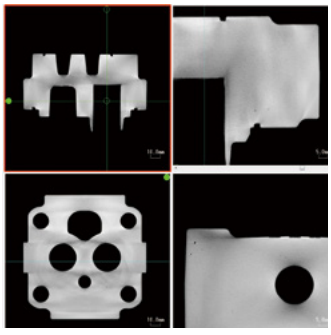


Defect Analysis

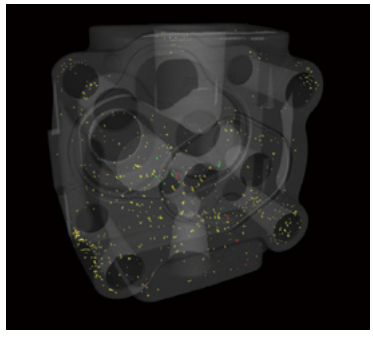


Defect Analysis Histogram

Defect analysis identifies voids and displays a color-coded map of the voids based on their volume. It can also display a frequency histogram of scale the void volume and count.



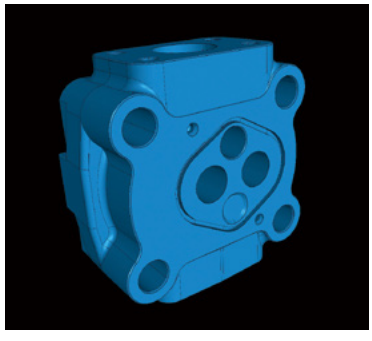
MPR Image FOV = ø161.5 mm



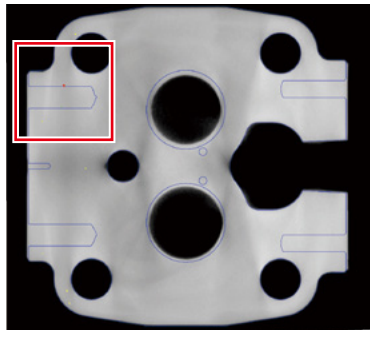
Defect Analysis

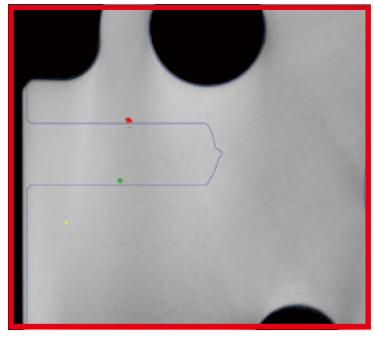
By scanning the die cast part before machining and then specifying the surface after machining (CAD data), the software can determine which voids are removed by machining, which remain internally, and which are exposed on the surface after machining.

- Voids that are removed
- Internal voids
- Voids exposed on the surface



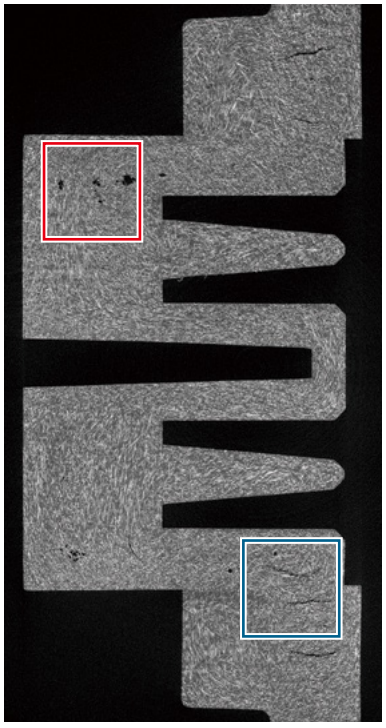
3D CAD



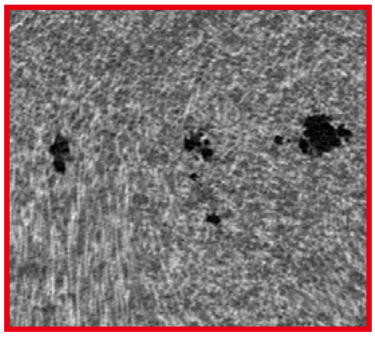


Void Determination Based on Specifying Defect Cross Section and Surface
Blue line: CAD data analysis after machining

