3D Image Visualization System Volume Extractor

Version 3.0

i-Plants Systems Limited Company

Forewords

In recent years, with rapid improvement in high speed computer performance, 3D image that once could only be processed at work station has become accessible now. 3D image has greatly extended its use from industry field to entertainment domain. Its application in simulation games and CAD is also being developed. In addition, 3D image reconstruction with CT has been applied to mummy ruins of archeological discoveries and simulation of generated cross-section for non-destructive inner examination. It can be said that 3D image has been very active in every aspect of our daily life.

In medical field, 3D image in CT/MRI has been widely acknowledged and used. Image diagnosis has been used for operation plan and informed consent. Even intermediate hospitals have been equipped with CT/MRI and small dental departments have started using CT. In addition, OCT has also been introduced into medical field. All of the above mentioned needs to output a large amount of tomographic image data. In order to make full use of tomographic image data and make them much more visual, it is necessary to transfer 2D image group set into 3D image, so high-end workstation and professional software are indispensable.

Volume Extractor is designed for processing medical images. As long as Windows systems are available, 3D reconstruction can be simply performed by inputting DICOM image. Besides this, any specified part or crossed section can be viewed from a variety of angles and used to generate real model with the help of PR apparatus for data output. The beginning user of Volume Extractor is able to skillfully process 3D images and perform various functions at simple operation guide.

Feel free to use simple and handy 3D image tool of Volume Extractor.

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5.7.1 Function Outline	
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Chapter 1 Preparations Before Use

1.1 Install

Installation Software Program of Volume Extractor 3.0 will install utility software and start controller on your computer.

1.1.1 Starting Installation Program

Installation by downloading: open the downloading file and double click setup.exe starting installation program.

Installation from CD: insert CD and the installation software of Volume Extractor 3.0 will automatically get started.

*If CD automatic playing does not work, open the disk driver, double click setup.exe and start installation program. (As shown in figure 1.1.1)



Figure 1.1.1 Starting Install Program

1.1.2 Essential Components To Be Installed

After the installation program in 1.1.1 gets started, a dialogue box will appear, telling you that ".NET Framework 4.0" is being installed. The one controller must be installed when Volume Extractor 3.0 is in operation. Click the dialogue box saying "Install" button. (As shown in Figure 1.1.2)

*The Controller Installation dialogue box will not appear once it has been installed.



Figure 1.1.2 Installation of Essential Parts

1.1.3 Application Installation

Related parts can be installed after the essential parts are finished with installation. (As shown in Figure 1.1.3)



Figure 1.1.3 Installation Screen (1)

Click "I accept the terms in the license agreement", and then click "Next" button. (As shown in Figure 1.1.4)



Figure 1.1.4 Installation Screen (2)

Click "Next" button. (As shown in Figure 1.1.5)



Figure 1.1.5 Installation Screen (3)

Click "Next" button and perform the installation (As shown in Figure 1.1.6)



Figure 1.1.6 Installation Screen (4), (5)

After installation is finished, it will make shortcut on Start Menu and the desktop. (Figure 1.1.7)

🐻 Volume Extractor 3.0 - InstallShield Wizard 🛛 🔀		
InstallShield Wizard Completed InstallShield Wizard Completed The InstallShield Wizard has successfully installed Volume Extractor 3.0. Click Finish to exit the wizard.		
< Back Einish	Cancel	
Microsoft SQL Server 2005		
Roxio Creator Premier Docum SafeNet Santeroft	ients	
SharePoint Picture SolidWorks 2012 Music	25	
SolidWorks Installation Manager SRWare Iron Games	;	
Volume Extractor 3.0	iter	
VTK 5.10.0 Control Windows Live	ol Panel	
WinRAR Device	s and Printers	
WinShot Defaul	t Programs	
・ ウイルスセキュリティ ・ Help a	nd Support	
Back Run		
Search programs and files Shut d	lown 🕨	

Figure 1.1.7 Installation Screen (7), (8), (9)

1.2 Uninstall

Uninstall is done from "Add and Remove Program" on Control Panel.

(As shown in Figure 1.2.1 and 1.1.2)

**when uninstalling Volume Extractor 3.0, choose "Remove" to delete the application program of "Volume Extractor 3.0", but ".NET Framework 4.0" and "VC++"cannot be uninstalled.



Figure 1.2.1 Display Control Panel

Programs and Features			×
G 🕞 🗢 🖾 🔹 All Control Panel It	tems	Search Programs and Features	<u> </u>
Control Panel Home	Uninstall or change a program		
View installed updates To uninstall a program, select it from the list and then dick Uninstall, Change, or Rep			
	Organize 🔻 Uninstall Change Repair	1= - 💽)
	Name 🔺	▼ Size ▼	
	ThinkPad USB Keyboard with TrackPoint	2.92 MB	Γ
	Visual Studio .NET Prerequisites - English	2.27 MB	
	Visual Studio 2005 Tools for Office Second Editio.		
	Wolume Extractor 3.0	6.04 MB	
	74 VTK 5.10.0		
	Nindows Live Essentials 2011		
	🔁 Windows Live Sync	2.76 MB	
	Windows Mobile 5.0 SDK R2 for Pocket PC	145 MB	
	Windows Mobile 5.0 SDK R2 for Smartphone	86.5 MB	
	WinMerge 2.12.4.22 x64	12.8 MB	•
	i-Plants Product version: 1.100.45 Help link: http://ww	ww.i-plants.jp/hp	

Figure 1.2.2 Add / Remove Program Screen

In the "Add / Remove Program", when you select "Remove Volume Extractor 3.0", the confirmation dialogue box will appear. Then Click "Yes" when you uninstall. (As shown in Figure 1.2.3)

*1.2 Warnings on Uninstallation

All the documents in Cache and Edit cache file saved inside the application program will be deleted when uninstall is performed. Cache and Edit cache are the files used in program running. so the data stored in them will not be saved.



Figure 1.2.3 Uninstall Confirmation Dialogue Box

1.3 System Requirements

Catagowy	Essential	Recommended
Category	Environment	Environment
OS	Microsoft® Windows® XP	Professional ^{*1.3}
	Microsoft® Windows® Vist	ta ^{*1.3}
	Microsoft® Windows® 7 ^{*1.}	3
	Microsoft® Windows® 8.x	*1.3
CPU	Over Intel® Pentium® 4	Over Intel [®] Core [™] 2 Duo
	2.8GHz	E6400
		(Dual core processors are recommended)
Memory	Over 512MB	Over 2GB
ivienior y		
Graphic Card	Over NVIDIA	Over NVIDIA
	GeForce® 5900 /	Quadro® FX 1300
	ATI [™] RADEON [™] 9800	Over VRAM 256MB
	Over VRAM 64MB	
Display	XGA(1024×768)	Over SXGA(1280×1024)
	32bit color	32bit color

(*1.3)32bits, 64 bits, System version (32bits latest Version is 3.3.0.0)

1.4 Information Consultation and Support

Telephone: +81-19-694-3103 (Direct Call) Mailbox: <u>ve_support@i-plants.jp</u> Web: <u>http://www.i-plants.jp/hp</u>

Chapter 2 About VE

2.1 Functions that can be performed by VE

VE focuses primarily on processing medical image data, and offers the following set of functions.

- Inputting DICOM images, such as medical images,
- Displaying multiple 3D images and constructing 3D images
- Extracting portions of 3D images (segmentation)
- Measuring 3D images
- Reconstructing and manipulating 3D images
- Outputting 3D image data and 3D shape data

In addition, these functions have been designed according to VR's human interface design, thus making conversational operation possible.

2.1.1 Inputting medical images

MRI and CT medical images can be input as the general DICOM image format. *2.1.1 Besides it, the original image in RAW formats can also be input.

*2.1.1 DICOM Image Format

DICOM is an abbreviation of "Digital Imaging and COmmunications in Medicine" and is becoming a main standard for medical image format. Different from image formats used by computers, DICOM can display data of different shades of color on monitors. For more details about file input, refer to [4.1 Data Input and Output].

For more details about File Input/Output, refer to [4.1 Data Input and Output].

2.1.2 Constructing 3D images

Constructing 3D image from multiple 2D images. (Figure 2.1.1) (The 3D images are referred to as "volumetric images" or "3D volumetric images") VE can perform high-speed display of 3D images by utilizing Graphic Processing Units (GPUs) for the volume rendering.



Multiple 2D cross-sectional MRI images

3D image

```
Figure 2.1.1 Construction of 3D images and shapes
```

For more details about 3D image construction, refer to [4.9 Volume Rendering].

2.1.3 Extracting regions (segmentation)

VE supports the following methods for the extraction of regions (segmentation): "Interactive segmentation", "Region Growing", and "Histogram base".

Reconstructing 3D model from extracted images has greatly increased the possibility of flexible date processing.

VE supports the following methods for the extraction of regions (segmentation): "Interactive segmentation", "Region Growing", and "Histogram base".

Reconstructing 3D model from extracted images has greatly increased the possibility of flexible date processing.



Figure 2.1.2 Segmentation with VE

2.1.4 Measuring 3D images

VE supports measurements of lengths, angles, areas, and volumes in 3D images through interactive dialogue box. (Fig 2.1.3)



Figure 2.1.3 Measurements performed on a 3D image

2.1.5 3D Shape Model Reconstruction and Manipulation

3D shapes can be reconstructed on the basis of 3D image data. (Fig 2.1.4) In addition, the generated 3D shape can also be edited by " Gap Repairing"," Pasting", "Surface Repairing" and etc. (Fig 2.1.5)



Figure 2.1.4 3D Shape Model Reconstruction



Figure 2.1.5 3D Shape Model Editing

2.1.6 Inputting 3D Image Data and Shape Data

It is possible to output 3D images and 3D shape models prepared with VE into files. Furthermore, output to the DICOM image format, as well as the STL, DXF, VRML and other shape model formats is also supported.



Figure 2.1.6 VE's Main functions and Composition

2.2 VE Application Examples

3D Shape Models generated by VE can be effectively applied to a variety of medical situations, for example, reconstructing shape models of internal organs, blood vessels and the like, technical support before operation, operation simulation, medical education, medical treatment, situation analysis and simulation and so on. In addition, VE also makes it possible to make solid models by means of optical modeling apparatus and 3D printers. (As shown in Figure 2.2.1, Figure 2.2.2, Figure 2.2.3)



Figure 2.2.1 Prototype Design by Optical Modeling Apparatus %Cooperated with Iwate Industrial Research Institute



Figure 2.2.2 A sample of the brain mode created with a 3D printer



Figure 2.2.3 Prototype Design by 3D Printer (Knee Model and Pottery Model)

Chapter 3 VE Screen Layout

3.1 Screen Layout

The screen layout of Volume Extractor is outlined as follows.

3.1.1 Starting Screen Layout

🕷 Volume Extractor x64 Edition	_
<u>F</u> ile <u>E</u> dit <u>T</u> ools <u>W</u> indow <u>H</u> elp	
🛎 🖬 👰 🔍 🔍 🔍 🖳 🖳 🖉 🖓 🔚 🛝 📼 🔯	3
	Slice View
	· · · · · · · · · · · · · · · · · · ·
	· · · · · · · · · · · · · · · · · · ·

Figure 3.1.1 Starting Screen Layout

No.	Items	Reference Sections
1	Main Menu	3.2 Menu Structure
2	Tool Bar	3.1.2 Toolbar
3	Slice View	4.18 SliceView

3.1.2 Toolbar



Figure3.1.2 Toolbar

Icon	Functions	Reference Sections
۲ ۲	Volume Data Reading	4.1 Data Input and Output
	Volume Data Saving	4.1 Data Input and Output
P	Clipping	4.2 Clipping
Ś	Region Growing	4.3 Area Expansion
	3D Voxel Paint	4.5 3D Rectangle Painting
٩	Iso-Surface Generation	4.12 Iso-Surface
	Volume Rendering	4.10 Volume Rendering
R.	Point-Based Volume	4.11 Point-Based Volume Rendering
	Rendering	

Icon	Functions	Reference Sections	
	Index Image	4.13 Index Image	
F	3D Cross-Section	4.14 3D Cross-Section	
\Leftrightarrow	Camera	4.15 Camera	
8	Preference	6.1 Application Preferences	
J.	Histogram	4.17 Histogram	
11111	Measuring	4.21 Measuring Function	
0	Screen Capture	4.23 Screen Capture	

3.2 Menu Structure

The menu structure of Volume Extractor is outlined as follows.

3.2.1 File

It includes data input, data output and exit.

File				
1	Open			
	Import	•	Images 🕨	Files
	Save		Polygon	Directory
	Export	•		3D Images
2	Exit			

Figure 3.2.1 File Menu (1)

File				
	Open			
	Import	•		
3	Save			_
	Export	•	Images 🕨	Files
	Exit		Polygon	3D Images

Figure 3.2.2 File Menu (2)

No.	Items	Reference Sections
1	Data Input	4.1 Data Input and Output
2	Exit	
	(Terminate VE application)	
3	Data Output	4.1 Data Input and Output

3.2.2 Edit

It includes a menu for volume data editing.

Edit

1	Clipping		
2	Region Growing		
3	Image Filter		
④	Voxel Paint		
5	Iso-Volume		
6	Volume Carving		
$\overline{\mathcal{O}}$	Volume Segment		
	Reverse	۲	8 Reverse X
			9 Reverse Y
Figu	re 3.2.3 Edit Menu		1 Reverse Z

No.	Items	Reference Sections
1	Clipping	4.2 Clipping
2	Region Growing	4.3 Area Expansion
3	Image Filter	4.4 3D Image Filter
4	Voxel Paint	4.5 3D Rectangle Painting
5	Iso-Volume	4.6 3D Image Linear Interpolation
6	Volume Carving	4.7 Dimensional Primitive (sphere,
		cylinder and rectangle) Carving
$\overline{\mathcal{O}}$	Volume Segment	4.8 Any shape (two-dimensional)
		Delete
8	Reverse X	4.9 Slice Direction Reversion
9	Reverse Y	4.9 Slice Direction Reversion
10	Reverse Z	4.9 Slice Direction Reversion

3.2.3 Tools

The following items are included in the tool menu: Volume Rendering, Iso-surface Generation, Mesh Editing, Camera Setting, File Information Skimming, Preference and so on.

Tools			
1 V	olume Rendering		
2 Is	o-Surface		
3 Pc	oint-Based Volume Rendering		
(4) In	dex Image		
5 C	ross Sections		
6 C	amera		
D	ICOM Manager 🛛 🕨	Ø	Rebuild
⑧ Fi	ile Information		
(9) Pr	reference		

Fig 3.2.4 Tool Menu

No.	Items	Reference Sections
1	Volume Rendering	4.10 Volume Rendering
2	Iso-Surface	4.12 Iso-Surface
3	Point-Based	4.11 Point-Based Volume Rendering
	Volume Rendering	
4	Index Image	4.13 Index Image
5	Cross Sections	4.14 3D Cross Section
6	Camera	4.15 Camera
(7)	Rebuild	
_	(Reconstructing DICOM Data	
	Base)	
8	File Information	4.16 File Information
9	Preference	6.1 Application Preferences

3.2.4 Mesh Editing

Meshing data can be displayed in active WorkForm. Refer to [Meshing Editing] in Chapter 5.

Mesh Editing		
Reconstruction/Reduction		
Smoothing		
Filling-Vertex		
Filling-Edge		
Filling-Ring		
Filling-Ring-OuterSelect		
Reverse-Manual		
Delete-Manual		
Auto-Modification		
Filling-Auto		
Reverse-Auto		
Delete-Auto		
Reverse-All		
Propriety Check		
Polygon Information		
Undo Edited		

Figure 3.2.5 Mesh Editing Menu

3.2.5 Window

It has two switchable windows: Special Menu Displaying Window and The Currently Active Window.



Figure 3.2.6 Window Menu

No.	Items	Reference Sections
1	Histogram	4.17 Histogram
2	Slice View	4.18 Slice View
3	DICOM Manager	4.20 DICOM Manager
	(DICOM	
	Management Tool)	
4	Measure Manager	4.21 Measuring Function
5	Window W/L	4.22 Window W/L
6	Slice View Fix to	
	Upper Right	
$\overline{7}$	Active Window	
	Switching	

3.2.6 Help

VE Version and Mouse Guide Information Menu

Help

- 1 About Volume Extractor...
- ② Mouse Operation Guide

Figure 3.2.7 Help Menu

No.	Item	Description
1	About Volume	Display VE Version Information Window
	Extractor	
2	Mouse Operation	Show how to operate the mouse on the work form
	Guide	

ODisplay example of mouse operation guide



3.3 WorkForm

WorkForm displays data reading. Refer to [Mesh Editing] in Chapter 5.

3.3.1 Function Outline

WorkForm has the following main functions: Volume Data 3D Display, Volume Data Cross-Section Display, Volume Data Display.

3.3.2 Screen Description



Figure 3.3.1 WorkForm of Division Model



Figure 3.3.2 Cross Section Display of WorkForm



Figure 3.3.3 3D Display of WorkForm

No.	Items	Descriptions
1	Title Bar	Display file names
2	XY Cross Section	Display volume data of XY cross section
3	YZ Cross Section	Display volume data of YZ cross section
4	XZ Cross Section	Display volume data of XZ cross section

No.	Items	Descriptions
5	3D Display	Display 3D image
6	State Bar	Display mesh editing function, measurement model, if volume data exists or not, if polygon data exists or not
7	3D Switch Display	Display switch between 3D Display and No Displaying
8	Volume Data Switch Display	Display switch between Volume Data Display and No Displaying
9	3D Cross Section Display	Display switch between 3D Cross Section Display and No Displaying
10	WorkForm Model Switch Display	Display WorkForm Model Switch. Refer to WorkForm Model Switch Display in 3.3.3 Operation Manual
1	Clipping Plane Switch Display	Switch from clipping plane display to Non display on 3D crossed section. For detailed information, refer to Regular Clipping Display Switch in 3.3.3 Operation Guide
	Information Switch Display	Switch between Display and Non Display of position on the cross section and light value WindowW/L value (WW/WC) (The number inside the bracket of light value refers to the previous scale number in ^{*3.3.1} If WindowW/L is invalid, WW/ WC will not display. For more information, see WindowW/L in Chapter 4 [Function Descriptions]
(13)	Cross Section Display	Display Cross Section Image
14	Horizontal Scrolling	Move the cross-section image horizontally
(15)	Vertical Scrolling	Move the cross-section image vertically
(16)	Size Changing Button	Display the size of the changed cross-section image
1	Slice Position Track Bar	Change the slice position of displayed cross section
18	Move the slice position up and down	Change the slice position of cross section
(19)	Three Dimension Display	Display Volume data or triangle face
20	Guide	Positions of 3D Display A : Anterior P : Posterior H : Head F : Feet R : Right L : Left

***3.3.1 Rescaling** Display height correction value according to the information of "Rescaling Tilt" "Rescaling Slice" included in DICOM images.

3.3.3 Operation Guide

○ Polygon Display Switch

If you click the icon, switch display appears.

Icon	Functions	Descriptions
\diamond	Vertex	Switch between Vertex Display and
		No Displaying
穷	Edge	Switch between Edge Display and
-		No Displaying
s	Flat Face	Display 3D Shapes in Flat Face
\square	Smooth Face	Display polygon shapes in smooth face
÷S	Normal	Switch between Normal Display and
-		No Displaying
<u>{0</u> }	Open Edge	Switch between Open Edge Display and
		No Displaying

\bigcirc Volume Display Switch

Click the icon and switch display will appear.

With regard to color table change, refer to [Volume Rendering] and [Index Image] of [Function Descriptions] in Chapter 4.