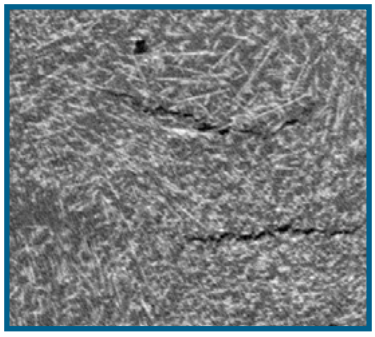
GFRP (Glass Fiber Reinforced Plastic)



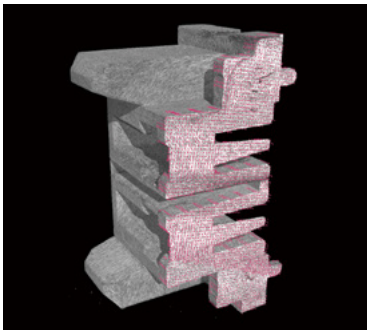
Cross-Sectional Image FOV = ø20 mm



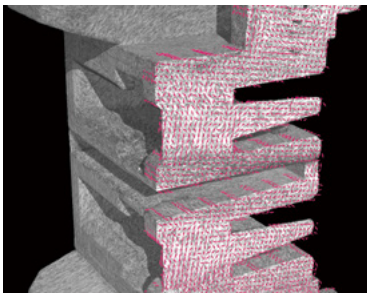
Cross-Sectional Image (enlarged view)



Cross-Sectional Image (enlarged view)

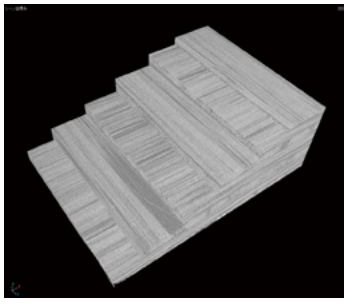


Fiber Orientation Analysis

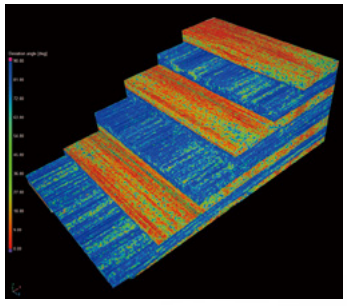


Fiber orientation analysis can display a color-coded map of filler orientation. Needles can also be displayed based on the orientation.

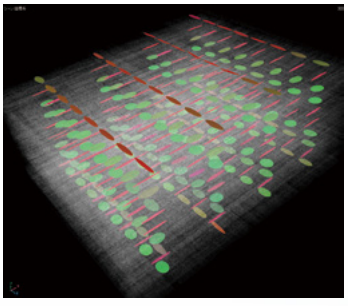
CFRTP



VR Image



Fiber Orientation Analysis

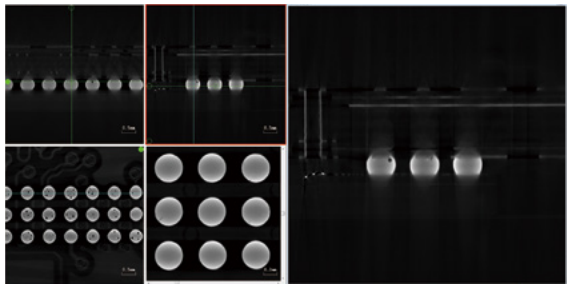


Evaluation of Orientation Tensor

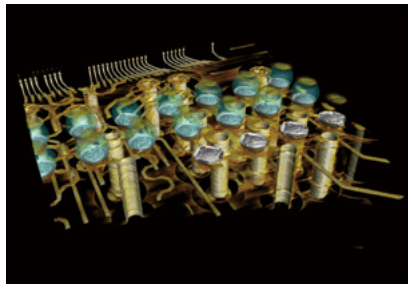
Applications

Visit our website to see enlarged application data.

BGA (Ball Grid Array)



MPR Image FOV = ø5 mm

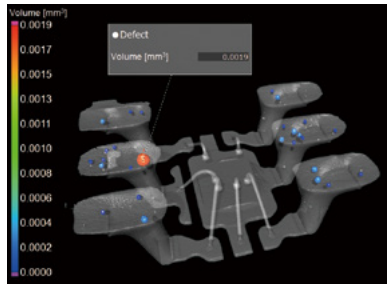


VR Image

Crystal Unit

CR Image FOV = 10 mm × 20 mm

VR Image

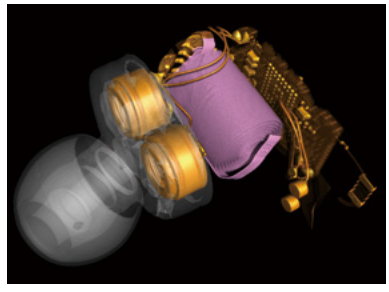


Defect Analysis

Wireless Earphones

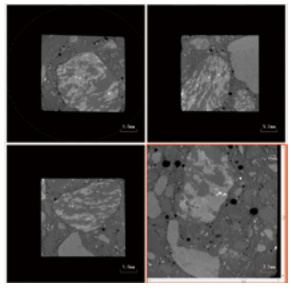
Oblique Image FOV = ø30 mm

Oblique Image FOV = ø30 mm

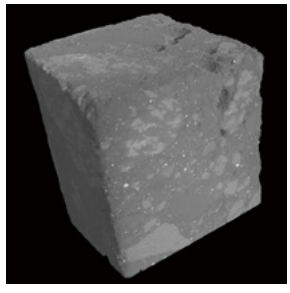


VR Image

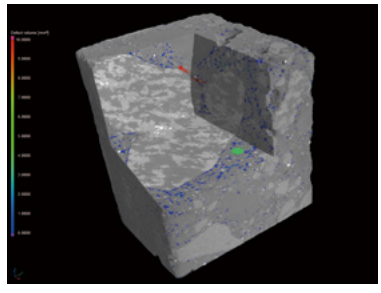
Concrete



MPR Image FOV = ø42 mm



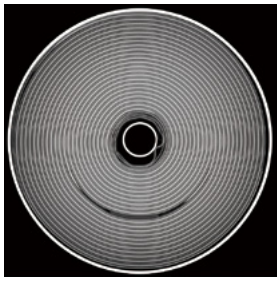
VR Image



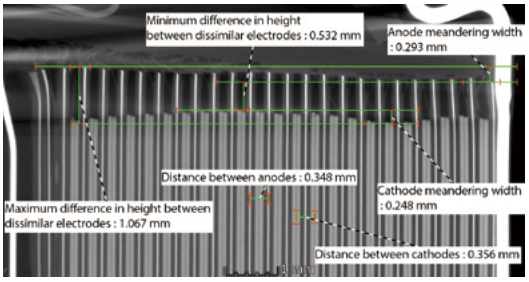
Void Analysis