Icon	Function	Description
Î	Volume	Switch between Volume Display and
+		No Displaying

\odot 3D Cross Section Display Switch

Click the icon and the switch gets started.

With regard to changing the position of cross section, refer to [3D Cross Section] in [Function Descriptions] of Chapter 4.

Icon	Function	Description
$\langle \rangle$	Cross Sections	Switch between Display Cross Section and
~		No Displaying

○ WorkForm Display Switch

Click the icon and the switch gets started.

Icon	Functions	Descriptions
	Division	Display quartering WorkForm
\bigcirc	3D	Display 3D Image only
\bigcirc	XY	Display XY Cross Section only
\bigcirc	YZ	Display YZ Cross Section only
\bigcirc	XZ	Display XZ Cross Section only

○ Clipping Plane Display Switch

Click the icon and the switch gets started.

Icon	Function	Description
(Í	Clipping Plane	Switch between Clipping Plane Display and
Carton.		No Displaying

○ Information Display Switch

Click the icon and the switch gets started.

Icon	Function	Description
ĉ	WorkForm Info	Switch between Pos, Lv, WW/WC Display and No Displaying

○ Cross section display operation

-Display the position change of cross section.

The position change can be done in horizontal and vertical scrolling. The cross section can also be dragged and shifted.

- The size of cross section can be changed. The change is done by using the Size Change Button.

-Change the position change of displayed slice

The change is done by moving the slice position upwards and downwards.

-Change Window W/L

This is done by dragging the image in upper right direction. For more details, refer to [WindowW/L] in [Function Descriptions] of Chapter 4.

○ Basic Operations of 3D Display

-Rotate the volume and polygon. This is done by dragging 3D image.

-Zoom in and Zoom out

This is done by dragging the image to the right. The section is zoomed in if the mouse cursor is moved upwards while the section is zoom out if the mouse cursor is moved downwards

-Move the camera leftwards and rightwards or upwards and downwards. This is done by pushing the button "Z" and dragging the image at the same time.

○ Clipping Plane Operation

- Rotate the clipping plane

Press down Ctrl key and drag the 3D image at the same time, making it rotate around the original point.

-Move the clipping plane

Press down Ctrl key and at the same time drag the image to the right towards the direction of a normal.

3.3.4 Preference

Refer to WorkForm Initialization in section [Various Setting] of Chapter 6.

Chapter 4 Function Descriptions

4.1 Data Input and Output

Input

From the menu list, select one of them:

[Open],[Impore]->[Image]->[Files],[Import]->[Images][Directory],[Impore]->[Images]->[D

irectory],[Import]->[Images]->[3D Images],[Import]->[Polygon] or click Toolbar

Output

From the menu list, select one of them: [Save],[Export]->[Images]->[Files],[Export]->[Images]->[3D

Images],[Export]->[Polygon] or click Toolbar

4.1.1 Function Outline

oInput

Read image data

In the [Open], read the file content in VDF and VOL format.

In the [Files], [Directory], read the file content in DICOM, RAW, BMP, JPEG and TIFF format.

In the [3D Images], read the file content in Analiyze7.5 File, Visualization Toolkit File, CarlZeiss File, 3DView File and other 3D Image File format. In the [Polygon], read the file content in STL and PLY format.

Please refer to the URL below for PLY format. http://www.cc.gatech.edu/projects/large_models/ply.html

oOutput

In the [Save], save the file in VDF and VIF1/VOL and VOL compress format. VOL compress saves VOL with run length compression and can read like VIF / VOL file input. In particular, it can be expected that the capacity will be drastically reduced for binary images with small thresholds.

In the [Images]-[Files], file saving is done in DICOM and RAW format.

In [Images]-[3D Images], file saving is done in Analyze7.5 and FLD and 3DView format.

In [Polygon], file saving is done in STL, MGF, DXF, VRML and SMF format.

Notes: files saved in DICOM format cannot found in DICOM Management.
4.1.2 Screen Specification

• Input

The following options are provided [Open], [Files], [3D Images], [Polygon].

🐠 Open				×
🔘 🚺 C:¥T	TESTVDF		Search TESTVDF	2
Organize 🔻 New f	folder		88 ▼	
🔶 Favorites	testvdf.vdf			
詞 Libraries				
🖳 Computer				
辑 Network		1		
	File <u>n</u> ame:		VDF File/VOL File (*.vdf;*.v	vol;*.v ▼
			3 <u>O</u> pen 4 Ca	ncel

Figure 4.1.1 File Selection Options

No.	Items	Descriptions
1	File List	Showing a list of all files
2	File Type	Making selection by its extension name
3	Open	Choose to open the file
4	Cancel	Choose to close the file reading

In [3D Images], it is possible to read a three-dimensional image of any format If you select [All Files] on the type of file. You are prompted to enter in the form of a three-dimensional image dialog box is displayed when you select a three-dimensional image file.

Volume Data Import	×
Skip Header Bytes: 0 1 Data Size (pixel) 2 Width: 1 x Height:	1 × Depth: 1
Pitch (mm) 3 X: 1 Y: 1 Z: 1	Data Type • unsigned char(1btyte) • unsigned short(2byte) • short(2byte) • int(4byte)
	б_ок

Figure 4.1.2 Three-dimensional image format input form

No.	Items	Descriptions
1	Skip Header Bytes	Specify the number of bytes to skip if there is wasted space at the top of the image file
2	Data Size	Specify the number of voxels X, Y, and Z directions
3	Pitch	Specify the pitch X, Y, and Z directions. Value of Default Pitch preferences form is the initial value
4	Data Type	Specify the number of bytes in a single voxel, unsigned or signed data
5	ОК	Read a three-dimensional image file based on the information you entered

Form in [Directory]

Browse For Folder		×	1
ktop 📃 Desktop		_	
🕀 浸 Libraries			
🛨 🥕 Santa	(1)		
🕀 🌉 Computer	C		
🕀 🗣 Network			
🕀 📴 Control Panel			
🧾 Recycle Bin			
E 📄 DICOM		•	
	C OK		/

Figure 4.1.3 File Selection Format

No.	Items	Descriptions
1	File List	Showing a list of all files
2	ОК	Open the chosen files
3	Cancel	Close the chosen files

In [Directory], the file list will be displayed if the files are saved in the above formats.

Sele	ect Files	×
	File Name (1)	
	IM1	
	IM10	
	IM100	
	IM101	
	IM102	
	IM103	
	IM104	
	IM105	
	IM106	
	IM107	
	IM108	
	IM109	
	IM11	
	IM110	
⊡	IM111	
⊡	IM112	
델	IM113	_
	IM114	_
Fo	rmat Type: DICOM Format 2 💿 3 Open 4 Cancel	

Figure 4.1.4 File Selection Form

No.	Items	Descriptions
1.	File List	Showing a list of all files
2.	Format Type	Choice open files format
3.	Open	Open the chosen files
4.	Cancel	Close the chosen files

Once the file is saved in DICOM format, the format will be displayed for DICOM information input.

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Raw file input when a form to enter the image information is displayed.

Raw Data Import 🛛 🗙			
Data Size (pixel)			
Width 1 📩 x Height 1			
Pitch (mm) 2			
× 1			
Y: 1			
Z: 1			
Data Type 3			
 unsigned char(1btyte) 			
C unsigned short(2byte)			
C short(2byte)			
C int(4byte)			
OK Cancel			

Figure 4.1.5 Raw Data Selection

No.	Items	Descriptions		
1	Data size	Designate the length and width of the image		
2	Pitch	Designate the length and width and height		
		pixels		
		Value of Default Pitch preferences form is the		
		initial value		
3	Data Type	Designate the data type		
4	ОК	Read file by input data		
(5)	Cancel	Stop file reading and close the window		

When the STL file is in input, the file will project a window screen. And then input image information.



Figure 4.1.6 Scale Information Input Form

No.	Items	Descriptions		
1	Polygon scale	Designate the scale information of the image in		
		length, width and height		
		Value of Default Polygon Scale preferences		
		form is the initial value		
2	ОК	Read file by input data		
3	Cancel	Stop file reading and close the window		

• Output

File output form

🖗 Save As				×
C:¥TESTVDF		Search TESTVDF		<u> </u>
Organize 🔻 New folder)
쑦 Favorites	testvdf.vdf			
🥞 Libraries				
🖳 Computer				
🙀 Network				
File name: testvdf.vdf			1	-
Save as type: VDF File(*.vdf)	(2)			-
Hide Folders	Ŭ	<u>3</u> <u>Save</u>	4 Cancel	

Figure 4.1.7 File Saving Form

No.	Items	Descriptions
1	File List	Display file list
2	File Type	Minimize the file size by its suffix name and designate file saving format
3	OK	Output file in specified format
4	Cancel	Stop file reading and close the window

If preservation is performed as a DICOM file, the form for inputting DICOM information will be displayed.



Figure 4.1.8 DICOM Information Input Form

No.	Items	Descriptions		
1	Modality	Input modality information		
2	Row	Input row data		
3	Column	Input column data		
4	Slice Thickness	Input slice-thickness of DICOM		
5	Spacing Between Slice	Input spacing between slices		
6	Pixel Spacing(X)	Input pixel spacing (X)		
$\overline{\mathcal{I}}$	Pixel Spacing(Y)	Input pixel spacing(Y)		
8	Pixel Padding	Input pixel padding		
9	Samples per Pixel	Input samples per pixel		
10	Photometric Interpretation	Indicate if there is brightness rotation		
11	Data Type	Select data type		
(12)	Windows Level	Input winder level		
13	Windows Width	Input window width		
14)	Rescale Intercept	Input rescaled intercept		
(15)	Rescale Slope	Input rescaled slope		
16	Save	Save the input data		
1)	Cancel	Close the file and stop saving		

4.2 Clipping

In [Edit] menu, select [Clipping]. And then clip Toolbar .

4.2.1 Function Outline

Take away a certain part of volume data.

• Result Handled Case

Take away one part of a head and visualize it through volume rendering and the result is clearly indicated.



Figure 4.2.1 Clipping Case

4.2.2 Screen Description



Figure 4.2.2 Clipping Form

No.	Items	Descriptions
1	X axis Track Bar	Indicate the clipping range of X axis
2	The minimum value of	Indicate the minimum value of X axis clipping
	X axis Clipping	
3	The maximum value of	Indicate the maximum value of X axis clipping
	X axis Clipping	
4	Y axis Track Bar	Indicate the clipping range of Y axis
5	The minimum value of	Indicate the minimum value of Y axis clipping
	Y axis Clipping	
6	The maximum value of	Indicate the maximum value of Y axis clipping
	Y axis Clipping	
$\overline{\mathcal{O}}$	Z axis Track Bar	Indicate the clipping range of Z axis
8	The minimum value of	Indicate the minimum value of Z axis clipping
	Z axis Clipping	
9	The maximum value of	Indicate the maximum value of Z axis clipping
	Z axis Clipping	
10	Move to Center	A sign that indicates moving the object to the center after
		clipping
1	Undo	Return to one previous state
(12)	Execute	Execute voxel clipping

When displaying clipping form, use red color line to indicate the range of clipping in WorkForm.



Figure 4.2.3 Clipping Range Display

4.2.3 Operation Guide

• Decide the clipping range of X, Y, Z axis

- In one of the following ways, I can select the clip range.
- Move the knob of X, Y, and Z-axis track bar
- Enter a number in the text box
- Click up and down in the box (up and down arrow)
- Press [Execute] key

1. Do clipping

2. When checking [Move to Center], move the object to the center after clipping

•Return to one previous state

After executing the fill process, the [Undo] button is enabled.

If you press the [Undo] button, you can return to the previous state.

*4.2.1 About Undo Button

Clipping processing undo function becomes invalid when clipping form is closed and it cannot return to the state just before processing.

Please note that this form will be closed automatically even if you switch

WorkForm.

4.3 Area Expansion

From [Edit] menu list, select [Region Growing] or Click Tool bar.

4.3.1 Function Outline

This part is to do an area expansion. A choice can be made between 2D area expansion and 3D area expansion. The SEED point can be chosen multiple times.

4.3.2 Display Description

 \circ Description of Each Control



Figure 4.3.1 Control Description of Area Expansion File

No.	Items	Descriptions		
1	Screen	Display the image to be handled		
2	Minimizing Key	Minimize the image area selected in $\textcircled{1}$		
3	Enlarging Key	Enlarge the image area selected in $\textcircled{1}$		
4	Use Slice Number to indicate the	Slice the specified area in ①		
	sliced bar			
5	Slice Number	Indicate the number of sliced area		
6	Fit to Screen	If the check is On, to view the entire image on the		
		screen		
\overline{O}	Handling Method	Indicate how to handle the image (2D, 3D)		
8	Seed List	Display SEED List		
9	Delete	Remove the selected points in the SEED List		
10	Delete All	Remove all the stuff in SEED		
(11)	Interactive G/L Settings	Switch between auto and manual of global and local		
	(Auto and Manual Setting of	parameters		
	Global and Local Parameters)			
(12)	General Parameters of Sliding	Designate general parameters		
	Bar			

No.	Items	Descriptions
(13)	Local Parameters of Sliding Bar	Designate local parameters
14)	Restricted region	Add the function of region restriction by using 2D-Multi
(15)	Limits to Z-Axis	Designate the sliced section by using 2D-Multi
16	Sliding Bar for deciding the range of sliced section	Designate the range of sliced section by using 2D-Multi
1	The maximum range of the sliced section	Designate the maximum range of sliced section by using 2D-Multi
18	The minimum range of the sliced section	Designate the minimum range of sliced section by using 2D-Multi
(19)	Execute	Implement Area Expansion
20	Reset	Implement deletion
21)	Inside Select	Choose You may need to do "Inside" the extended area fill Not Change: not performed Select Value: Do fill
22	Inside Paint Parameter	When Inside is Select Value, to specify the value of the fill. The initial value is the maximum value of the slice
23	Outside Select	Choose You may need to do "Outside" the expansion area fill Not Change: not performed Select Value: Do fill
24	Outside Paint Parameter	When Outside is Select Value, to specify the value of the fill. The initial value is the minimum value of the slice
25	Window W/L	Toggle enable / disable of window level setting for slice image
26	ОК	Accept the data and close the form
27)	Cancel	Cancel the result and close the form

4.3.3 Operation Guide

• Change the screen size

Use the control button described in (2) and (3) to designate the size.

If the size to be designated goes beyond what is described in (1), it should be demonstrated in the scroll bar.

• Fit to Screen

Input Check in control description (6).

• Change the sliced section

Move the sliding bar in Control Description (4). The left side is (1) and the right side is the maximum number for slicing. Or input number into Control Description (5).

Add SEED

Inside ①, click the place that SEED wants to fix. Use number ⑧ to indicate the addition of SEED. When executing area expansion, use the list in ⑧. From the unhandled place, delete check box in ⑧.

• Decide handling approach

Specification can be done in Control Description in (7), which has 2D, 2D-Multi, and 3D. In 2D-Multi, the check box in (4) and (5) of control description is valid.

• Use the specified scope (only for 2D-Multi) Input Check in control description ④ and execute region growing in the specified scope.

• Specify global and local parameter

Input Check in control description (1).

The operation described in control description ①, ① becomes possible.

Specify the number by moving the scroll bar.

If the check button does not exist in control description 1, the number can be automatically set.

• Decide Z scope (only for 2D-Multi)

Insert Check into control description (b). The operation described in control description (b), (1), (18) becomes possible. Specify the scope by moving the scroll bar. If the Check button does not exist, all the slices are to be done.

Region Growing

Click Button Description in ①.

•After determining the area, I will extract only in the extended area (Inside)

- 1. Running the region growing method in advance button 1
- 2. Select "Not Change" in Inside Combo box
- 3. Select "Select Value" in Outside Combo box (In this case, number of Outside the minimum value of the pixel has been entered)
- 4. Press button (25), "and then exit to update the data. Are you sure you want?" Because the message is displayed, and then select the "Yes". Thus, three-dimensional image data is updated, only Inside is extracted

•After determining the area, I do binarization in the extended area (Inside) and extended outside the region (Outside)

- 1. Running the region growing method in advance button 1
- 2. Select "Select Value" in Inside Combo box (In this case, number of Inside the maximum value of the pixel has been entered)
- 3. Select "Select Value" in Outside Combo box (In this case, number of Outside the minimum value of the pixel has been entered)
- 4. Press button (25), "and then exit to update the data. Are you sure you want?" Because the message is displayed, and then select the "Yes". As a result, the three-dimensional image data is updated, it is binarized

•After determining the area, I do fill only extended outside the region (Outside)

- 1. Running the region growing method in advance button 1
- 2. Select "Select Value" in Inside Combo box, more to change the right of the numeric value to the same value as the Outside of the numerical
- 3. Select "Not Change" in Outside Combo box
- 4. Press the button (2), "and then exit to update the data. Are you sure you want?" Because the message is displayed, and then select the "Yes". As a result, the three-dimensional image data is updated, only Outside is filled with black (it is the same result as the Inside only extraction)



Figure 4.3.3 Result Handled Case

4.3.4 Setting

Refer to [Area Expansion] in Chapter 6 [Application Preferences].

4.4 3D Image Filter

3D image filter cannot be used in WorkForm that does not contain volume data. Select [Image Filter] in [Edit] menu.

4.4.1 Function Outline

Volume data can perform the following functions:

- Smoothly delete simple low noise
- Make binary image
- Switch between bright and dark color
- Edge Extraction
- Dilation or Erosion image
- Distance Transformation to binary image
- Gradient Filtering
- Standard Deviation Filtering
- Handle the filter defined by the user

*Dilation/Erosion supports gray scale image and binary image. Distance Transformation supports binary image

• Handled Case Description

The picture before handling (as shown in figure 4.4.1) and the picture after the shade of color are changed. (As shown in figure 4.4.2)







Figure 4.4.2 After Reversing

4.4.2 Screen Description



Figure 4.4.3 Image Filter Form^{*4.4.1}

*4.4.1 Screen Structure of Image Filter Form

Image Filter Form is used to filter the selected screen and change the indicated controller. Example, as $(5)\sim(7)$ of Figure 4.4.3, this form is represented only when [Binaries] or [Dilation/Erosion] is selected.