Provided by Emeritus Professor Moriyoshi at Hokkaido University

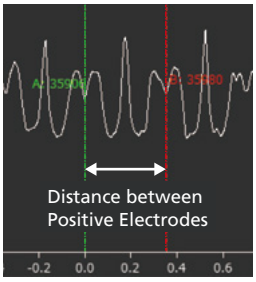
Lithium-Ion Rechargeable Battery



Cross-Sectional Image FOV = ø18.4 mm

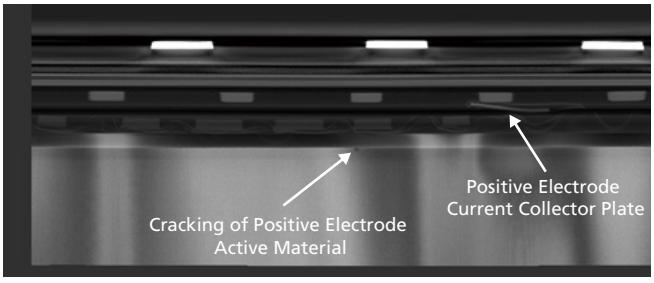


Cross-Sectional Image FOV = ø15 mm
Distance Measurement between Electrodes



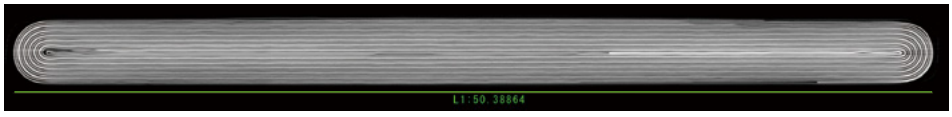
Line Profile of Grayscale Value

VR Image (Unrolled the Purple Cylinder)

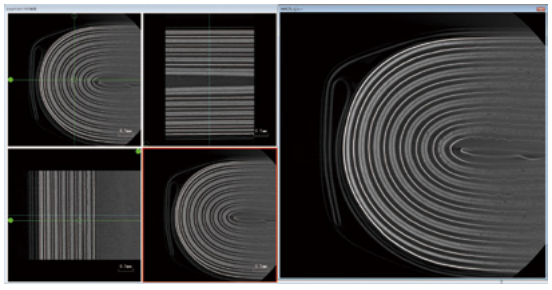


Unrolled Cylinder Cross-Sectional Image of Cathode Active Materials

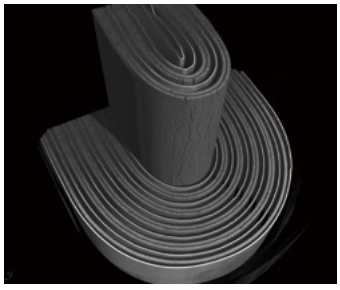
Rectangular Lithium Polymer Battery (for Smartphones)



Cross-Sectional Image

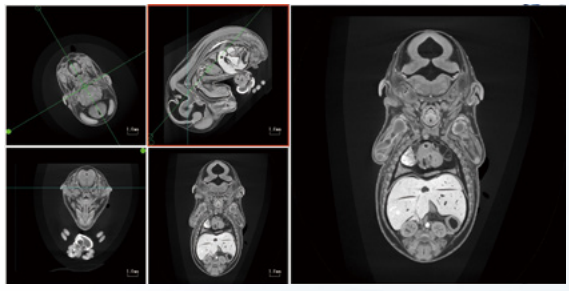


MPR Image FOV = ø4.4 mm

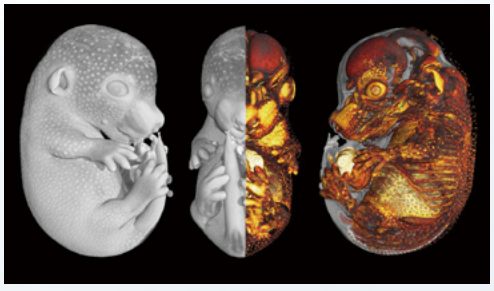


VR Image

Mouse fetus



MPR Image FOV = ø13.7 mm



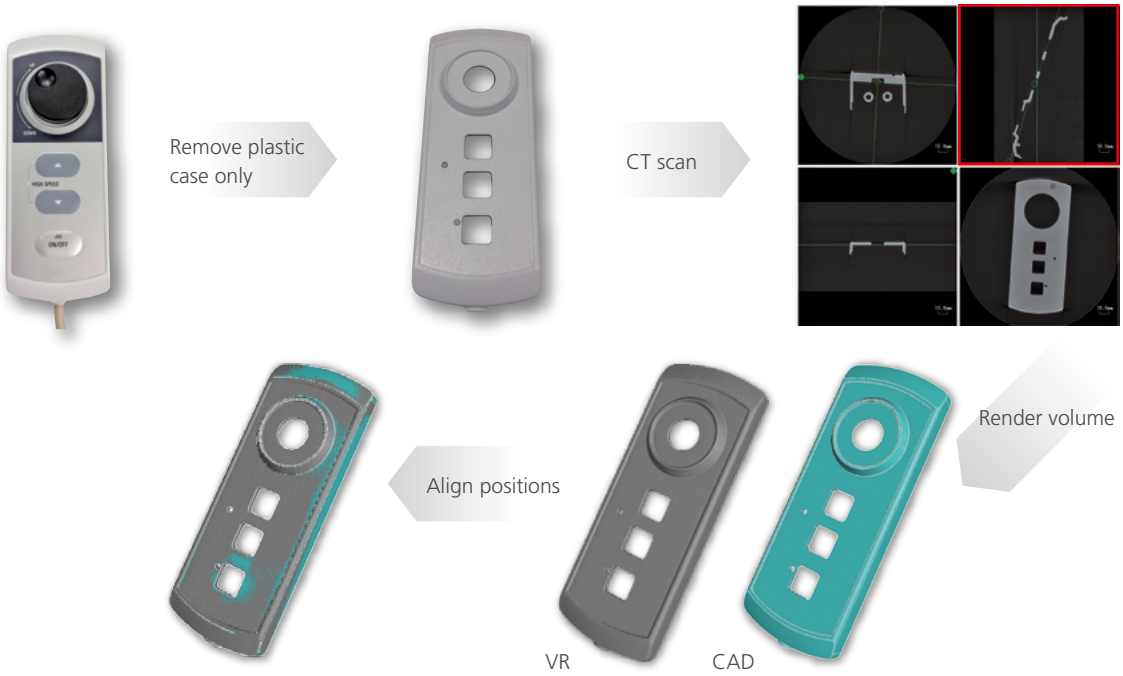
VR Image

Product Verification Example

Visit our website to see application data.

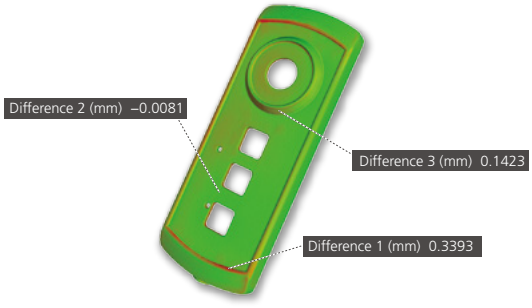
Analysis Using PointMaster Reverse Engineering Software

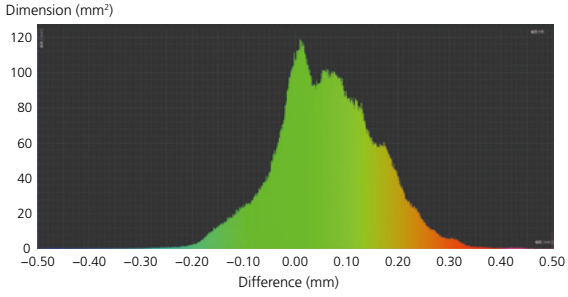
The software can align CT data with 3D-CAD data, calculate the distance between the boundary surface defined in the CT data and the corresponding 3D-CAD data, and display a color-coded map based on such differences.