Figure 4.4.4 Image Filter Form (Smoothing)



Figure 4.4.5 Image Filter Form (Edge Extraction)



Figure 4.4.6 Image Filter Form (Dilation or Erosion)



Figure 4.4.7 Image Filter Form (Gradient)



Figure 4.4.8 Image Filter Form (Standard Deviation)

No.	Items	Descriptions
1	Cross section Display	Display the crossed section
2	Image Size Adjustment	Adjust the magnification of the screen in $\textcircled{1}$
3	Sliced Position	Designate the sliced position of the cross section
	Track Bar	
4	Sliced Position	Designate the sliced position of the cross section
	Numerical Box	
(5)	Select Filter	Select screen handling filter
6	Preview Check Box	Prepare to use $\textcircled{1}$ to confirm the binarized result
$\overline{\mathcal{O}}$	Threshold's up down	Designate the binarized threshold
8	Threshold's Track Bar	Designate the binarized threshold
9	Min Value	Designate the binarized min value (black value)
	Track Bar	
(10)	Min Value	Designate the binarized min value (black value)
	Numerical Box	
1	Max Value	Designate the binarized max value (white value)
	Track Bar	
(12)	Max Value	Designate the binarized max value (white value)
	Numerical Box	

No.	Items	Descriptions
(13)	Apply Button	Use filter to handle the selected screen
(14)	Reset Button	Restore to the first preview image
(15)	Select Plane Type	Select the displayed plane from XY, YZ, XZ
16	Preview Window W/L Mode Check Box	Make valid the screen set by Window W/L in WorkForm
17	OK Button	It is used to handle the data in Window W/L
		Close Image Filter form
(18)	Cancel Button	Cancel the handled image and close Image Filter form
(19)	X button	Cancel the handled image and close Image Filter form
20	Neighbor Type	Select the vicinity type and the range of time of scanning
		the image.
		You can choose Neighbor Type [Rectangle] or [Sphere]
		radio button. You can also choose Neighbor Range
		[Voxels] (Pixel size) or [Length] (Real size).
		For more information, please refer to "4.4.3 Operation Guide"
(21)	Sobel / Laplacian	Select edge sampling filter type
(22)	Dilation / Erosion	Select dilation or erosion filter type
	Radio Button	
23	Iteration Num	Select dilation or erosion filter iteration times
24)	Gradient	Determine slope (difference in density) between pixels to
		extract only pixels to be above a specified threshold value
(25)	Standard Deviation	Standard Deviation in the vicinity specified by the
		Neighbor Type for each pixel to extract only pixels to be
		above a specified threshold value

4.4.3 Operation Guide

• Execute Simple Noise Deletion

- 1. Select [Simple Noise Deletion] filter
- 2. Click Apply Button
- Execute Smoothing
 - 1. Select [Smoothing] filter
 - 2. Click Apply button
- Execute Binarize
 - 1. Use the filter to select [Binarize]
 - 2. Use the threshold track bar and threshold up down to designate threshold
 - 3. Click Apply button

• Execute Distance Transformation^{*4.4.2}

- 1. Use [Binarize] filter and surface to be extracted
- 2. Select [Distance Transformation] filter
- 3. Click Apply button

*4.4.2 About [Distance Transformation] Image Filter

On the binary image, it is a filter that performs a three-dimensional Euclidean distance transformation. Against the background of a black image, it will represent the shortest path to reach the white at a concentration of 0-255. It will be whiter closer to 255. For example, a blood vessel (coronary artery, hepatic vein, etc.) to the CT image, which put the contrast agent to, it is can be applied,

such as finding the shortest route to the vessel arrival.



Figure 4.4.9 Example of Distance Transformation

- Carry out color shade reversing
 - 1. Use the filter to select [Reversing B/W]
 - 2. Click Apply button
- Carry out edge sampling
 - 1. Use the filter to select [Edge Extraction]
 - 2. Select Sobel or Laplacian
 - 3. Click Apply button

• Carry out dilation or erosion

- 1. Use the filter to select [Dilation/Erosion]
- 2. Select Dilation or Erosion filter type and Input the loop count.
- 3. Click Apply button

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• Change the screen size

Click minus (-) button and the image will become smaller. Click plus (+) button and the image will be enlarged.

• Change cross section

Click any of the three choices [XY] [YZ] [XZ] if the section is to be crossed. When changing the sliced position, move the sliced position track bar or move the sliced bar up and down.

• Change Neighbor Type (Only - Dilation or Erosion filter, Standard Deviation filter)

- 1. From ① Neighbor Type, Select [Rectangle] or [Sphere]
- 2. Select [Voxels] or [Length], you can specify a range in the vicinity. In the case of Voxels, it can be one from the right of the combo box of $[3 \times 3 \times 3]$ or $[5 \times 5 \times 5]$ or $[7 \times 7 \times 7]$. For Length, you can specify a [1-10]
- 3. Click Apply Button

oTerminating screen operation

- 1. Click OK button if they handled screen applies to WorkForm
- 2. Click \times button or Cancel button if they handled screen does not apply to WorkForm.

*4.4.3 About [Gradient] and [Standard Deviation] Image Filter

Both gradient and standard deviation are effective for edge detection. The gradient extracts only pixels with large variation from the difference between the pixel of interest and the adjacent pixel. The calculation formula of the threshold when the number of pixels n and the difference in each axis direction is fx, fy, fz is shown.

$$g = \sqrt{fx^2 * fy^2 * fz^2}$$

For standard deviation, we extract only pixels with large standard deviation from neighboring pixels of the target pixel. The calculation formula of the threshold when the number of pixels n and arithmetic mean μ is shown.

$$\sigma = \sqrt{\frac{1}{n} \sum_{i=1}^{n} (x_i - \mu)^2}$$

4.5 3D Rectangle Painting

In [Edit] menu, select [Voxel Paint] or click Toolbar.

4.5.1 Function outline

It will specify the area to be painted on 3D space. The painting is done according to the specified brightness by confirming the data content.



Figure 4.5.1 Function of Fully painted 3D Rectangle Cube

4.5.2 Screen Description

Control Form



Figure 4.5.2 Operating Form of 3D Rectangle Cube Painting

No.	Items	Descriptions
1	X Track Bar	It specifies the painting area in X bar direction
		(to the minimum or to the maximum)
2	The minimum	It specifies the minimum value of painted area in X bar
	value of X Bar	direction in number
3	The maximum	It specifies the maximum value of painted area in X bar
	value of X Bar	direction in number
4	Y Track Bar	It specifies the painting area in Y bar direction
		(to the minimum or to the maximum)
5	The minimum	It specifies the minimum value of painted area in Y bar
	value of Y Bar	direction in number
6	The maximum	It specifies the maximum value of painted area in Y bar
	value of Y Bar	direction in number
$\overline{\mathcal{O}}$	Z Track Bar	It specifies the painting area in Z bar direction.
		(to the minimum or to the maximum)
8	The minimum	It specifies the minimum value of painted area in Z bar
	value of Z Bar	direction in number
9	The maximum	It specifies the maximum value of painted area in Z bar
	value of Z Bar	direction in number
10	Coloring Brightness	The coloring brightness is specified in number
	Specification	
1	Coloring Brightness	It can indicate the shade difference in painting
	Shade Difference	
(12)	Coloring Brightness	Use the track bar to select the painting brightness
	Selection	
	(Track Bar)	
(13)	Preview	Switch for displaying the previewed content in the specified
	(Preview Check Box)	area

No.	Items	Descriptions
(14)	Opacity of 2D Tex	Specify the opacity of 2D Tex the needed by the designated
	(Track bar for	rectangle area
	specifying opacity of	
	2D Tex)	
(15)	View inner Volume	Switch to show if there is display of volume screen in the
	Check Box for volume	specified area or not
	view switch	
(16)	Undo	Returns the executed process to the previous state
	(Undo Button)	
1	Execute	Implement the painting task
	(Execute Button)	

4.5.3 Operation Guide

• Specifying painting areas

To specify the painting areas, select X, Y, Z track bars in (1-9), or change the number indicating slice position.

• Displaying preview screen

This can be done by check the Preview Check Box in (13) Previewing can be done in 2D Tex and 3D volume.

2D Tex can be displayed on selected rectangle shape by using opacity track bar in 4 to adjust its projecting level.^{*4.5.1}

3D volume indicates the volume within the rectangle space by clicking the checking box for volume switch 5 which indicates On or Off.^{*4.5.2}

*<u>4.5.1 2D Tex Display Specification</u> 2D Tex is not only opacity specification, but also demonstrates the specified content in Window W/L. (As shown in Figure 4.5.3)





Figure 4.5.3 2D Texture display specified according to Window W/L

*4.5.2 Preview on-display volume screen

Previewing on-display 3D volume screen is executed by means of specified rendering. (Volume Rendering, Point Base Volume Rendering and Index Image)

• Preview volume screen only

When volume screen is to be previewed only, move the track bar of 2D Tex opacity to the left, making 2D Tex become transparent and 3D volume display possible. *4.5.3 *4.5.4

*4.5.3 This function cannot be co-used with Clipping Plane.

Once 3D volume screen is previewed, the two functions cannot be co-used. Once co-used, the volume screen within rectangle cannot be displayed. (As shown in Figure 4.5.4)





Normal Clipping Figure 4.5.4 The change caused by using by Clipping Plane

***4.5.4 Image overlapping may occur at the usual rendering function.** When displaying rectangle volume, it is possible to display usual volume rendering.

If rectangle volume is displayed only, perform this by volume display switch on WorkForm.

• Perform painting

- 1. Input number in 10 of Control Form or use the brightness number in 12 track.^{*4.5.5}
- 2. Press [Execute] button in 1 and carry out painting. *4.5.6

*4.5.5 Movement of Window W/L and Specified Painting Color Brightness number indicated in ① and gradation indicated in ② can be moved together at Window W/L.(As shown in Figure 4.5.5)



Figure 4.5.5 Color Change of Painting Specification by Window W/L

***4.5.6** Use the color brightness to express volume

After painting with maximum and minimum brightness, volume screen can be previewed with a variety of brightness inside the rectangle. At this time, the preview is performed at specification of default transfer function of volume rendering. (As shown in Figure 4.5.6)



Figure 4.5.6 Painting Processed Case

 \circ Restore the part being processed to its former state.

[Undo] button becomes valid after painting is processed. Once [Undo] button is clicked, the previous state is restored. *4.5.7

*4.5.7 About canceling function
When terminating 3D rectangle painting process, close off 3D Voxel Paint
Form and, thus making painting invalid and unable to return to its former
state. Remember that this form can be automatically closed down when
switched to Word Form.

4.6 3D Image Linear Interpolation

Select [Iso-Volume] in [Edit] menu.

4.6.1 Function outline

Through this function, line insertion can be made onto 3D image. The executed image will have the same voxel size with X, Y, Z and the same the volume.

4.6.2 Screen Description

 \circ Control Form

Is	o-Volume					×
	-Current S	ize - 1				
		Grid		Pitch	I	
	Grid X	512		0.86	3281	
	Grid Y	512		0.86	3281	
	Grid Z	320		2.5		
	- Result Siz					
	Grid X	512		0.86	3281	
	Grid Y	512		0.86	3281	
	Grid Z	320		2.5		
	Interpolat	e Rate				
	X Rate	1.000	÷	3		
	Y Rate	1.000	÷	4)	C	
	Z Rate	1.000	÷	5)_E	iquant	
					a	
				Б	ecute	

Figure 4.6.2.1 Line Insertion Diagram Screen

No.	Items	Descriptions
1	Indicate the current	Display the current Voxel number of X, Y, Z direction of 3D image
	Voxel number	
2	Indicate Result	Display the Voxel number of X, Y, Z direction of 3D image after
	Voxel Number	insertion
3	X Rate	Specify the Voxel number of X direction at the rate of current
		voxel number
4	Y Rate	Specify the Voxel number of Y direction at the rate of current
		voxel number
5	Z Rate	Specify the Voxel number of Z direction at the rate of current
		voxel number
6	Equant Button	The magnification used as an equant voxel is set up automatically
$\overline{\mathcal{I}}$	Execute Button	Execute the Linear Interpolation

4.6.3 Operation Guide

• Specify Rate

Specify the number of ③, ④, ⑤, by clicking addition or subtraction button on the right. Input by means of keyboard.

*6 If it clicks a equant voxel button, the magnification at the time of forming the method voxel can be calculated automatically.

\circ Insertion

Click $\ensuremath{\overline{\mathcal{D}}}$ and insertion is performed.

4.7 Dimensional Primitive (sphere, cylinder and rectangle) Carving

From [Edit] menu, select [Volume Carving].

4.7.1 Function Outline

On 3D screen, specify the domain to be carved. Carve the specified place only. (Mode: inside). Carve the area beyond the specified domain. (Mode: outside).



Figure 4.7.1.1 Cylinder Carving (Inside)



Figure 4.7.1.2 Cylinder Carving (Outside)

4.7.2 Screen Description

\circ Control Form

Volume Carving	\mathbf{X}				
Box Width X J 512 Y J 512 Z J 248	1 2 3				
Angle 0 Y J 0 Z J 0	4 5 6				
Box Position X J Y J Z	7 8 9				
Style Rectangle C Cylinder C Sphere Segment Area Inside C Outside C Inside (Keep Size) Inside (Change Coordinate System) Pitch 04687500000					
Move to Center (13) (14) Undo Execute					

Figure 4.7.2.1 Extraction Specification Control Form

No.	Items	Descriptions
1	Carving X width	Specify the size of carving in X direction
2	Carving Y width	Specify the size of carving in Y direction
3	Carving Z width	Specify the size of carving in Z direction
4	Carving X angle	Specify X angle of carving shape
(5)	Carving Y angle	Specify Y angle of carving shape
6	Carving Z angle	Specify Z angle of carving shape
$\overline{\mathcal{I}}$	Carving X position	Specify carving position in X direction
8	Carving Y position	Specify carving position in Y direction
9	Carving Z position	Specify carving position in Z direction
10	Carving Shape Selection	Select carving shape
1	Carving Shape Selection	Select carving area: Inside the specified area or Outside the
		specified area
(12)	Move to Center	Move to Center the carving volume
(13)	Undo Button	Return to one previous state
14	Execute Button	Execute extraction

4.7.3 Operation Guide

• Decide carving area

Decide carving size according (1-3). decide carving position according to (7-9); decide carving angle according to (4-6). The rectangle on display indicates the output 3D size.

• Select carving shape

Select carving shape from cylinder, rectangle and sphere in 1. When selecting cylinder, the domain size in X, Y direction is often the same. When selecting sphere, the domain size in X,Y direction is often the same.

• Select carving domain

With the output scope, make selection between Inside (the specified scope) and Outside (the specified scope). When selecting Inside in ①, the object should be handled inside the specified scope. When selecting Outside in ①, paint the specified area with the minimum value of 3D screen.

When selecting Inside(Keep Size) in (1), it extracts within the specified range without changing the image size.

When Inside (Change Coordinate System) is selected, a volume image tilted so that only the selected area is included is generated. At this time, it isotropically voxelized (numerical values of X, Y, Z pitch are same with the same numerical value) with the numerical value input to Pitch. The initial value of Pitch is set to the smallest value among the X, Y, Z pitch width of the original image.

•Return to one previous state

After executing the fill process, ⁽¹⁾ the [Undo] button is enabled. If you press the [Undo] button, you can return to the previous state.

4.8 Any Shape Delete (3D)

From [Edit] menu, select [Volume Segment].

4.8.1 Function Outline

Shape specified on screen, and cut out part of 3D image (area delete).



Figure 4.8.1.1 Select Delete Area

4.8.2 Screen Description



Figure 4.8.1.2 Delete Result

Volume Segment			
Style Rec 2 EI 3 Po	itangle 6	Segment Area Inside O Outside Area X 1 	256
4 Fre	ehand	Area Y	
5	urve	· · · · · · · · · · · · · · · · · · ·	229
8 _0	lear	Area Z	
9	Indo		
10 Ex	ecute	i	

Figure 4.8.2 Area selection and cut-out by any shape

No.	Items	Descriptions
1	Rectangle	Specify the area to be deleted rectangle
2	Ellipse	Specify the area to be deleted ellipse
3	Polygon	Specify the area to be deleted polygon
4	Curve	Specify the area to be deleted curve. The region surrounded by the curve will be deleted
5	Freehand	Specify the area to be deleted freehand
6	Inside	Delete the inside of the specified area
$\overline{\mathcal{O}}$	Outside	Delete the outside of the specified area
8	Clear	Clear segment area
9	Undo	Return to one previous state
10	Execute	Execute segmentation
11	Segment Area	Specify the segment area in XYZ direction

4.8.3 Operation Guide

 $\,\odot\,$ Specify delete area

- 1. Choose shape of erased area from (1) (5)
- 2. Left-click anywhere on the three-dimensional view
- 3. Mouse were moved, and then left-click the next point
- 4. Delete area and then right-click if you turned to the shape you want. It confirms the deleted area in this work

 \times In the case of rectangle(1) and ellipse(2), area designation will be completed in two clicks \times In the case of polygons(3), curves(4) and freehand(5), drawing will continue until you right-click

% In the case of a free hand, drag in will create a straight line from the point of any line, in the mouse movement you release the left button at the end

- 5. Repeat 1-4, you can specify more than one area (Figure 4.8.3.1)
- 6. If you want to clear the inside of the area (6), if you want to erase the external area, select (7). (Figure 4.8.3.2)
- \bigcirc Edit delete area
 - 1. Align the mouse button on the handle(\square)
 - When the color of the handle is changed, and then drag (Figure 4.8.3.3)
 ^{*} freehand areas are cannot be edited



Figure 4.8.3.1 Specify delete areas



Figure 4.8.3.3 Edit Delete area



Figure 4.8.3.2 Reverse delete areas



4.9 Slice Direction Reversion

Form [Edit] menu, select [Reverse X] [Reverse Y], and [Reverse Z]. After selection, make execution right away. It will return to its original state if the reverse is done twice.

Form [Edit] menu, select [Reverse X] [Reverse Y], and [Reverse Z]. After selection, make execution right away. It will return to its original state if the reverse is done twice.

4.9.1 Function Outline

The following case is Head/Feet reversion of volume data that is done according to [Reverse Z].



Figure 4.9.1 Reversion Case

4.10 Volume Rendering

Select [Volume Rendering] in [Tools] menu.

4.10.1 Function Outline

Its task is to divide the general brightness of volume data into several areas, specify each area's color and brightness and display them in 3D image. It can also save the specified color and brightness (These parameters are called transfer function) in files for future use. After inputting volume rendering, make brightness work as a domain and specify color and transparency according to the environment setting. With regard to environment setting of volume rendering, refer to [Volume Rendering] in Chapter 6 [Various Setting].

Handled Case

Handled Case of color and brightness specification through volume rendering (As shown in Figure 4.10.1)



Figure 4.10.1 Rendering result

4.10.2 Screen Illustration



Figure 4.10.2 Volume Rendering Form

No.	Items	Descriptions
1	Preset Selection	Make preset selection
		(As for how to make preset file, Preset Folder of
		[Volume Rendering] in Chapter 6 [Various Setting]
2	Preset Switch	Make a switch between Preset and Non Preset
3	Graph	Specify histogram and color, display a diagram of brightness curves, move the brightness point up and down in left track
4	Minimum Brightness	Indicate the minimum brightness of volume rendering
5	Maximum Brightness	Indicate the maximum brightness of volume rendering
6	Transparency Track Bar	With right side click, a new item is added. With left side click, the item is deleted. A new item can be moved upward and downward with left track
$\overline{\mathcal{O}}$	Visible	Specify the area visibility of the selected transparency and
	(Visible State Switch)	the next transparency ^{*4.10.1}
8	Value	Specify the transparency of the selected block ^{*4.10.1}
	(Transparency)	
9	Level(Alpha)	Input Key for indicating brightness of transparency of the
	(Brightness box)	selected block. Change the number with spin button ^{4,10,1}
10	Shade Track Bar	Add new shade with right side click and delete the new one
		with left side click. This bar can be
		dragged from left to right or vice versa
1	Color	Change to selected color ^{*4.10.1}
	(Color Change)	
(12)	R	Input key for indicating R element of the selected color.
	(R element)	It can be changed by spin button ^{*4.10.1}
(13)	G	Input key for indicating G element of the selected color.
	(G element)	It can be changed by spin button ^{*4.10.1}
14	В	Input key for indicating B element of the selected color.
	(B element)	It can be changed by spin button ^{*4.10.1}
(15)	Level(Color)	Input key for indicating brightness. It can be changed by spin
	(Color Brightness Box)	button ^{~4.10.1}
No.	Items	Descriptions
------	-------------	--
(16)	Save	Indicate the form of folder that saves present transfer
		function.
1)	Load	Indicate form for reading files of transfer function (As shown
		in Figure 4.10.4)
(18)	Shading	In the case of a rendering, it is set up whether shade
		attachment is performed.
(19)	Auto Update	Each specified change will indicate if rendering is needed or
		not.
20	Update	Make rendering of the present specified item.

*4.10.1 Timing for the possible control

In terms of controls of (7)(8)(9) and $(1)\sim(15)$, it can work only when one single item is selected, but it will not work well if two or more items are selected at the same time.