Shape Comparison

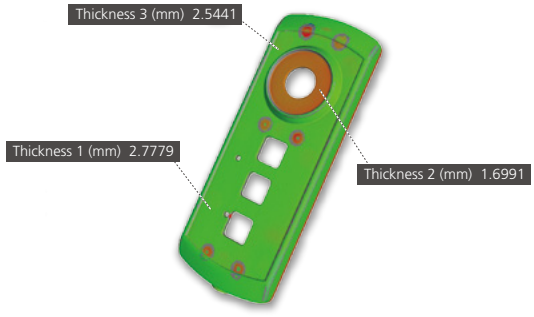
Results from shape comparison analysis

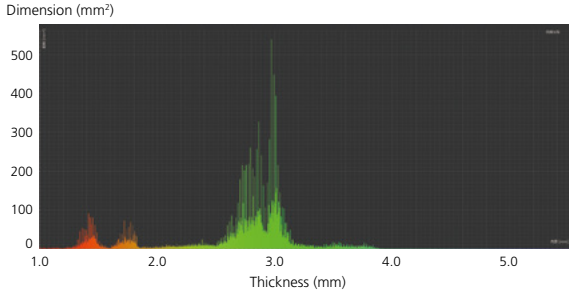




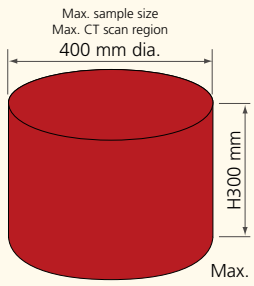
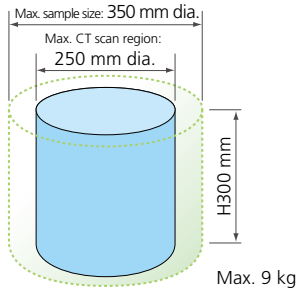
Wall Thickness Measurement

Results from thickness analysis





Specifications

inspeXio SMX-225CT Series			
Model		**inspeXio SMX-225CT FPD HR**	**inspeXio SMX-225CT FPD**
P/N		362-91000-58	362-84850
X-Ray Generator	Rated Power	135 W	
	Max. Tube Voltage	225 kV	
	Max. Tube Current	1000 µA	
X-Ray Detector		Flat panel detector	
X-Ray Detector Size		16 inch	8 inch
X-Ray Detector Shades of Gray		16-bit = 65,536 shades of gray	14-bit = 16,384 shades of gray
Max. Input Resolution (for Offset Scan)		Approx. 14,000,000 pixels	Approx. 1,800,000 pixels
Max. Sample Size and Weight, and Max. CT-Scan Region			
Max. CT Image Size	Two-Dimensional CT	4,096 × 4,096	
	Cone-Beam CT	4,096 × 4,096	2,048 × 2,048
High-Performance Computing System	Version	HPCinspeXio ver. 3.0	
	For 1,024 × 1,024 pixel CT images	10 sec or less after completing data acquisition	5 to 10 sec after completing data acquisition
	Positioning via an Exterior Camera	Yes	
Scan Support Functions	3D CT Scan Region Display Function	Yes	
	Recommend Scanning	Yes	
	SRD Axis*1	890 mm	690 mm
CT Stage Max. Stroke	SDD Axis*2	Switchable between 2 levels (800, 1200)	Switchable between 4 levels (400, 600, 800, 1000)
	CT-Z Axis	300 mm	
Scan Modes		Normal scan, half scan, offset scan, FS scan*3, 2DCT*4, CBCT*5	
CT Data Acquisition Time		Any value from 10 sec to 60 min	Any value from 10 sec to 30 min
Shield Box Size and Mass		W2,170 × D1,350 × H1,857 mm, approx. 3,100 kg	
Specialized Desk Size and Mass		W1,400 × D800 × H700 mm, approx. 60 kg	
Power Requirements	Main Unit	AC 200/220/230/240 V (tap switching) ±10 %, 50/60 Hz, 2 kVA	AC 200 V AC ±10 %, 50/60 Hz, 3 kVA
	Control Computer (Note 1)(Note 2)	AC100 V – AC 240 V ±10 %, 50/60 Hz, 1.5 kVA	100 V AC ±10 %, 50/60 Hz, 1 kVA
	Ground	Type-D ground (100 ohm max. ground resistance)	
CE Compatible		Yes	No
External Leakage Dose		1 µSv/h or less	