Save RPF File				×
Directory D:¥_VE¥SampleDa	ita (1)		2	
		R		
CT_heartrpf	CT_iliumrpf	CT_ilium_arearpf	CT_knee_bone_area.rpf	
Comment 5				<u>(9)</u>
FileName 6		l	🕗 Sar	VE Use Capture Image

Figure 4.10.3 Transfer Function Saving Form

No.	Items	Descriptions
1	Transfer Function File	Display the directory name of each save transfer
	Saving Directory	function file.
2	Directory Change	Display the directory selection dialogue for
		directory change.
3	Directory Moving	Move to upper level directory.
4	Transfer Function File	Display Transfer Function File List in the directory.
	List	
(5)	Comment Box	Input the comments for saved transfer function file
6	File Name Box	Input the name of transfer function file
\bigcirc	Save	Save transfer function file in specified information
		(file name, comments and preview image)
8	Preview Image	Display the preview image saved in transfer
		function file.
9	Image File Name Box	Display the preview image name of transfer
		function file.
10	Image File Change Box	Display the dialogue for preview image selection.
(1)	Use Capture Image	Use the captured image of WorkForm in image
		previewing.

Load RPF File				×
Directory D:¥_VE¥SampleData	1		2	3 Preview
CT_heartrpf	CT_ilium.rpf	CT_ilium_arearpf	CT_knee_bone_arearpf	
Comment CT ilium 5				CT_iliumbmp (9)
FileName CT_ilium.rpf 6			🕖 Load	🗖 Use Capture Image

Figure 4.10.4 Reading Transfer Function Form

No.	Items	Description
1	Transfer Function File	Display directory name of transfer function file
	Reading Directory	
2	Directory Change	Display the directory selection dialogue for directory change
3	Directory Moving	Move to upper level directory
4	Transfer Function File	Display Transfer Function File List in the directory
	List	
(5)	Comment Box	Display the comments for transfer function file selected in $\textcircled{4}$
6	Input File Box	Display transfer function file name
$\overline{\mathcal{O}}$	Load	Load the transfer function file selected in $\textcircled{4}$
8	Preview Image	Display the preview image of transfer function file selected in
		④
9	Image File Name Box	Display the preview image name of transfer function file
		selected in $\textcircled{4}$. It will be a blank space if it is not specified

4.10.3 Operation Guide

- \circ Divide the brightness distribution area $^{\rm *4.10.2}$
 - 1. Click transparency track bar on the left side and a new button will be added. (As shown in Figure 4.10.5)

On the graph click [Ctrl] key, a new item can also be added. (As shown in Figure 4.10.6)

The clicking position is set between the minimum brightness and maximum brightness at the graph bottom. The brightness distribution area is divided into two domains by the button.

In selection status for adding slider (Unselected is \triangle while Selected is \triangle), indicates brightness in brightness box.

2. Use the track bar to move the slider leftward or rightward to change the slider brightness.

*4.10.2 Domain Division It means using slider to divide brightness. One domain refers to the interval between one brightness slider and the next brightness slider. Transparency is specified in sliders. Brightness without sliders is applied to slider transparency.



Figure 4.10.5 Transparency Increase



Figure 4.10.6 Transparency Increase on the graph

Select multiple points

1. Click the starting slider on the transparency bar or the starting point on the graph.

(As shown in Figure 4.10.7)

2. Shift clicks the starting slider on the transparency bar or the starting point on the graph. (As shown in Figure 4.10.8)



Figure 4.10.7 Starting Point Selection



Figure 4.10.8 Ending Point Selection

• Use rectangle to select multiple points (As shown in Figure 4.10.9)

- 1. By dragging the selected scope on the graph, a half-transparent rectangle comes up on it.
- 2. Once you release the mouse and stop dragging, you can select multiple points included in the rectangle.



Figure 4.10.9 Multiple Selection by using a rectangle

 \circ Move multiple points on the graph ^{*4.10.3} (As shown in Figure 4.10.10)

- 1. On the graph, drag the selected points and it will show what it looks like after moving. It is usually a horizontal movement. Shift key is for vertical movement and Alt key is for free movement
- 2. If the mouse is released, dragging is finished and so is the movement

***4.10.3 Multiple selected point determines multiple point movement.** When making multiple point movement, points can be added automatically in order to save unselected points for transparency graph, However, points cannot added when moving one single point.



Figure 4.10.10 Point Movement on the graph

 \circ Set invisible domain ^{*4.10.4}

- 1. Left click track bar transparency and turn it into invisible domain
- 2. Click [visible], turn off Check
- 3. Click [Update] key

*4.10.4 Invisible Domain

It refers to the domain with 0 transparencies. When the beginning of this domain and the next transparency are marked as 0, it means the domain disappears, which is called "Zero Transparency" state. To make it invisible, turn off [visible] Check at the beginning of the domain.

• Color Setting

- 1. When left clicking the color track bar, a slider is added. (As shown in Figure 4.10.11)
- 2. The added slider stays in selection status, which indicates brightness in color slider brightness box.
- 3. Move the slider leftwards or rightwards with left track bar to change slider brightness.
- 4. Double click the slider to be changed to change its color or click [Color] key to display [Color Setting] form (As shown in Figure 4.10.12)



Figure 4.10.11 Color Slider Addition

Color			×
Basic colors:			
			•
Queter estars			
		Hu <u>e</u> : 120	<u>R</u> ed: 128
		<u>S</u> at: 240	<u>G</u> reen: 255
Define Gustom Golors >>	Color Solid	<u>L</u> um: 180	Bl <u>u</u> e: 255
OK Cancel	A	dd to Custom C	olors

Figure 4.10.12 Color Setting Form

- It makes automatic updating valid
 - 1. Click [Auto Update] key, turn on Check box
 - 2. In WorkForm, if it is in volume displaying state, every slider changing by this color setting will make volume rendering possible
- \circ Save transfer function file with comments
 - 1. Click [Save] key and display transfer function saving format
 - 2. Input comments into comment box
 - 3. Input file name and click [Save] key



Figure 4.10.13 Comment Form of transfer function file

• Save the specified transfer WorkForm capture as function file preview image

- 1. Click [Save] key and display transfer function saving form
- 2. Click [Use Capture Image] and turn on Check (As shown in Figure 4.10.14)
- 3. Input file name and click [Save] key

Save RPF File	×
Directory D.¥_VE¥SampleData	-Preview
CT_heartrpf CT_iliur Click [Use capture Image] item	
Comment Comment Sample	
FileName samplerpf Save	Use Capture Image

Figure 4.10.14 Specify preview icon of transfer function file 1

 \circ Save the specified original image file as transfer function file preview image

- 1. Click [Save] key and display transfer function saving form
- 2. Click image file change button (As shown in Figure 4.10.15), Use the displayed form, i.e. open the file to specify image file
- 3. Input file name and click [Save] key



Figure 4.10.15 Specification of Preview Icon of Transfer Function File 2

• Load transfer function specification

- 1. Click [Load] key and display transfer function loading form
- 2. Select a file from transfer function preview list (As shown in Figure 4.10.16), click [Load] button
- 3. In loading setting, insert a renewing slider. If the system is in WorkForm with volume, display, volume rendering can be performed

Load RPF File	×
Directory D¥_VE¥SampleData 🗊	Preview
Click input transfer function file	
CT_heartrpf CT_ilium_rpf CT_ilium_arearpf CT_knee_bone_arearpf	144
Comment CT ilium	CT_iliumbmp
FileName CT_iliumrpf Load	Use Capture Image

Figure 4.10.16 Transfer Function File Selection

***4.10.5 What is Insertion Renewal** When making slider setting file with volume data of different brightness distribution, make slider insertion by maintaining the slider position relation to match the present brightness. When using brightness distribution between

50~232 to load files set on brightness distribution between 0~637, each slider's brightness will be changed. (As shown in Figure 4.10.17)

	Brightne	ess distributiong	0~637	
0	150	300	500	637
4		۵		ľ
50	92	135	192	232
	Brightne	ess distributiong	50~232	

Figure 4.10.17 Insertion Changing Case

4.10.4 Environment Setting

 \circ Cross-section Displaying Form

- 1. Right click on graph and menu will come up (As shown in 4.10.18)
- 2. Select [Normal] or select standard form [Logarithm] and use log to display graph

Volume Rende	ring – Logarithm			×
		Normal Logarithm)	
Alpha			Mar Maria	637
Visible Color	Value 56 🗇	Level 279	4	<u> </u>
	Color R 255 🌩	G 200 ≎ B 227 ≎	Level	366 🗇
Save	Load		Shading	AutoUpdate

Figure 4.10.18 Contrast menu

4.11 Point-Based Volume Rendering

Select [Point-Based Volume Rendering] in [Tools] menu or click tool bar

4.11.1 Function Outline

In concept, point-based volume rendering is the same as [Volume Rendering] in 4.10. However, displaying approaches are different. In point-based volume rendering, each Voxel is illustrated by cube points. But according to the date pitch, points toward Z position can be automatically adjusted.

Result Handled Case

Specify color and brightness to display rendering results. (As shown in 4.11.1)



Figure 4.11.1 Rendering Result

*4.11.1 Point adjustment towards Z position

In point rendering, voxel is displayed through cube points. Therefore, there is a huge difference between the pitch towards X and Y position and the pitch towards Z position. With such a big data difference, the points towards Z position can be possibly far from each other.

When inserting new points between other points (As shown in Figure 4.11.2), adjust the new points so that no crack could appear in volume.



Figure 4.11.2 Point Adjustment towards Z point

4.11.2 Screen Description

Point-Based Volume Rendering – L	Logarithm	×
CT leg - knee		C
CT leg - knee - bones	3	
CT upper part of the this		
industrial CT - clay pot	Alpha 6	5 637
MRI head		À
MRI head - inner vessels		
MRI head subcutaneous		
Sphere512x512x512	Bendering Area	Update

Figure 4.11.3 Volume Rendering

No.	Items	Descriptions
1	Preset Selection	Make preset selection
		Regarding preset file setting, refer to Preset Folder of
		[Volume Rendering] in Chapter 6 [Various Setting]
2	Preset Switch	Switch between Preset and Non Preset
3	Graph	Display brightness histogram and transparency
		curved line graph and transparency points by
		moving up and down on the left track
4	Minimum Brightness	Display the minimum brightness of volume data
5	Maximum Brightness	Display the maximum brightness of volume data
6	Transparency Track Bar	Add a new slider by making a right-side click
Ŭ		Delete a slider by making a left-side click
		Sliders can be dragged from side to side by left track
$\overline{\mathcal{O}}$	Visible	Specify if the domain is visible or not from the
	(Visible State Switch)	selected transparency slider to next transparency
		slider
8	Value	Specify transparency of selected sliders.
	(Transparency)	
9	Level (Alpha)	Display brightness of selected transparency sliders.
	(Transparency Slider	Input the key or use sliders to change value
	Brightness Box)	
10	Color Track Bar	Add a new slider by making a right-side click
		Delete a slider by making a left-side click
		Sliders can be dragged from side to side by left track
(11)	Color	Change the color of the selected slider
	(Color Change)	
(12)	R	Display R element of selected slider color
	(R element)	Input the key or use the spin button to change it
(13)	G	Display G element of selected slider color
	(G element)	Input the key or use the spin button to change it
(14)	B	Display B element of selected slider color
	(B element)	Input the key or use the spin button to change it

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No.	Items	Descriptions
(15)	Level (Color)	Display brightness of selected slider color
	Color Slider Brightness Box	Input the key or use the spin button to change the
		number
16	Save	Display the form for saving the present transfer
		function file (As shown in 4.11.4)
1	Load	Display the form for loading transfer function file
		(As shown in 4.11.5)
(18)	Rendering Area	Display the form for limiting described areas
		(As shown in 4.11.6)
(19)	Auto Update	Specify if each slider change setting is rendered or
		not
20	Update	Use the current setting for rendering



Figure 4.11.4 Transfer function Saving Form

No.	Items	Descriptions
1	Transfer Function	Display directory name of transfer function saving file
	File Saving	
	Directory	
2	Directory Change	Display the directory selection dialogue for changing the
		transfer function file directory
3	Directory	Move to upper level directory
	Movement	
4	Transfer Function	Display transfer function file list saved in directory
	File List	
5	Comment Box	Input transfer function file comments written unto saved
		transfer function file
6	File Name Box	Input transfer function file name
$\overline{\mathcal{O}}$	Save	Save transfer function file of specified information such
		as file name, comments and preview image
8	Preview Image	Display preview image of transfer function file to be
		saved
9	Image file name	Display preview image file name of transfer function file
	box	to be saved
10	Image File Change	Display dialogue for preview image selection
(11)	Use Image Capture	Use the captured WorkForm for image previewing



Figure 4.11.5 Transfer Function Loading Form

No.	Items	Descriptions
1	Loading Transfer	Display directory name of transfer function files
	Function	
	Directory	
2	Directory Change	Display the directory selection dialogue for changing
		transfer function file directory
3	Directory	Move to upper level directory
	Movement	
4	Transfer Function	Display transfer function file list saved in directory
	File List	
5	Comment Box	Display comments of transfer function selected in $\textcircled{4}$
6	File Input Box	Display transfer function file name
\bigcirc	Load	Load transfer function selected in ④
8	Preview Image	Display the image of transfer function file selected in
		④
9	Image File Name	Display the image name of transfer function file selected
	Box	in ④. It is blank if not specified

Point-Based Volume Rendering	-Area- 🛛 🗵
Area X Direction	512 2 1 3
Z Direction	512 5
	248 8
O High O Middle	• Low
🛈 O Big 💿 Middle	C Small

Figure 4.11.6 Transfer Function Loading Form

No.	Items	Descriptions
1	Painting Area	Click the slider and specify two moveable sliders: maximum and
	towards X bar	minimum of painting area towards X direction
2	Maximum	Specify the maximum value of painting area towards X direction
	Painting Area	
	towards X bar	
3	Minimum Painting	Specify the minimum value of painting area towards X direction
	Area towards X	
	bar	
4	Painting Area	Click the slider and specify two moveable sliders: maximum and
	towards Y bar	minimum of painting area towards Y direction
5	Maximum	Specify the maximum value of painting area towards Y direction
	Painting Area	
	towards Y bar	
6	Minimum Painting	Specify the minimum value of painting area towards Y direction
	Area towards Y	
	bar	
\bigcirc	Painting Area	Click the slider and specify two moveable sliders: maximum and
	towards Z bar	minimum of painting area towards Z direction
8	Maximum	Specify the maximum value of painting area towards Z direction
	Painting Area	
	towards Z bar	
9	Minimum Painting	Specify the minimum value of painting area towards Z direction
	Area towards Z	
	bar	
(10)	Painting Density	Specify the voxel pitch in painting
_		[High] No voxel; [Middle] one voxel; [Low] two voxels
11	Painting Point	Specify the point size in painting. If default is [Middle], then
	Size	[Middle]'s point size is 100%, [Low] is 67% and [Big] is 250%

4.11.3 Operation Guide

 \circ In terms of transfer function adjustment, saving and loading, its function is the same as that of volume rendering refer to 4.10 Volume Rendering for more detailed information.

• Setting Painting Area

- 1. Click [Rendering Area...] key and the painting area setting form will be displayed
- 2. Move the painting areas towards X, Y, Z direction by moving track bar slider on the left track (As shown in Figure 4.11.7)



Figure 4.11.7 Painting Area Setting

Painting Density Setting

- 1. Click [Rendering Area...] to display setting form of painted areas
- 2. Click the button for painting density to choose density. (As shown in Figure 4.11.8)



Figure 4.11.8 Painting Density Setting

\circ Setting painting point size

- 1. Click [Rendering Area...] key to display setting form of painted areas
- 2. Click point size button to choose points size. (As shown in Figure 4.11.9)

Image: State Stat	D#VOLUME-TEST#VDF#MRBrain_DoiA.vdf	Point-Based Volume Rendering -Area- 🛛 🔟
DVUUUUE TESTVORTHIBRens, build will be an and an an and an and an and an and an and an and	DEVOLUME-TESTROUTANTROPANE, DOURANT	Point-Based Volume Rendering - Area Area X Direction Y Direction Y Direction Z Direction Y Direction<
DVUCLUME-TESTVUCHMBBaaa, Boak.vdf		1
DVOLUME-TESTVD/PHRB/rain_Dou/Avdf Image: Constraint of the second seco	DEVOLUME-TESTRUDEAMRBrain_DouAvdt	Point-Based Volume Rendering - Area Area X Direction Y Direction
-Z G Big C Middle C Small	DYVOLUME-TESTYVDFYMRBrain_DoiAvdf	Point-Based Volume Rendering -Area Area X Direction Y Direction Y Direction Z Direction Dencity High Middle C Low Big Middle Small

Figure 4.11.9 Point Size Setting

4.11.4 Setting

• Switch displaying form

- 1. Make a right-side click on the graph to display a detailed menu (As shown in Figure 4.11.10)
- 2. Normal means standard form while [Logarithm] is log form



Figure 4.11.10 Contrast Menu

4.12 Iso-Surface

In [Tools] menu, select [Iso-Surface] or click tool bar

4.12.1 Function Outline

Extract brightness and iso-element from volume data. This element, together with the adjacent elements, will be connected making a triangle surface which will become a polygon data. This polygon data enables mesh editing, file output and other applications to become possible.

 \circ Result Handled Case

Displaying Iso-Surface Generation Result. (As shown in Figure 4.12.1)



Figure 4.12.1 Generation Result

4.12.2 Screen Description

Iso-Surface	×
maker the temperature of the	Constant C 70 =
	Ratio of Data Reduction
3	View Direction 5 C XY Plane C YZ Plane C XZ Plane
1 1 d 2 -	Preview Mode
1 () () () () () () () () () (Closed Boundary
	□ 3D Printer Mode (8)
	Num of Polygon 0

Figure 4.12.2 Iso-surface form

No.	Items	Descriptions
1	Constant C	Specify the extracted brightness as iso-surface
2	Ratio of Data Reduction	Specify reduction rate of volume data ^{*4.12.1}
3	Preview	Preview and display iso-surface value generated by the present Constant C and iso-value brightness
4	Slice number	In the case of a 2D preview display current slice number. The display shows what the current image slices, and the slide bar and the switching value input by the possible In the case of D preview, this operation is disabled.
5	View Direction	Specify the ongoing view direction
6	Preview Mode	Select preview 2D slice image or 3D slice image. In the 2D slice image, ON / OFF of the window level function it is also possible
7	Closed Boundary	When volume data has broken off by the end side of space, it is chosen whether an iso-surface is closed
8	3D Printer Mode	If you want to output the shape file of 3D printers, reduce the miscalculation of support and modeling at the time of the 3D printer is set to ON
9	Num of Polygon (Iso-surface Generation Number)	Display iso-surface generation number
10	Delete (Delete Iso-surface)	Delete iso-surface generation

No.	Items	Descriptions
1	Execute	Use the present setting to generate iso-surface
	(Iso-surface	
	Generation)	

*4.12.1 Reduction Rate of Volume Data

Reduction rate of volume data will affect the quality of iso-surface generation. If the reduction rate becomes smaller, the generation time will be shortened and the generated surface will become rough. If the reduction rate becomes bigger, the generated surface will become smooth and delicate even if the generation time takes longer.

4.12.3 Operation Guide

\circ Iso-Surface Generation Drag

- 1. [Constant C] track bar and input Constant C.
- 2. The preview will vary with different Constant C. (As shown in 4.12.3)
- 3. If you want to see the preview from other direction, click [Direction] key to change previewing direction. (As shown in 4.12.4)
- 4. Click [Ratio of Reduction] key to input reduction number.
- 5. Click [Closed Boundary] key to choose an iso-surface is closed. (As shown in 4.12.5)
- 6. Click [3D Printer Mode] key to choose an output suitable for modeling in 3D Printer. (As shown in 4.12.6)
- 7. Click [Execute] key.
- 8. Display the generated result in WorkForm.



Figure 4.12.3 Change of Constant C



Figure 4.12.4 Change of Previewing Direction



Figure 4.12.5 Change of the border plane in "Closed Boundary"OFF/ON



Figure 4.12.6 Change of the border plane in "3D Printer Mode" OFF/ON

•Preview from 2D, generate the equivalent surface

- 1. The Preview Mode switch to 2D (As shown in 4.12.7)
- 2. Preview of any field. The upper left corner of the cursor is currently represented by the brightness value of the image. In that state, the value of the constant C is changed. At this time, the constant C expressed in accordance with the equivalent surface of the display line (contour). (As shown in 4.12.8)
- 3. In WindowW / L check box is possible ON / OFF of the window level function. This function is linked with the dialog operation of the "4.22 WindowW / L". (As shown in 4.12.9)
- 4. Switch the current serial number, enter the value of the slider. (As shown in 4.12.10)
- 5. If you want to see it from another angle. Please select the radio button (Direction) to change direction (As shown in 4.12.11)
- 6. Drag the Track bar to input the date of [Ratio of Data Reduction]
- 7. [Closed Boundary] Choose whether to close the check box
- 8. [3D Printer Mode] Select the check box for the 3D printer's model for the appropriate output
- 9. [Execute] Click the button below
- 10. Represents the result of a worksheet (As shown in 4.2.12)

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Figure 4.12.7 Preview type conversion

Iso-Surface	<u>×</u>
	-Constant C
	Ratio of Data Reduction
	View Direction C XY Plane C YZ Plane C XZ Plane
Si Carl	Preview Mode © 2D C 3D 🔽 WindowW/L
	 ✓ Closed Boundary ☑ 3D Printer Mode
	Num of Polygon 0
	Delete
Iso-Surface	
anna ing an start an	-Constant C 55
52 m	Ratio of Data Reduction
	View Direction
	C XY Plane C YZ Plane C XZ Plane
Sea Charles	Preview Mode 2D C 3D WindowW/L
1000000	I Closed Boundary □ 3D Printer Mode
Contract of the State of the St	Num of Polygon 0

Figure 4.12.8 Preview 2D image contour generation

Iso-Surface		1	
	Constant C		
Contraction of the State	- Ratio of Data Reduction		
	.)		
	View Direction		
	XY Plane C YZ Plane C XZ Plane X		
	Preview Mode		
St- 8 - 3 - 1	© 2D C 3D C WindowW/L		
	Closed Boundary		
	3D Printer Mode		
	Num of Polygon 0		
124 =	Deleteixecute		
		-	
lso-Surface	3	a	
	Constant C		
	Ratio of Data Reduction		
	0.40	WindowW/L	
Berty Stat			
	View Direction	WindowW/L Mode	Default
KA Y TH	XY Plane C YZ Plane C XZ Plane	Window Width	166 🗮
A TY A TY	Preview Mode	1	637
V 1 - 1 - 1	● 2D		
VE AXA V		Window Center	91 🗮
	IV Closed Boundary □ 3D Printer Mode	0	637
	Num of Polygon 0		
191	Delete Execute		
	Denote Execute		

Figure 4.12.9 Preview WindowLevel ON / OFF image



Figure 4.12.10 Change of serial number representation



Figure 4.12.11 Preview direction changes (2D)



Figure 4.12.12 Preview 2D's equivalent surface generation

4.13 Index Image

4.13.1 Index Image

In [Tools] menu, select [Index Image] or click tool bar

4.13.1.1 Function Outline

It can divide the overall brightness of volume data into several domains and make color specification for each domain and display them in 3D image. The specified color can be reused again if saved. After inputting volume data, each brightness is seen as a domain which is set between the minimum and maximum position. As for index image setting, refer to Index Image in Chapter 6 [Various Setting]. Unlike volume rendering^{*4,13,1}, the color of each slider is constant.

*4.13.1 Difference between volume rendering and index image

Volume rendering uses transparency and color for line insertion within the specified domain while index image uses a specified color within the domain. In index image, there is no concept like transparency, but there is only a choice between Visible and Invisible.

• Result Handled Case

Rendering Result of specified color. (As shown in Figure 4.13.1)





Figure 4.13.1 Rendering Result

4.13.1.2 Screen Description



Figure 4.13.2 Index Image Form

No.	Items	Descriptions
1	Preset Selection	Make presetting selection
		(As for presetting file setting, refer to [Preset Folder] of
		[Volume Rendering] in Chapter 6 [Various Setting]
2	Preset Display	Switch between Preset Display and Non Display
	Switch	
3	Graph	Display brightness histogram, color setting and visible curved line
	Brightness	Display the minimum brightness of volume data
•	Minimum	Display the minimum originaless of volume data
5	Brightness	Display the maximum brightness of volume data
	Maximum	
6	Color Setting Track	Click on the right and a new slider is added. Click on the left and
	Bar	the new slider is deleted. The slider can be moved from side to
		side by left track bar
\bigcirc	Visible	To show if it is visible or not from the selected color slider to the
	(Switch between	next one
	Visible and	
	Invisible state)	
(8)	Color	Change the color of selected slider
	(Color Change)	
(9)	R element	Display R element of selected slider color
		Input the key or use the spin button to change it
(10)	G element	Display G element of selected slider color
	D 1	Input the key or use the spin button to change it
(11)	B element	Display B element of selected slider color.
	T 1	Input the key or use the spin button to change it
(12)	Level	Display brightness of selected color slider
	(Color Slider	Input the key or use the spin button to change it
	Brightness Box)	
	Save	Save the present transparency and color slider setting in the file
(14)	Load	Load color slider setting from the file
(15)	Segmentation	Display segmentation form
		See 4.13.2 [Segmentation] for more information

No.	Items	Descriptions
(16)	Shading	In the case of a rendering, it is set up whether shade attachment is
		performed
17	Auto Update	Specify t if each slider changes setting is visible or not
	(Auto Update	
	Switch)	
(18)	Update	Make rendering on the present setting



Figure 4.13.3 Transfer Function Saving Form

No.	Items	Descriptions
1	Transfer Function	Display directory name of transfer function saving file
	File Saving	
	Directory	
2	Directory Change	Display the directory selection dialogue for changing the transfer
		function file directory
3	Directory	Move to upper level directory
	Movement	
4	Transfer Function	Display transfer function file list saved in directory
	File List	
5	Comment Box	Input transfer function file comments written unto saved transfer
		function file
6	File Name Box	Input transfer function file name
$\overline{\mathcal{O}}$	Save	Save transfer function file of specified information such as file
		name, comments and preview image
8	Preview Image	Display preview image of transfer function file to be saved
9	Image file name	Display preview image file name of transfer function file to be
	box	saved
10	Image File Change	Display dialogue for preview image selection
1	Use Image Capture	Use the captured WorkForm for image previewing

Load RPF File		×
Directory D:¥_VE¥SampleData	1	2. 13 Preview
i 🖉 🖉		
CT_heartrpf CT_ilium.rpf	CT_ilium_arearpf CT_knee_bone_arearp	of the second
Comment CT ilium		Tiliumbmp
FileName CT_illiumspf	Ø	Load Use Capture Image

Figure 4.13.4 Transfer Function Loading Form

No.	Items	Description
1	Transfer Function	Display directory name of transfer function file
	File.	
	Reading Original	
	Directory	
2	Directory Change	Display the directory selection dialogue for directory
		change
3	Directory Moving	Move to upper level directory
4	Transfer Function	Display Transfer Function File List in the directory
	File List	
(5)	Comment Box	Display the comments for transfer function file
		selected in ④
6	Input File Box	Display transfer function file name.
\bigcirc	Load	Load the transfer function file selected in $\textcircled{4}$
8	Preview Image	Display the preview image of transfer function file
		selected in ④
9	Image File Name Box	Display the preview image name of transfer function
		file selected in ④
		It will be a blank space if it is not specified

4.13.1.3 Operation Guide

• Brightness distribution is divided into several domains to specify color for each domain.

- 1. Make a left-side click on the color track bar to add new sliders (As shown in 4.13.5) Clicking position is between the minimum and maximum brightness at the bottom of graph. Brightness distribution is divided into two domains because of slider addition
- 2. When the added slider stays in selection state, it indicates brightness in slider brightness box
- 3. When changing slider brightness, drag the slider from side to side on left track bar
- 4. When changing slider color, click [Color] key to display [Color Setting] form



Figure 4.13.5 Color Slider Addition

• Setting an Invisible Domain (see 4.10 Volume Rendering 4.10.2)

- 1. It turns into selection state by clicking the color track bar on the left if you don't want to see the domain
- 2. Click [Visible] key to turn off [Check]
- 3. Click [Update] key

• Validating automatic updating

- 1. Click [Auto Update] to turn on [Check]
- 2. When volume is displayed in WorkForm, rendering is finished on each slider change

• Setting slider saving

- 1. Click [Save] key to display [Save with Attached Name] form
- 2. Input file name and click [Save] button
- Setting loading slider
 - 1. Click [Load] button to display [Open files] form
 - 2. Input file names and click [Open] button
 - Insert a new spin slider while loading setting. (For more information, refer to 4.10.3 Operation Guide – [Loading Transfer Function Setting]). Rendering is done in volume WorkForm

4.13.1.4 Setting

Switch Display Form

- 1. Click the right side button on the graph to show a detailed menu (As shown in 4.13.6)
- 2. [Normal] means Standard Form while [Logarithm] is log form



Figure 4.13.6 Contrast Menu

4.13.2 Segmentation

Click [Segmentation] button in [Index Image] form.

4.13.2.1 Function Outlines

Change the brightness value in different domains made with an index image. It can concentrate on one of the brightness value of all the domains. The specified brightness value varies according to volume data.^{*4.13.2}

*4.13.2 Data Type

Volume data will have different brightness area because of data type. Confirm [data type] with [File Information] in [Tools] menu.

Data Type 1:0~255 Data Type 2: 0~65535 Data Type 3:-32768~32767 Data Type 4:-2147483648~2147483647

Result Handled Case

Domain with brightness value between 100~299 is changed into domain with brightness value 150. (As shown in Figure 4.13.7)



Figure 4.13.7 Segmented Result

4.13.2.2 Screen Description



Figure 4.13.8 Segmentation Form

No.	Items	Descriptions
1	Area List	The list shows the minimum and maximum
		brightness value of each domain
2	Parameter Change	It indicates setting change of each domain
	Setting	
3	Edit	Specify brightness value change according to the
	Brightness Value	input value in Area List
	Input Setting	
4	Brightness Input	Input brightness number to be changed
	Box	

No.	Items	Descriptions
(5)	No change Setting	Specify No Change in brightness with Area domain
6	Minimum	Change the present volume data into minimum
	Brightness Setting	brightness in Area Domain
$\overline{\mathcal{I}}$	Maximum	Change the present volume data into maximum
	Brightness Setting	brightness in Area Domain
8	Zero Setting	Change the present volume data into Zero brightness in
		Area Domain
9	Execute	Do segmentation in present setting
10	Reset	Return to the post-segmentation state

4.13.2.3 Operation Guide

• Make setting according to domain brightness number.

- 1. In Area List, select the domain that needs to change brightness number. Click [Edit] button
- 2. Input the changed brightness number into brightness box

 \circ Make segmentation^{*4.13.3}

- 1. After the domain setting is finished, click [Execute] button, but [Execute] button cannot be used for segmentation if all the brightness becomes one same number
- 2. Confirm histogram both before and after segmentation in index image form
- 3. Click [Reset] point, segmentation is deleted and it returns to its initial state



Figure 4.13.9 Contrast of Histogram Graph

*4.13.3 Slider Position after segmentation
Basically, the brightness value of segmentation slider does not change.
(As shown in Figure 4.13.10)
As an exception, if brightness number is set beyond brightness
distribution before segmentation, the brightness of outmost slider will
be changed. (As shown in Figure 4.13.11)


Figure 4.13.10 Case of Unchanged Slider Brightness



Figure 4.13.11 Changed Slider Brightness

4.14 3D Cross Section

 \circ Control Form

In [Tools] menu, select [Cross Sections] or click tool bar of Main Frame

• Display

Click WorkForm Tool Bar

4.14.1 Function Outline

 \circ Control Form

Display position adjustment form of cross section. In form, switch between Display and Non Display and make slice selection. Specified Pitch and Yaw, you can change the angle of cross-selected image. Cross section specified here will be reflected in the display of MeasureView.

If the loading data of a plane, lines or points is not volume data, this function will not work.

• Display

In WorkForm, the cross-selected image is displayed in density. Density decomposition is specified according to Resolution of [Volume Rendering] in Chapter 6 [Various Setting].

If the loading data of plane, lines or points is not volume data, this function will not work.

4.14.2 Screen Description

 \circ Control Form

Cross Sections	×
✓ X-Dir.(Y-Z)	No. Pitch Yaw
✓ Y-Dir.(X-Z)	
Z-Dir.(X-Y) J	

Figure 4.14.1 3D Cross Section Control Form

No.	Items	Descriptions
1	YZ Plane	Switch between YZ Plane Display and Non Display
	Display Graph	
2	XZ Plane	Switch between XZ Plane Display and Non Display
	Display Graph	
3	XY Plane	Switch between XY Plane Display and Non Display
	Display Graph	
4	YZ Plane Position	Set YZ plane position
(5)	XZ Plane Position	Set XZ plane position
6	XY Plane Position	Set XY plane position
$\overline{\mathcal{O}}$	YZ Pitch Rotate	Set YZ plane position

No.	Items	Descriptions
8	XZ Pitch Rotate	Set XZ plane position
9	XY Pitch Rotate	Set XY plane position
10	YZ Yaw Rotate	Set rotation angle of the YZ plane
		Pitch rotation, you can freely rotate the cross-section
		by a combination of Yaw rotation
(11)	XZ Yaw Rotate	Set rotation angle of the XZ plane
(12)	XY Yaw Rotate	Set rotation angle of the XY plane

The cross-sectional image displayed on the WorkForm.

Cross-sectional images works in conjunction with the display of MeasureView. This allows the display of the cross-sectional slice from any position and angle.

C:¥VOLUME¥MRBrain_DoiA.vol	Cross Section	IS	<u>×</u>
Pos: (-,-,-)[sheet] WW: 166 WO: 91	Pos: (¬¬¬)[sheet] WW: 166 WC: Pos: (¬¬¬)[mm] □▼ X~Dir.(Y~Z)	No.	Pitch Yaw
Lv: -		329 🗮 [C	
843		J 195 🗄 [0	
The stand	→7	J [180 🗄 [0	
_ + J 180 <u>_</u>	- · 329 = -		
Pos: (-,-,-)[sheet] WW: 166 WO: 91 ▲ Pos: (-,-,-)[mm]	Ŷ		
Lv: -			
+z			
	VolumeData = invisible IsoData = None		

Figure 4.14.2 3D Cross Section Display

4.14.3 Operation Guide

- No displaying of YZ cross section
 Delete Check Box in ① of Control Form.
- Displaying YZ cross section Add Check Box in ① of Control Form.
- Move display position of YZ cross section
 Move control form ④ or specify the number of ⑦.

4.14.4 Setting

Refer to [Wireframe Color] in Chapter 6 [Various Setting]. In this function, you can switch between color and the visible invisible border that indicates the existence range of the cross-section.

4.15 Camera

In [Tools] menu, select [Camera] or click tool bar $\stackrel{\frown}{\clubsuit}$.

4.15.1 Function Outline

It changes viewpoints on WorkForm. It is easier to understand and correct to operate because of the use of camera menu. In addition, the same operations can be done by means of mouse.

• Basic operation by using mouse to make 3D display. (spinning, enlarging and moving)

1) Rotation of volume and polygon

Make a rotation by dragging 3D displayed part.

- 2) Zoom in and zoom out Zoom by dragging 3D displayed image to right. Zoom in by moving the mouse cursor upward and zoom out by moving the mouse cursor downwards.
 2) Move the set of the set o
- 3) Move the camera upwards or downwards and from right side to left side Horizontal and vertical movement is made by pressing "Z" key and dragging 3D displayed image at the same time. In addition, the similar operation like cutting, rotating and moving can be made on any clipping plane by using mouse cursor.

• Simple Cutting Operation

1) Clipping Plane Operation

Click WorkForm icon

2) Clipping Plane Rotating

Drag 3D displayed image by pressing Ctrl and make rotation on the original point.

3) Clipping plane Moving

Drag 3D displayed image by pressing Ctrl and move towards a normal line.

4.15.2 Screen Description

• Simple Screen Image



Figure 4.15.1 Camera Form (Simple Illustration)

No.	Items	Descriptions
1	Preset Button 1	Move the viewpoint in the front
2	Preset Button 2	Move the viewpoint at the back
3	Preset Button 3	Move the viewpoint on the right
4	Preset Button 4	Move the viewpoint on the left
(5)	Preset Button 5	Move the viewpoint at the top
6	Preset Button 6	Move the viewpoint at the bottom
$\overline{\mathcal{O}}$	Rolling 1	Move the viewpoint to the specified angle, i.e. the right side
8	Rolling 2	Move the viewpoint to the specified angle, i.e. the left side
9	Rolling 3	Move the viewpoint to the specified angle, i.e. the top
(10)	Rolling 4	Move the viewpoint to the specified angle, i.e. the bottom
1	Rolling 5	The viewpoint spins towards the left
(12)	Rolling 6	The viewpoint spins towards the right
(13)	Parallel Movement 1	Move the viewpoint to the specified distance, i.e. the left side
(14)	Parallel Movement 2	Move the viewpoint to the specified distance, i.e. the right side
(15)	Parallel Movement 3	Move the viewpoint to the specified distance, i.e. the bottom
(16)	Parallel Movement 4	Move the viewpoint to the specified distance, i.e. the top
1)	Angle and Distance	Indicate angle and distance with $7-16$
(18)	Detail	Switch between Simple Screen and Detailed Screen
	Mode Switch	
(19)	Reset	Reset viewpoint movement information

Detailed Screen

Introduce the functions of detailed screen.



Figure 4.15.2 Camera Form (Detailed Illustration)

No.	Items	Descriptions
1	Viewpoint 1	Specify viewpoint position on XY plane by number
2	Viewpoint 1	Specify viewpoint on XY plane
	Track Bar	
3	Yaw	Display viewpoint position on XY plane
	Display Viewpoint 1	
4	Viewpoint 2	Specify viewpoint position on Z bar by number
5	Viewpoint 2	Specify viewpoint position on Z bar
	Track Bar	
6	Pitch	Display viewpoint position on Z bar
	Display Viewpoint 2	
\overline{O}	Camera Roll	Display viewpoint rolling by number
	Viewpoint Roll	
8	Viewpoint Rolling	Specify viewpoint rolling
	Track Bar	
9	Zoom	Specify the distance between the object and the
	Distance Track Bar	viewpoint
(10)	View Mode	Switch between Parallel and Perspective
	Displaying Mode	

4.15.3 Operation Description

- Observe an object from the frontage Click [Preset Button 1] in ① of Simple Screen.
- Observe an object from the right Click [Preset Button 3] in ③ of Simple Screen.
- Observe an object from the top Click [Preset Button 5] in (5) of Simple Screen.
- \circ Move the viewpoint 10° to the left
 - 1. Input 10 in (13) of Simple Screen and click [Rolling 2] in (8) of Simple Screen.
 - 2. Press [Rolling 2] again and it will roll 10°.
- \circ Move the viewpoint 20°downwardst
 - 1. Input 20 in (13) of Simple Screen and click [Rolling 4] in (10) of Simple Screen.
 - 2. Press [Rolling 4] again and it will roll 20°.
- Roll 15° to the left
 - 1. Input 15 in (1) of Simple Screen and click [Rolling 5] in (1) of Simple Screen.
 - 2. Press [Rolling 5] again and it will roll 15°.
- Observe an object from backwards at 45° Input 135 in ① of Detailed Screen.
- Look down a point at 45°
 Input 45 in (5) of Detailed Screen.
- Push the object away Move distance track bar to the left.