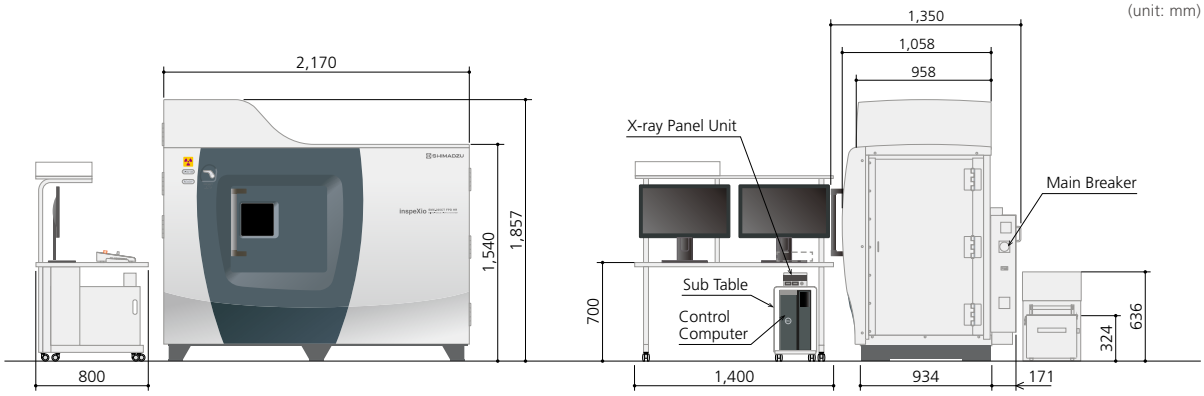
• Model "inspeXio SMX-225CT FPD HR" of this equipment includes "Plus" as a sub name for models equipped with CT control software inspeXio64 ver. 3.0.

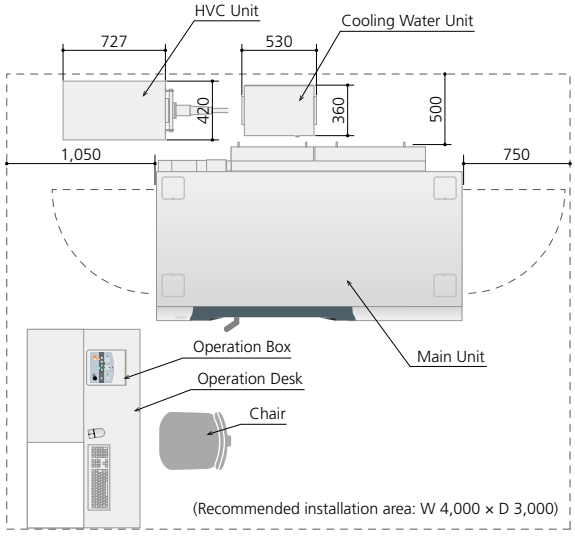
*1 SRD axis: The source-to-rotation center distance (SRD) is the distance from the X-ray source to the rotation center of the sample.
*2 SDD axis: The source-to-detector distance (SDD) is the distance from the X-ray source to the X-ray detector.
*3 FS scan: The fan-shaped (FS) scan obtains CT images by scanning the sample at 60, 90, and 120 degree rotation angles.
*4 2DCT: Two-dimensional computed tomography (2DCT) obtains one or three CT images from each CT scan.
*5 CBCT: Cone beam computed tomography (CBCT) obtains several hundred CT images from each CT scan.

Note 1: For Japanese specifications, table tap and PC inlet cables (3 pcs) are included.
Note 2: Except for Japanese specifications, table tap and PC inlet cables (3 pcs) are not included. Please prepare products in compliance with each country's standards.

Layout and Dimensional Drawings

(unit: mm)





ANALYTICAL INTELLIGENCE

- Automated support functions utilizing digital technology, such as M2M, IoT, and Artificial Intelligence (AI), that enable higher productivity and maximum reliability.
- Allows a system to monitor and diagnose itself, handle any issues during data acquisition without user input, and automatically behave as if it were operated by an expert.
- Supports the acquisition of high quality, reproducible data regardless of an operator's skill level for both routine and demanding applications.

SHIMADZU

Shimadzu Corporation

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