4.16 File Information

In [Tools] menu, select [File Information].

4.16.1 Function Outline

Display File-information.

In addition, it can change the screen size and polygon size.

4.16.2 Screen Description

File Information	X	
-Data Information		
File name:	D:¥testdicom2¥2¥1.2.840.11361	1
Image Size:	512 x 512 x 248	2
Start Point:	-0.5 -0.5 -0.36207	3
Pitch (mm):	0.46875 0.46875 0.700000	4
Grid Width:	0.001956 0.001956 0.002928	5
Polygon Scale (mm):		6
Data Type:	3 - Signed Short	Ø
Client Information		_
Accession Number:		8
Patient's Name:	Doi Akio	9
Patient ID:	VS330331	1
Patient's Birth Date:	19580331	1
Patient's Sex:	М	12
Study Date:	20031107	13
Institution Name:	IWATE HFMRI Institute	1
Study Description:		15
Modality:	MR	16
·	OK Cancel	

Figure 4.16.1 File Information

No.	Items	Descriptions
1	File name	Indicate a file name
2	Image Size	Indicate image size
3	Start Point	Indicate the painting position of the object
	(Start Point	
	Of Painting)	
4	Pitch	Indicate one pixel size
	(Big and Small)	
(5)	Grid Width	Indicate interval between pixels
6	Polygon Scale	Indicate size number
$\overline{\mathcal{I}}$	Data Type	Indicate data type
8	Accession Number	Indicate Accession Number of the client
9	Patient's Name	Indicate the name of the patient
(10)	Patient ID	Indicate the patient ID
1	Patient's Birth Date	Indicate birthday of the patient
(12)	Patient's Sex	Indicate gender of the patient

No.	Items	Descriptions
(13)	Study Date	Indicate the checkup date
(14)	Institution Name	Indicate the name of the institution
(15)	Study Description	Indicate study description
(16)	Modality	Indicate mode
1)	ОК	Close information change form
(18)	Cancel	Close the form of no information change

When loading volume data, it is possible to edit pitch information. When loading shape data, it is possible to edit polygon size information.

Pitch (mm):	0.46875	0.46875	0.7
Grid Width:	0.001956	0.001956	0.002928
Polygon Scale (mm):	1	1	1

Figure 4.16.2 Situation when pitch can be edited.

Pitch (mm):	1	1	1
Grid Width:	0	0	0
Polygon Scale (mm):	1	1	1

Figure 4.16.3 Situation when polygon size can be edited

4.16.3 Operation Guide

• Change pitch

- 1. Input number in ④.From the most left side is X, Y, Z
- 2. Click ①. Close File Information form. After calculating ④ and ⑤, the display of cross section and the object of WorkForm will be changed

Change polygon size

- 1. Input number in ⁽⁶⁾.From the most left side is X, Y, Z
- 2. Click ①. Close File Information form and the object display of WorkForm will be changed

4.17 Histogram

In [window] menu, select [Histogram] or click tool bar $\int \mathcal{N}$.

4.17.1 Function Outline

Display brightness distribution of loaded image data with histogram.

Result Handled Case

Histogram of Head MRI Image



Figure 4.17.1 Histogram

4.17.2 Screen Description



Figure 4.17.2 Histogram

No.	Items	Descriptions	
1	Histogram	Indicate brightness distribution	
2	Display Mode	Indicate either Normal (standard form) or, Logarithm (log	
		form)	
3	Window Width	Window Width number	
		It is illustrated on the graph with light green width	
4	Window Center	Window Center number	
		The position is displayed with green line on the graph	

4.17.3 Setting

• Switch between Normal (standard form) and Logarithm (log form)

When right click on the form, the context menu will appear.

Select [Normal] from the context menu and histogram will be displayed at Normal form. Select [Logarithm], histogram will be displayed at log form.



Figure 4.17.3 Context Menu



Figure 4.17.4 Histogram in log form

4.18 Slice View

From [Window] menu, select [Slice View].

4.18.1 Function Outline

Display image in different plane relations like XY, YZ, and XZ. But the image in shape data cannot be displayed.

4.18.2 Screen Description



Figure 4.18.1 Slice View Form

No.	Items	Descriptions
1	File Name	Display loaded file name
2	XY Plane	Display XY plane image and information
	(XY Plane Image)	
3	XY Plane	Specify XY plane position
	Position Track Bar	

No.	Items	Descriptions
4	XY Plane	Move the XY plane position towards minus direction
	Movement Button (-)	
5	XY Plane	Move the XY plane position towards plus direction
	Movement Button(+)	
6	YZ Plane	Display YZ plane image and information
	(YZ Plane Image)	
$\overline{\mathcal{O}}$	YZ Plane	Specify YZ plane position
	Position Track Bar	
8	YZ Plane	Move the YZ plane position towards minus direction
	Movement Button(-)	
9	YZ Plane	Move the YZ plane position towards plus direction
	Movement Button(+)	
10	XZ Plane	Display XZ plane image and information
	(XZ Plane Image)	
1	XZ Plane	Specify XZ plane position
	Position Track Bar	
(12)	XZ Plane	Move the XZ plane position towards minus direction
	Movement Button(-)	
(13)	XZ Plane	Move the XZ plane position towards plus direction
	Movement Button(+)	

• Inside Image Display



Figure 4.17.2 Inside Image Display Information

No.	Items	Descriptions
1	Plane Name	Indicate type of plane (XY, YZ, and XZ)
2	Intersection	XY,YZ,XZ coordinate of plane intersection
	Point	
3	Screen size	The maximum value on X, Y, Z bars

4.18.3 Operation Guide

• If XY plane is moved, the screen display will change.

1. Move the slide bar of Form 3 from side to side. Use Form 4 and 5 buttons for more detailed adjustment



Figure 4.18.3 XY Plane Display

- If YZ plane is moved, the screen display will change
 - 1. Move the slide bar of Form ⑦ from side to side. Use Form ⑧ and ⑨ buttons for more detailed adjustment



Figure 4.18.4 YZ Plane Display

 $\circ If XZ$ plane is moved, the screen display will change

1. Move the slide bar of Form ① from side to side. Use Form ① and ③ buttons for more detailed adjustment



Figure 4.18.5 XZ Plane Display

- \circ Replace the displayed screen (when loading multiple data)
 - 1. Press 1 button to replace a file name
 - 2. Replace WorkForm activity at the same time
- Display slice editing form (with volume data)
 - 1. Double click Form (2), or Form (6), Form (1)

4.19 Slice Edit

Double click the displayed screen in slice form.

Double click XY plane image, an editing screen will appear corresponding to XY plane, Double click YZ plane image, an editing screen will appear corresponding to YZ plane, Double click XZ plane image, an editing screen will appear corresponding to XZ plane. As for Slicing Display Form, see [4.18 Slice View].

4.19.1 Function Outline

Edit slices.

With single slice and multi slices as objects^{*4.19.1}, it is possible to paint pens and rectangles.

*4.19.1 Edited Object

It refers to slicing within specified scope at single slice mode and multi slice mode.

4.19.2 Screen Description



Figure 4.19.1 Slice Correction Form

No.	Items	Descriptions
1	Screen	Display the plane image
2	Pen Drawing	Draw pen
3	Rectangle Drawing	Draw rectangle
4	Dropper	Specified color is sucked up
5	Pen Thickness	Specify the thickness of pen
6	Multi Slice Mode	Change the slice mode
	Mode Switch	
\bigcirc	Start Slice Number	Specify the start slice of multi slicing
8	End Slice Number	Specify the end slice of multi slicing

No.	Items	Descriptions
9	Painting Brightness	Brightness for corresponding paint
10	Painting Color	Current selecting color
(1)	Painting Color	Select painting color
	Selection Track Bar	
(12)	Save Button	The contents of edit are applied without closing form
(13)	Reset Button	Abandon edited image
(14)	Preview	Choose whether to apply WindowW/L with respect to
	WindowW/L Mode	the display of (1) , (1) , (1)
(15)	Screen Minimizing	Use $\textcircled{1}$ to minimize the displayed screen
	Button	
(16)	Screen Magnifying	Use $\textcircled{1}$ to magnify the displayed screen
	Button	
1	Number Indicating	Use $\textcircled{1}$ to specify the displayed screen slicing
	Sliced Bar	
(18)	Slice Number	Use $\textcircled{1}$ to display the screen number
(19)	Fit to Screen	If the check is On, to view the entire image on the screen
20	OK Button	Close and apply the edited image
21)	Cancel Button	Close and cancel the edited image

4.19.3 Operation Guide

• Change image size

- 1. Change the size of (15) and (16). If the size goes beyond the scope of (1), use scroll bar in (1) to show it
- 2. Or right click on ①, the top position is for enlarging and the bottom position is for minimizing
- Change the slice on display
 - 1. Move the scroll bar in 1. On the left is 1 while the maximum number is on the right
 - 2. Or input number into (18)
- Valid the WindowW/L mode Add Check box in (1).
- Invalid the WindowW/L mode Delete Check box in (1).
- Pen Drawing
 - 1. Click ②
 - 2. Use (5) to specify thickness of pen
 - 3. Click on 1 and make drawing on it ^{*4.19.2}

*4.19.2 Points that need attention in pen drawing

In multi-slicing form, when specifying multi slice within the designated scope, the handling takes longer time after clicking is done. • Rectangle painting

- 1. Click ④
- 2. On ①, drag the image rectangle painting
- 3. Draw the rectangle shape by connecting the starting point and ending point
- Change single slicing form Delete Check box in **6**.
- Change into multi slicing form Add Check box in (6).
- Change the first slice Input number in ⑦.
- Change the last slice Input number in (8).
- Use Dropper Mode
 - 1. Click 4
 - 2. Click on Reading Mode (1)
 - 3. Take color from the area clicked, replace it with the color in Editing Mode 9-11
- Change painting color
 - 1. Move the Editing Mode (1) up and down. Brightness becomes weak at the top while brightness becomes stronger at the bottom
 - 2. And input brightness number into Editing Mode (9), the brightness will change
- Restore the screen to its previous state Click [Ctrl+Z] Key.

4.19.4 Cut out or extract any shape from the slice screen

Multiple Primitives can be drawn on the slice screen and can be clipped or extracted within the specified range.



Figure 4.19.2 Slice Edit Form(AnyShapes)

No.	項目	説明
1	➡Add Shape	Change to [Add Shape] Mode
		Left click to add a point on the screen
		Right click to confirm the shape
2	★Clear Shape	Delete all shapes on screen
3	Edit Shape	Change to [Edit Shape] Mode
	_	Move a point on the mouse cursor with left drag
		Right click to delete a point
		Left click with 2 points changed to red,
		add a point between 2 points
4	Copy Shape	Duplicate the shape added just before to the
		current slice image range
(5)	Reverse Selected	Select whether the filling execution range is inside
	Range	the shape or outside, specify the thickness of the
		pen
6	✓ Apply	Fills or extracts the range of the specified shape
$\overline{\mathcal{O}}$	←Undo	Fold back the result to the previous state
8	Select-Curve	Curves shapes for additional operation
9	Select-Polygon	Polygons shapes for additional operation

- Add Shape
- 1. Click + and change to [Add Shape] mode
- 2. Click \triangleleft or \triangleright and select to shape type
- 3. Each time you left-click on the slice screen, points are added and the line segment changes. The more points, the finer the line segment can be adjusted
- 4. Right click to confirm the shape and automatically go to [Edit Shape] mode

Edit Shape

- 1. Click 💪 and change to [Edit Shape] mode (This operation is unnecessary if it is just after adding a shape)
- 2. When you move the mouse cursor to a point, it changes to yellow, so if you drag left in this state, you can edit the range of the shape

\circ Reverse Selected Range

1. Click this will change the execution range of the fill. At this time, only the brightly displayed area becomes the extraction range



Figure 4.19.3 Add shape, Edit shape, and Reverse selected range

 \circ Copy shapes and multi slices

- 1. Move to other slice
- Click and duplicate the shape you just added (Ex: Add shapes to the 100th sheet, move to the 150th sheet and press the copy button, the same shape is duplicated on the 100th to 150th sheets)
- 3. After the above operation, as you drag the point to the duplicated shape left drag it automatically interpolates and approximates the shape between

• Perform clipping or extraction with shapes

- \circ Undo result
- 1. Press the \Leftarrow button to return the operation to the previous position



Figure 4.19.4 Result and Undo Operation

4.20 DICOM Manager

From [Window] menu, select [DICOM Manager].

4.20.1 Function Outline

It operates Explorer and is a tool to manage DICOM file. It has the following three functions.

• DICOM Managing Function

In stratum^{*4.20.1} it manages DICOM data and indicate that stratum. It performs display switch, head addition & deletion and sorting.

Launch Function

Send data to Main Frame and WorkForm and display screen.

• Screen Display Function

Display the selected DICOM data screen and tag information.

*4.20.1 About DICOM Data Stratification

Stratify DICOM data automatically according to the following sequence.

- 1. Make a list of DICOM data under DICOM Root.(As for DICOM Root setting, see [DICOM Manager] in Chapter 6 [Various Setting])
- 2. Analyze tag information of DICOM data and log onto data base.
- 3. The stratified sequence becomes the following: 「(Patient)」「(Modality)」「 Study date」
- 4. Display Tree in the dialogue at the sequence in 3.

In CT/MRI, one check will turn into one dataset which is recognized according to tag information in this system. Even if DICOM data file is placed in other files, the dataset with a tree structure can still be identified.

4.20.2 Screen Description

 \circ Main Form

DICOM Manager		
🖃 📲 cache	Name 🛆	
🖻 🎍 0007334665 : DOI AKIO : N	20070507	
······ <u>(</u> 20070507	2	
(1)		

Figure 4.20.1 DICOM Managing Tool

No.	Items	Descriptions
1	Stratum Indication	Display DICOM screen in stratum form
2	Stratum Content	Display selected stratum content

\circ Context Menu of Main Form

1	Display 🕨 🕨	Icons
2	Choose Columns	 Details
3	Select All	
4	Property	

Figure 4.20.2 DICOM Context Menu of Managing Tool

No.	Items	Descriptions
1	Display	Switch display modes
	Display Switch	
	of	
	Stratum Content	
2	Choose	Select displayed items in Details of $\textcircled{1}$
	Columns	
	Display Head	
	Selection	
3	Select All	Turn all the displayed items into selection state
4	Property	Display screen data in screen display form

Column Selection Form



Figure 4.20.3 Column Selection Form

No.	Items	Descriptions
1	Name	Display file name or not
2	Seq No	Display management number in Tool or not
3	Study UID	Display Study ID or not
4	Series UID	Display Series ID or not
(5)	Body Part	Display body part or not
6	Accession Number	Display accession number or not
$\overline{\mathcal{I}}$	Institute	Display institute number or not
8	Physician	Display Physician or not
9	Description	Display description or not
10	Series No.	Display Series No or not
1	Image No.	Display Image Number or not
(12)	ОК	It applies to selected result in main form
13	Cancel	Give up content change. Closing Form

• Screen Display Form



Figure 4.20.4 Screen Display Form

No.	Items	Descriptions
1	Screen display	Display the selected screen

• Context Menu of Screen Display Form

1	- Tag Information
2	Previous

(3) Next

Figure 4.20.5 Context Menu of Screen Display Form

No.	Items	Descriptions
1	Tag Information	Switch between Having Tag information and No Tag
	Switch	Information
2	Previous	the previous item in the same stratum form
3	Next	the next item in the same stratum form

4.20.3 Operation Description

• Stratum Content Switch Display

- 1. Right click on Main Form ② and the context menu of Main Form will be opened
- 2. Target the cursor at the context menu of Main Form and click the submenu Icon or Details
- 3. Stratum and image file can be displayed in Icon. The image file is displayed in thumbnail and Details are displayed in a form of list

• Switch List Sort Condition (Only in List Form)

- 1. In List Head of Main Form ①, click the item that needs to be sorted
- 2. Click it again for reversing the sorting
 - 1. In List Head of Main Form ①, click the item that needs to be sorted.
 - 2. Click it again for reversing the sorting.

• Display image in screen display form.(pattern:1)

- 1. Select the screen to be displayed
- 2. Right click and open the context menu of Main Form

•Display image in screen display form.(pattern:2)

1. Double click the screen to be displayed

• Tag Information Display on Switch Screen Display Form

- 1. Right click on Main Form and the context menu of Main Form will be opened
- 2. Click the context menu 1 in screen display form
- List Head Addition / Deletion
 - 1. Right click on Main Form ② to open the context menu of Main Form
 - 2. Click the context menu ② of Main Form
 - 3. In column selection form, decide the items to added or deleted
 - 4. Click column selection form 1

• Display selected image cluster in volume data

- 1. Select a large number of images
- 2. Drag or drop them in Main Frame
- \circ In selected image cluster, switch volume data in WorkForm
 - 1. Select a large number of images
 - 2. Drag or drop them in Main Frame

4.21 Measuring Function

Measurement cannot be performed in WorkForm with nothing volume data.

From [Window] menu, select [Measure Manager], or click tool bar

4.21.1 Function Outline

It can measure distance, angel and area of each specified line segment, angel and domain in WorkForm. It can also measure their volume by means of both Volume Rendering form and Index Image form.

After volume measurement, it can change screen brightness of 3D image filter, segmentation and area expansion. When clipping is performed, measurement domain display won't work.

\circ One Processed Case

Domain specification case of cross-segmentation area (As shown in Figure 4.21.1) and the measuring result. (As shown in Figure 4.21.2)



Figure 4.21.1 Domain specification of segmentation area

Me	easure Ma	inager			×
	Distance	Angle	Area	Volume	
[Name		Sol	ution(mm^2)	ΤĹ
	🔽 Area0			19710.901	1
		Ac	bt	Delete	

Figure 4.21.2 Measuring Result

4.21.2 Screen Description

M	easure Ma	mager			61	×
(1	D	Anala	Area	ba	u 	V
1	Distance	Angle	nica		ume	E1
	Name		So	lution(μm 2)	
		`		20	189.930	
	୯ ଓ	,		4	,	-
						-
						-
						-
						-
	0					-
	(5)	Distar	nce			-
		Angle				-
		Area				-
		Volun	ne			
		·				
		6 Ad	d	D	elete	
		8) Cano	cel	9 8	àve	1
		U o o o n				

Figure 4.21.3 Measure Manager

No.	Items	Descriptions
1	Tub control	Select the type of measurement
2	Check Box	Switch between WorkForm and Non WorkForm
		Display the checked item
3	Name	Display the name of measuring result
4	Measuring results	Display measuring result
5	Measurement	Select the type of measurement
	selection	
6	Add Key	Display (5)
$\overline{\mathcal{I}}$	Delete Key	Delete the selected measuring result.

No.	Items	Descriptions
8	Cancel Key	Cancel the measurement
9	Save Key	Save the measurement result in csv format (Measurement division, will include the name, number, the unit)
10	×Key	Close Measure Manager form.

4.21.3 Operation Guide

 \circ Measuring distance

- 1. Click Add key, select [Distance]
- 2. Click on the segmented image and add measurement points (As shown in Figure 4.21.4)
- 3. Make a right-side click, or click the area around the added points to decide the items to be measured. Remember at least two measurement points must be added
- 4. Unfold [Distance] of Measure Manager Form, attach measuring result



Figure 4.21.4 Distance Measurement Points Addition

Angle Measurement

- 1. Click Add key and select [Angle]
- 2. Click on the segmented image, add three more measurement points. (As shown in Figure 4.21.5)
- 3. Unfold [Angle] in Measure Manager form and add measuring result



Figure 4.21.5 Angle Measurement Points Addition

\circ Area Measurement

- 1. Click Add key and select [Area]
- 2. Click on the segmented image and add measurement points.^{*4.21.1} (As shown in Figure 4.21.6)
- 3. Do click right-side or the vicinity of initially added points to decide the element to be measured. More than three measurement points should be added
- 4. Unfold [Area] of Measure Manager and add measuring result



Figure 4.21.6 Area Measurement Points Addition



 \circ Measuring volume

- 1. Click Add key, select [Volume]
- 2. Unfold [Volume] of Measure Manager form and add measuring result.^{*4.21.2}

*4.21.2 Volume measurement

Volume measurement will become brightness area specified by "Visible" with color tablet displayed by volume. As for color tablet displayed by volume, refer to [Volume Rendering], [Point-Based Volume Rendering] and [Index Image] in Chapter 4 [Function Descriptions].

 \circ Delete measuring result $^{*4.21.3}$

- 1. Select measuring result to be deleted
- 2. Click Delete button

*4.21.3 Things that can be deleted and things that can not be deleted

The Delete button can only delete the measurement input by uses. However, it cannot delete measurement type like [Distance]

 \circ Change measurement name ^{*4.20.4}

- 1. Select a measurement name to be changed
- 2. Click name
- 3. Input a new name
- 4. Click Enter button

*4.21.4 Things that can change names or things that cannot change names

Name change is only confined to the measuring result input by the user. Measuring type name such as [Distance] cannot be changed.

• Change measuring point

- 1. Select to change measuring point as a measuring result
- 2. In WorkForm, drag the measuring point to be changed (drag the apex when measuring area)

OCancel the measurement

1. The user presses the Cancel button 1. During a measurement mode

 \bigcirc Save the measurement result

- 1. Pressing the Save button
- 2. Specify the file name in the file save dialog, to save (Figure 4.21.7)

	A	В	С	D
1	[Distance]	Distance0	111.641	(um)
2	[Distance]	Distance1	177.381	(um)
3	[Angle]	Angle0	46.36	(deg)
- 4	[Area]	Area0	20189.94	(um^2)
5	[Volume]	Volume0	9999366	(um^3)
-				

Figure 4.21.7 display the output of the measurement result

OChange angle of cross section image

In conjunction with Cross Section, you can perform measurement with respect to the inclined section. For more information, please refer to the control form of Chapter 4, "3D Cross Section".



Figure 4.21.8 Conjunction Measure-View and Cross-Section

4.21.4 Setting

As for display color setting for measurement, refer to [Measure Manager] in Chapter 6 [Various Setting].

4.22 WindowW/L

WindowW/L cannot be used in WorkForm that does not contain volume data. In [Window] menu, select [WindowW/L].^{*4.21.1}

4.22.1 Function Outline

WindowW/L is to display the extracted brightness scope through specified window width and window level.

WindowW/L is to display the extracted brightness scope through specified window width and window level.

The contrast becomes weaker when window width is enlarged. On the contrary, the contrast becomes stronger when window width is minimized. If window level becomes bigger, the screen turns darker and it turns brighter when window level becomes smaller.

One Handled Case





Figure 4.22.1 Width: 636, Center: 318

Figure 4.22.2 Width: 200, Center: 318



Figure 4.22.3 Width: 636, Center: 131



Figure 4.22.4 Width: 200, Center: 131

*4.22.1 WindowW/L Notation It can be called Window setting. Besides, "Window Center" is also called Window Level".

4.22.2 Screen Description



Figure 4.22.5 WindowW/L Form

No.	Items	Descriptions
1	WindowW/L Mode	Validize WindowW/L setting
	Form ON/OFF	
2	Preset Selection	Select for preset parameters.
3	Window Width	Specify for window width at the track bar
	(Track Bar)	
4	Window Width	Specify for window width at the numerical text
	(Numeric)	
5	Window Center	Specify for window level at the track bar
	(Track Bar)	
6	Window Center	Specify for window level at the numerical text
	(Numeric)	
$\overline{\mathcal{O}}$	Close Button	Close the WindowW/L Form
4.22.3 Operation Guide

 \circ Set by means of Control key

Make specification by moving track bar up and down. (Figure 4.22.5 ③-⑥), or by inputting correct number and making proper and careful adjustments through image check.

• Make specification by hand on screen

On the plane section, specify by right clicking the mouse.

It can adjust window width and window level at the same time, so it is good for visual screen observation.

Clicking Direction	Number Change
Up	Decrease Window Center
Down	Increase Window Center
Left	Increase Window Width
Right	Decrease Window Width

Change Presetting

Select from ② of drop down list (As shown in Figure 4.22.5). "Default" of initial setting value^{*4.22.2}, can be remembered if set by hand, including information in "Bone condition""Lungs Field""Mediastinum""Abdominal PLN""AbdominalCE" except "Custom".

*4.22.2 Initial set value of WindowW/L

It basically reflects the information quantity of WindowW/L" with DICOM tag. When loading data set that does not have "WindowW/L" of DICOM tag, set window width and window level automatically from brightness width with volume data.

4.23 Screen Capture Function

Click tool bar

4.23.1 Function Outline

Save the active WorkForm on display in an image file with full color (24bit) BMP.

4.23.2 Operation Guide

• Save WorkForm status in an image file

- Click tool bar , which displays form of saving with a file name
 Input the file name and click [Save] key

Chapter 5 Mesh Editing Function

5.1 Summary

A feature that is included in the [Mesh Editing] menu, you can edit the mesh data. If you select from the menu, "execution of a function" or, "change of mesh editing mode" will be performed. However, it will be the end of the operation mode if you select the menu again in the mode of running. The current mode can be known from the status bar or check mark, the menu. (As shown in Figure 5.1.1)

The other than function of [Polygon Information] will be forcibly terminated when you switch WorkForm. In addition, it becomes the treatment which closed form without canceling also when cancellable Confirmation Form is displayed.

[Filling-Vertex], [Filling-Edge], [Filling-Ring], [Filling-Ring-OuterSelect], [Reverse-Manual], and [Delete-Manual] is possible the end of the mode by [Esc] key.



Figure 5.1.1 Mesh Editing Mode

Display Status	Mode
Reconstruction/Reduction	Reconstruction/Reduction (5.2)
Smoothing	Smoothing (5.3)
Filling- Vertex	Manual filling starting from Vertex (5.4)
Filling- Edge	Manual filling starting from Edge (5.5)
Filling- Ring	Manual filling starting from Ring (5.6)
Filling- Ring-Outer Select	Manual filling from Ring-Outer Select (5.7)
Reverse-Manual	Reverse-Manual (5.8)
Delete-Manual	Delete-Manual (5.9)
Filling-Auto	Filling-Auto (5.11)
Reverse-Auto	Reverse-Auto (5.12)
Delete-Auto	Delete-Auto (5.13)

5.2 Reconstruction/Reduction

Select [Reconstruction/Reduction] on [Mesh Editing] menu, and the [Reconstruction/Reduction] dialog will be appeared.

5.2.1 Function Outline

This dialog is used to execute [Reconstruction] or [Reduction] of the polygon. Here, [Reconstruction] can improve polygon shape with maintaining the accuracy of the polygon, and reduce the number of polygons at the same time. It is suitable to use 3D printer. [Reduction] reduce the number of polygons by setting "number of reduction targets"(*5.1) of polygon, make the reduction of the polygon shape to be equal to or less than the "number of reduction targets". If you prioritize the use of 3D printer or polygon accuracy, [Reconstruction] should be selected. If you prioritize the number of polygons, [Reduction] would be fine.

You can use [Undo] button of [Reconstruction/Reduction] dialog to undo the previous situation only once. In addition, the [Undo] information will be discarded when the dialog is closed. [Undo] button does not work until you perform a [Reconstruction] or [Reduction] functions.

*5.1 Number of Reduction targets

First, [Reduction] function calculates the importance to each polygon. The importance means the model feature of polygon shape, and if the value is larger, it represents the important characteristics of the polygon model. In [Reduction] function, in order to maintain model features, the polygon with lower weight of importance will be selected, and deleted firstly. When the polygons have the same importance, the polygons will be deleted simultaneously. Therefore, it may be different form the number of reduction targets (final target value).

\circ Result Handled Case

Select the polygon accuracy "Middle" of the reconstruction result as shown in Figure 5.2.1. Select the reduction ratio 20% of the reduction result as shown in Figure 5.2.2.



Figure 5.2.1 Result of Polygon Reconstruction (Before => After)



Figure 5.2.2 Result of Polygon Reduction (Before => After)

5.2.2 Screen Description

Polygon Reconstruction/Reduction	×
Reconstruction (3) (4)	1
Depth C Low Middle C High	
(5) 🗖 Input 🛛 (6) 8 🚍	
C Reduction	1
Ratio(%) 8 9 50 -	
Polygon 🛈 3324224 -> 🛈 1662112 🚍	
Num of Polygon 🛈 3324224	
(13) (14)	
Undo Execute	

Figure 5.2.3 Reduction Form

No.	Items	Descriptions
1	Reconstruction	Select [Reconstruction] mode
	(Radio Button)	
2	Low	Configuration in the polygon accuracy "Low"
		\rightarrow Automatically set to polygon accuracy 6
		Data is small, but accuracy will be lower
3	Middle	Configuration in the polygon accuracy "Middle"
		\rightarrow Automatically set to polygon accuracy 8
		This is the default setting
4	High	Configuration in the polygon accuracy "High"
		\rightarrow Automatically set to polygon accuracy 10
		Accuracy is high, but the data will be larger
5	Input check box	Select enable or disable the accuracy of manual
		input operation
		Default check is OFF (disabled)
6	Input polygon accuracy	⑤ of the check is ON the case of a (valid), you
		can change the number manually (input range is
		1 to 12)
$\overline{\mathcal{O}}$	Reduction	Select [Reduction] mode
	(Radio Button)	
8	Reduction Rate Track	Specify reduction rate of polygon number
	Bar	
9	Reduction Rate	Display reduction rate of polygon number
	Numeric	Input the number on keyboard
10	The Total Number of	Display the total number of polygons of model
	Polygons	data
1	Polygon Reduction	Display polygon number to be reduced
	Numeric	Input the number with keyboard
12	Num of Polygon	Display current number of polygon triangles
13	Undo	Restore polygons in the previous state
(14)	Execute	Execute [Reconstruction] or [Reduction]

5.2.3 Operation Guide

 \circ Change polygon number for reduction according to reduction ratio

- 1. Click on the left and move reduction rate track bar from left to right to fix reduction rate
- 2. Change the polygon number of reduction to match the reduction ratio

 \circ Directly change polygon number for reduction

- 1. Input the target number into Polygon Reduction Number Box
- 2. Change the reduction rate to match the target number

5.3 Smoothing

From [Mesh Editing] menu, select [Smoothing] and smoothing dialog is displayed.

5.3.1 Function Outline

Execute sampling^{*5.2} on a model, then smoothing process are executed. Undo operation can execute only once after smoothing operation. It is recommended to save file trying to execute smoothing operation many times.

*5.2 Sampling

It refers to gather data of particular vertex group in polygons. Smoothing operation implements by moving vertexes of polygons, on the occasion of calculating moving distance of a certain vertex, it is calculated based on gathered data of neighbor vertexes.

Result Handled Case

The smoothing results are below. (As shown in Figure 5.3.1)





Figure 5.3.1 Smoothed Result

5.3.2 Screen Description



Figure 5.3.2 Smoothing Dialog

No.	Items	Descriptions
1	Iteration Number Box	Display iteration number of smoothing
		operation. Input the number with keyboard
2	Preserve Edge Corner	Check box on when you wish to preserve
	Specification	corners of polygons
3	Wide Sampling Area	Specify extending sampling area or not
	Specification	

4	Parameter Setting	Specify permitting to input smoothing
	Specification	parameter or not
5	Smoothness Track Bar	Specify smoothness rate of polygon with track
		bar
6	Smoothness Box	Specify smoothness rate of polygon with
		keyboard
\bigcirc	Retain Edge Track Bar	Specify retain rate of edge with track bar
8	Retain Edge Box	Specify retain rate of edge with keyboard
9	Undo	Restore polygons in the previous state
10	Execute(Smoothing)	Execute smoothing at the current specification

5.3.3 Operation Method

• Smooth whole model

- 1. Input the number into [Iteration Number Box] to set iteration times of smoothing operation. A large effect can be expected with increasing iteration times, but there are cases which the shape of polygon is very different from original shape of it when too large iteration number is given
- 2. Click [Wide Sampling Area Check] on and it has an effect to smooth whole model to make more even. But there are cases which it has no effect on surface which is nearly flat from start
- 3. Click [Parameter Setting Check] on and it enables for parameter to be entered. Entering the small number into [Smoothness Number Box] reduces the effect of smoothing

• Smooth retaining angular parts of model

- 1. Click [Preserve Edge Corner Check Box] on and smoothing operation is executed in preserve corners
- 2. Click [Parameter Setting Check] on and it enables for parameter to be entered. The smaller number entering into [Retain Edge Number Box], the more angular parts of model are preserved when smoothing operation is executed

5.4 Manual Filling From Vertex Selection

From [Mesh Editing] menu, select [Filling-Vertex] to enter a mode of Manual Filling Starting from Vertex.

5.4.1 Function Outline

Choose three vertexes to make a new polygon. The outside and inside of the new polygon is determined by its selected sequence.^{*5.3}

*5.3 Selected Vertex Sequence

When selecting vertex in clockwise way, it becomes a polygon facing outward. When selecting vertex in anti-clockwise way, it becomes a polygon facing inward. (As shown in Figure 5.4.1)



Outside Figure 5.4.1 Polygon Facing



Inside

• Result Handled Case Filling Case (As shown in Figure 5.4.2)



Figure 5.4.2 Filling Case

5.4.2 Operation Guide

• Select Vertex

Press [Shift] key and click the left to select vertex. The selected vertex turns into the specified color.^{*5.4}

<u>*5.4 Specified Color</u>
 The color of vertex, edge and polygon should all be specified for change.
 As or color specification, refer to [Mesh Editing Function] in Chapter 6 [Various Setting].

• Terminate Filling Mode half way

Select [Filling-Vertex] from [Mesh Editing] menu in vertex selection.

 \circ Restore filling to the original status.

Press [Ctrl+Z] key or select [Undo Edited] from [Mesh Editing] menu.

5.5 Manual Filling From Edge Selection

From [Mesh Editing] menu, select [Filling-Edge] to enter a mode of Manual Filling from Edge.

5.5.1 Function Outline

Select open edges^{*5.5} that makes holes of model data for one more time filling.

*5.5 Open Edge

Open edge refers to the edge that is not adjacent to polygons. Any hole and polygon edge of model end are open edge.

OResult Handled Case

Filling Case (As shown in Figure 5.5.1)



Figure 5.5.1 Hole Filling Case

5.5.2 Operation Guide

• Make Filling

- 1. Press [Shift] key and click the left side to select open edge for filling. Confirm the mode
- 2. After confirmation, click [Execute] key and click [Cancel] for canceling

Fill	ing-Edge	×
	Execute	
	Reverse	
	Cancel	

Figure 5.5.2 Mode Confirmation

• Reverse the filled polygon

In confirmation mode, click [Reverse] key and replace the inside of the polygon with the outside of polygon.

• Terminate hole-filling mode half way

Before selecting open edge, select [Filling-Edge] from [Mesh Editing] menu. After filling is finished, click [Cancel] key in confirmation mode of Filling –Edge.

 \circ Restore the filled shape to its original status.

Press [Ctrl+Z] key, or select [Undo Edited] from [Mesh Editing] menu.

5.6 Manual Filling From Ring Selection

From [Mesh Editing] menu, select [Filling-Ring] to enter a mode of Manual Filling from Ring Selection

5.6.1 Function Outline

It makes filling through selecting rings.^{*5.6} In selecting rings, make the longest ring as the outside so that other smaller rings cannot change into polygons. If the outside ring is shorter than other inside rings, see [5.6 Manual Filling Outside the Ring].



Result Handled Case

Filling Result (As shown in Figure 5.6.1)



Figure 5.6.1 Filling Result

5.6.2 Operation Guide

• Making Filling

1. Press [Shift] key and click on the right mouse key. After one ring is selected, a confirmation window will come up. At this time, [Execute] does not work. And filling cannot be done. (As shown in Figure 5.6.2)



Figure 5.6.2 Filling Result

2. When the next ring is selected, [Execute] in confirmation mode will work and filling can be executed. (As shown in Figure 5.6.3)



Figure 5.6.3 Select the next ring

Reverse filled polygon

In confirmation window mode that comes up after filling, click [Reverse] button and reverse the filled polygon.

• Terminate Filling Mode

Before selecting a ring, select [Filling-Ring] from [Mesh Editing] menu. Click [Cancel] key in confirmation window mode to cancel filling

 \circ Restore filled polygon to its original status.

Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

5.7 Manual Filling From Outer Ring Selection

From [Mesh Editing] menu, select [Filling-Ring-Outer Select] and enter mode of filling-ring-outer selection.

5.7.1 Function Outline

It performs multi ring filling. If the first selected ring is outside the shape, make a polygon without having the edge overlap other edges. Selecting outer ring is different from what is described in [5.6 Manual Filling From Ring Selection].

• Result Handled Case

Filling Case (As shown in Figure 5.7.1)



Figure 5.7.1 Filling Result

5.7.2 Operation Guide

• Make Filling

1. Press [Shift] key and click at the left to select the most outward ring. Then a confirmation form will come up. At this time, [Execute] does not work. And filling cannot be done (As shown in Figure 5.7.2)



Figure 5.7.2 Selecting Outer Ring

2. When the next inner ring is selected, [Execute] in confirmation mode will work and filling can be executed. (As shown in Figure 5.7.3)



Figure 5.7.3 Selecting Inner ring Rings

•Reverse filled polygon

In confirmation mode that comes up after filling, click [Reverse] button and switch the inside and outside of the filled polygon.

oTerminate Filling Mode half way

Before selecting edge, select [Filling-Ring-Outer Select] from [Mesh Editing] menu. Click [Cancel] button in confirmation mode when selecting one more edge.

• Restore filled polygon to its original status.

Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

5.8 Manual Reversion

From [Mesh Editing] menu, select [Reverse-Manual] and enter manual reversions mode.

5.8.1 Function Outline

Select polygons and reverse the inside out.

\circ Result Handled Case

Reversion Case (As shown in Figure 5.8.1)



Figure 5.8.1 Reversed Results

5.8.2 Operation Guide

 \circ Make reversion

Press [Shift] key and click at the left key to select the polygon to be reversed.

- Terminate reversion mode half way Select [Reverse-Manual] from [Mesh Editing].
- Restore the reversed object to its original status.
 Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

5.9 Manual Deletion

Select [Delete-Manual] from [Mesh Editing] menu and enter Manual Delete Mode.

5.9.1 Function Outline

Select polygons for deletion.

\circ Result Handled Case

Deletion Case (As shown in Figure 5.9.1)



Figure 5.9.1 Deletion Result

5.9.2 Operation Guide

Perform Deletion

Press [Shift] key and click at the left key to select the polygon to be deleted.

•Terminate manual deletion half way

Select [Delete-Manual] from [Mesh Editing].

• Restore the deleted object to its original status.

Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

5.10 Auto Modification

From [Mesh Editing] menu, select [Auto-Modification] to enter a mode of Auto Modification.

5.10.1 Function Outline

"Auto Filling", "Remove duplicates-face", "Auto Delete" is executed in the order. A check mark is displayed in the [Auto-Modification] is on the menu, but the mode display on the status bar will be [Delete-Auto]. Also, become subject to undo only [Delete-Auto]. If you exit without performing the delete, [Undo Edited] is disabled state.

5.10.2 Operation Guide

oExecution

It will perform, if [Auto-Modification] is chosen from the [Mesh Editing] menu, and finally Auto Deletion Modes is display. Please refer to the section "5.13 Auto Deletion" for a description of the Auto Deletion Form.

5.11 Auto Filling

From [Mesh Editing] menu, select [Filling-Auto] and enter auto filling mode.

5.11.1 Function Outline

Automatically check out holes of model data and perform filling.

Result Handled Case

Filling Case (As shown in Figure 5.11.1)



Figure 5.11.1 Filling case

5.11.2 Operation Guide

• Perform Filling

Click [Execute] key in confirmation mode that comes up after filling.



Figure 5.11.2 Confirmation Form

Delete Filling Result

Click [Cancel] key in confirmation mode that comes up after filling.

• Restore the filled object to its original status.

Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

5.12 Auto Reversion

From [Mesh Editing] menu, select [Reverse-Auto] and enter Auto Reversion Mode.

5.12.1 Function Outline

It can automatically reverse the polygon' inside outward. If the inside and outside reversion fails^{*5.7}, refer to [5.8 Manual Reversion].

*5.7 Failure Case of Inside and Outside Reversion

Failure occurs if the inside and outside of surrounding polygons are mixed up.

• Result Handled Case

Reversion Case (As shown in Figure 5.12.1)



Figure 5.12.1 Reversion Result

5.12.2 Operation Guide

\circ Perform Reversion

Click [Execute] key in confirmation mode that comes up after reversion.



Figure 5.12.2 Confirmation Form

 \circ Delete Reversion Result

Click [Cancel] key in confirmation mode that comes up after reversion.

• Restore the reversed object to its original status. Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

5.13 Auto Deletion

From [Mesh Editing] menu, select [Delete-Auto] and enter auto deletion mode.

5.13.1 Function Outline

Divide polygon chuck of model data into groups and perform deletion by group.

Result Handled Case

Deletion Result (As shown in Figure 5.13.1)



Figure 5.13.1 Deletion Result

5.13.2 Screen Description



Figure 5.13.2 Auto Deletion Form

No.	Items	Descriptions
1	Group	Display polygon group number in sequence
	(Polygon Group No List)	
2	Number	Display the number of polygons in each group
	(Polygon Number List)	
3	Threshold of Polygon	Specify the threshold of polygons
	Polygon Number	Polygon group under the specified threshold will
	Threshold Track Bar	enter selection status in a list
4	Polygon Number Box	Specify the threshold of polygons
		Polygon group under the specified threshold will
		enter selection status in a list
(5)	Execute Deletion	Delete polygon group selected from the list

5.13.3 Operation Guide

Select polygon group

Select the group to be deleted in the polygon group list (As shown in Figure 5.13.3). The display of selected polygon group will change in WorkForm. Press [Ctrl] key and click the left key at the same time to make multiple selection.



Figure 5.13.3 Polygon Group Selections

• Select polygon group with threshold of polygon

Change threshold with the threshold track bar. Polygon group under the specified threshold will enter selection status in a list. (As shown in Figure 5.13.4)



Figure 5.13.4 Threshold Change

Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

- \circ Extract only the required polygon group
 - 1. Enter a low value, such as thresholds 100 directly, the group needed to confirm that not highlighted on the work form, (not selected)
 - 2. After determining the threshold, and then press the Execute button
 - 3. The remaining one group was to select only unwanted group from the list, press the Execute button again (if unnecessary groups is large, repeat 1-2 step first)
 - 4. Repeat 1 to 3, and close the dialog, leaving only the required groups

[•] Restore the deleted object to its original status.

5.14 Total Reversion

Select [Reverse-All] from [Mesh Editing] menu.

5.14.1 Function Outline

Reverse all of the polygons.

 \circ Result Handled Case

Total Reversion Result Display. (As shown in Figure 5.14.1)



Figure 5.14.1 Result of Reversing All

5.14.2 Operation Guide

- Perform All Reversion
 From [Mesh Editing] menu, select [Reverse-All].
- Restore reversion result to its original status.

Press [Ctrl+Z] key at the same time or select [Undo Edited] from [Mesh Editing] menu.

5.15 Undoing

From [Mesh Editing] menu, select [Undo Edited].

5.15.1 Function Outline

Record the information of filling, reversion and deletion into the buffer for future restoration. Undoing is using the recorded information to restore the operation to the original. The buffer is cleared when performing different type operation.^{*5.8}

*5.8 Different Type Operation

Meshing editing function is classified into four kinds: reduction, filling, reversion and deletion.

- Reduction
- Filling: Manual Filling of all kinds and Auto Filling
- Reversion: Manual Reversion, Auto Reversion, Reversing All
- Deletion: Manual Deletion, Auto Deletion

For example, Auto Reversion and Manual Reversion can be undone. However, the last auto reversion cannot be undone when other operations such as manual deletion are under way.



Consecutive same type operation



Consecutive different type operation

Figure 5.15.1 Operation and Undo buffer

5.16 Propriety Check

From [Mesh Editing] menu, select [Propriety Check] to display Propriety Check mode. (As shown in Figure 5.16.1)

5.16.1 Screen Description

Propriety Check	×
Duplicate	1
2 Vertex5 0	
3 Edge 6 0	
Polygo	
8 Check 9 Fix	
1 Vertex - 2 Edge -	1
Polygon 🕦 0	
1 Check 3 Fix	
1 Edge - 2 Polygon -	1
Edge 🚯 0	
Polygon 🚯 0	
Check 🚯 Fix	
Mormal ■	1
Polygon ญ 0	
D Check D Fix	
	1

Figure 5.16.1 Propriety Check Form

No.	Items	Descriptions
1	Repeated Error Retrieving	Specify retrieving of repeated error of vertex, edge and
	Specification	polygon or not ^{*5.9}
	(Duplicate)	Specify error display or non-display. With Check on,
		mesh editing can be performed, thus making automatic
		repeated error retrieving possible
2	Repeated Error Vertex	Specify retrieving of repeated error of vertex or not
	Retrieving Specification	Specify error display or non-display. With Check on,
	(Duplicate- Vertex)	mesh editing can be performed, thus making automatic
		repeated error retrieving possible
3	Repeated Error Edge	Specify retrieving of repeated error of edge or not
	Retrieving Specification	Specify error display or non-display. With Check on,
	(Duplicate-Edge)	mesh editing can be performed, thus making automatic
		repeated error retrieving possible

No.	Items	Descriptions
4	Repeated Error Polygon	Specify retrieving of repeated error of polygon or not
	Retrieving Specification	Specify error display or non-display. With Check on,
	(Duplicate-Polygon)	mesh editing can be performed, thus making automatic
		repeated error retrieving possible
5	Repeated Error Vertex No.	Display Repeated Error Vertex No.
6	Repeated Error Edge No.	Display Repeated Error Edge No.
$\overline{\mathcal{O}}$	Repeated Error Polygon No.	Display Repeated Error Polygon No.
8	Repeated Error Retrieving	Perform Repeated Error Retrieving
9	Repeated Error Correction	Perform Repeated Error Correction(Deletion)
10	1Vertex-2 Edge Continuous	Specify retrieving of continuous error of 1Vertex-2 Edge
	Error Retrieving	or not $^{*5.10}$
	Specification	Specify error display or non-display. With Check on,
	(1 Vertex - 2 Edge)	mesh editing can be performed, thus making automatic
		error retrieving possible
(11)	Polygon Number of	Display the number of polygon made up of 1Vertex-2
	1 Vertex-2 Edge Continuous	Edge and continuous error vertex
	Error	
(12)	I Vertex-2 Edge Continuous	Perform Vertex-2 Edge Continuous Error Retrieving
(1)	Error Retrieving	Douton Wester 2 Edge Continuous Error
(13)	Free Correction	Correction(Deletion)
	1Edge 2Polygon	Confection(Deletion)
(14)	Continuous Error	1Edge-2Polygon or not ^{*5.11}
	Specification	Specify error display or non-display With Check on
	(1Edge-2Polygon)	mesh editing can be performed, thus making automatic
		repeated error retrieving possible
(15)	Edge Number of	Display the edge number of 1Edge-2Polygon continuous
0	1Edge-2Polygon	error
	Continuous Error	
(16)	Polygon Number of	Display the number of polygon made up of edges of
	1Edge-2Polygon	1Edge-2Polygon continuous error
	Continuous Error	
1	1Edge-2Polygon	Perform 1Edge-2Polygon Continuous Error Retrieving
	Continuous Error Retrieving	
(18)	1Edge-2Polygon	Perform 1Edge-2Polygon Continuous Error Correction
	Continuous Error	(Deletion)
	Correction Specify Normal Error	Specify notationing of normal amon on not ^{*5.12}
(19)	Specify Normal Error	Specify retrieving of normal error of not Specify error display or non-display With Check on
	(Normal)	mush editing can be performed, thus making automatic
		error retrieving possible
(20)	Polygon Number of Normal	Display Polygon Number of Normal Error
~~ ~	Error	
(21)	Normal Error Retrieving	Perform Normal Error Retrieving
(??)	Normal Error Correction	Perform Normal Error Correction(reversion)
Ŵ		

*5.9 Repeated Error of vertex, edge and polygons

Repeated Error of vertex refers to the repeated vertex in the coordinate. Repeated Error of edge refers to the edge made up of two same vertexes. Repeated Error of polygons refers to the polygon made up of three same edges.

*5.10 1Vertex-2 Edge Continuous Error

The vertex that makes normal model must have three edges connected, in which case retrieving can be executed...

(As shown in Figure 5.16.2). The vertex that does not conform will become an error. (As shown in Figure 5.16.3). When the polygon with unsuitable vertex becomes a starting point of the model, holes will appear.



Figure 5.16.2 Edge Number of Vertex Linking



Figure 5.16.3 1Vertex-2Edge Continuous Error Case Retrieving





Figure 5.16.4 Case of 1Edge-2Polygon Continuous Error

*5.12 Normal Errors

The outside of polygon (normal facing) has the following facings. .anti-clockwise: facing outward clockwise: facing inward (As shown in Figure 5.16.5) If two adjacent polygons have the same facing, the edge shared by the two polygons should face different directions. If not, that is an error. (As shown in Figure 5.16.6)



Figure 5.16.5 Edge Facing and Polygon Facing



Figure 5.16.6 Facing Direction of Shared Edge

5.16.2 Operation Guide

• Repeated Error Retrieving

- 1. Click [Duplicate Check] on, the retrieved element like [Vertex], [Edge], and [Polygon] should be on working status. And then click [Check] button to start retrieving
- 2. Use green color to display the error element (As shown in Figure 5.16.7)
- 3. If [Duplicate Check] is clicked off, error display of Vertex], [Edge], [Polygon] will disappear



Figure 5.16.7 Repeated Error Polygon Display

• Repeated Error Correction

- 1. After error retrieving, use [Fix] button for correction
- 2. Once correction is finished, automatic error retrieving will be performed
- 3. If the error of vertex, edge and polygon become zero, correction will be repeated

• Error Retrieving of 1Edge-2 Edge

- 1. Click [1 Vertex 2 Edge Check] on and use [Check] button for retrieving
- 2. Use purple to display polygons made up of error vertexes. (As shown in Figure 5.16.8)
- 3. If [1 Vertex 2 Edge Check] is clicked off, error display will disappear



Figure 5.16.8 Continuous Error of 1 Vertex – 2 Edges

○Continuous Error Correction of 1 Vertex – 2 Edge

- 1. Click [1 Vertex 2 Edge Check] on and use [Check] button for retrieving
- 2. Use purple to display polygons made up of error vertexes
- 3. If [1 Vertex 2 Edge Check] is clicked off, error display will disappear

 \circ Continuous Error Correction of 1 Vertex – 2 Edges

- 1. After retrieving continuous error of [1 Vertex 2 Edge Check], use [Fix] for correction, which means deleting polygons with wrong vertexes
- 2. Once correction is finished, automatic error retrieving will be performed
- 3. Auto filling will be done to those holes. Polygon reversion will also be done if needed

 \circ Continuous Error Correction of 1 Vertex – 2 Edges

- 1. Click [1 Vertex 2 Edge Check] on and use [Check] button for retrieving
- 2. Use red color to display error edge and yellow color to display polygons made up of error edge. (As shown in 5.16.9)
- 3. If [1 Vertex 2 Edge Check] is clicked off, error display will disappear



Figure 5.16.9 Display of Continuous Error Correction of 1 Vertex – 2 Edges

 \circ Continuous Error Correction of 1 Vertex – 2 Edge

- 1. After retrieving continuous error of [1 Vertex 2 Edge Check], use [Fix] button for correction, which means deleting polygons with wrong edges
- 2. Once correction is finished, automatic error retrieving will be performed
- 3. Auto filling will be done to those holes. Polygon reversion will also be done if needed



Figure 5.16.10 Continuous Error Correction of 1 Vertex – 2 Edges



Figure 5.16.11 After one filling is executed.



Figure 5.16.12 Reverse after filling is all done.

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Normal Error Check

- 1. Click [Normal Check] on and use [Check] button for retrieving
- 2. Use the red color to display error polygon
- 3. If [Normal Check] is clicked off, error display will disappear

Normal Error Correction

- 1. After checking normal errors, use [Fix] button for correction
- 2. Once correction is finished, automatic error retrieving will be performed
- 3. It the error number turns to zero (0), repeated correction will be performed again. But the error covers other areas other than the normal error, it won't turn to zero



Figure 5.16.13 Normal Error Retrieving and Correction
5.17 Polygon Information

From [Mesh Editing] menu, select [Polygon Information] for displaying edited polygon information. (As shown in Figure 5.17.1)

5.17.1 Screen Description

Po	olygon In	form	nat	ion	×
	Number	of —			
	Vertex			2428	
	Edge	2		7288	
	Polygor	3		4860	

Figure 5.17.1 Polygon Information Form

No.	Items	Descriptions
1	Vertex Number	Display vertex number
2	Edge Number	Display edge number
3	Polygon Number	Display polygon number

Chapter 6 Various Setting

6.1 Application Preferences

From [Tools] menu, select [Preference] or click tool bar

6.1.1 Function Outline

Specify display color and initial value.

6.1.2 Screen Description

Setting Specification Mode

Preference	
General WorkForm Initialize Region Growing Iso-Surface Mesh Editing Uolume Rendering Measure Manager DICOM Manager Wireframe Color	Default Pitch (mm) X: 1 Z: 1 Z: 1 Default Polygon Scale (mm) X: 1 Y: 1 Z: 1 Z: 1 Language English
	OK Cancel Accept

Figure 6.1 Setting Specification Modes

No.	Items	Descriptions
1	Specified Item List	Display the specified item list
2	Specified Content	Display the specified content related to specification
3	OK Button	This button is used for changing and closing
4	Cancel	This button is used for change canceling and closing
5	Accept Button	It is used for changing and continuous performance

○ Item 『General』

X: 1
Y: 1
Z: 1
Default Polygon Scale (mm)
X: 1 2
Y: 1
Z: 1

Figure 6.2 General Item

No.	Items	Descriptions
1	Default Pitch	Indicate the initial value of pitch
		This feature is used in the Raw file input
2	Default Polygon Scale	Indicate the initial value of polygon size
		This feature is used in the STL file input
3	Language	Switch the application language settings.
		Japanese and English are available.

 \circ Item $\llbracket \mbox{WorkForm Initialize} \rrbracket$

C Iso-Surface Volume Guide Settings Guide Type ● Cube ● Axis Guide Size Normal ▼ ③ Face Color ④ Edge Color ⑤	-Default View M None	1odel	
Ovolume Guide Settings Guide Type Guide Size Normal Face Color (4) Edge Color	C Iso-Surface		
Guide Settings Guide Type © Cube © Axis 2 Guide Size Normal I 3 Face Color 4 Edge Color 5	C Volume		
Guide Type Cube Axis 2 Guide Size Normal 3 Face Color 4 Edge Color 5	-Guide Settings		
Guide Size Normal Image: Color Face Color Image: Color Image: Color Edge Color Image: Color Image: Color	Guide Type 💿	Cube 🔿 Axis	2
Face Color (4) Edge Color (5)	Guide Size	Normal 💌	3
Edge Color (5)	Face Color	4	
	Edge Color	5	
	L		

Figure 6.3 WorkForm Initialize Item

No.	Items	Descriptions
1	Default View Model	Specify display of model after data loading
2	Guide Type	Specify guide type in WorkForm
3	Guide Size	Specify guide size
4	Face Color	Specify the guide surface color
	(Surface Color)	
(5)	Edge Color	Specify the guide's line color
	(line color)	

\circ Item $\ensuremath{\lceil} \ensuremath{\mathsf{Region}}$ Growing $\ensuremath{\rfloor}$



Figure 6.4 Region Growing Item

No.	Items	Descriptions
1	Region Color	Indicate the color of expanded object
2	Default Seed Color	Indicate SEED color
3	Selected Seed Color	Select the color in SEED list

○ Item 『Iso-Surface』

Default Ratio Constant C 0.5 1 Reduction 0.4 2		
Default Colors		
Front Side Color		
Back Side Color		
Contour Color 5		
File Export Mode		
Iso-Surface Algorithm - 🕥 Marching Cubes Marching Tetrahedra		

Figure 6.5 Iso-Surface Items

No.	Items	Descriptions
1	Constant C	Indicate Constant C
2	Reduction	Indicate initial value of reduction rate
3	Front Side Color	Indicate the fore color of polygons
4	Back Side Color	Indicate the back color of polygons
5	Contour Color	2D preview color of contour
6	File Export Mode	The coordinate system at the time of outputting a STL file is specified Notes: As for "Center" and "Image", the center of a three-dimensional picture and the lower left of a three-dimensional picture serve as the starting point " DICOM" the starting point specified by the DICOM coordinate system turns into the starting point Each coordinate value is a world coordinates system, and serves as the same scale altogether
7	Iso-Surface Algorithm	The generation method of an equivalence side is chosen from a marching cube method or the marching Tetrahedra method (4th page physique child method)

\circ Item $\left[\!\!\left[\operatorname{Mesh}\,\operatorname{Editing}\,\right]\!\!\right]$



Figure 6.6 Mesh Editing Item

No.	Items	Descriptions
1	Vertex Color	Display vertex color in WorkForm
2	Selection Color	Display the selected color
3	Edge Color	Display the edge color of polygon in WorkForm
4	Open Edge Color	Display the open edge color in WorkForm
5	Normal Color	Display the normal color in WorkForm
6	Result Color	Display the result color in WorkForm
$\overline{\mathcal{O}}$	Normal Length	Display the normal length in WorkForm

 \circ Item \llbracket Volume Rendering \rrbracket

Texture Type 🕕 3D 💌
Resolution 2256 🔽 🗖 Compress 3
Default Transfer function
• Auto OldStyle 💌 (5)
© File 6
Default Index Image Color 🛞
💿 Color Min Color 🧕 9
Graph
Histogram Line Color 🚺 🔃
Alpha Line Color 🚺
Preset Folder
D:¥_VE¥VE3301_Release_debugmydocuments
Shading Brightness (%) - 16 J 0

Figure 6.7 Volume Rendering Item

No.	Items	Descriptions
1	Texture Type	Indicate the texture type to be used
2	Resolution	Indicate texture resolution
3	Compress	This sub-menu lets you specify whether to use a compressed
		texture volume rendering
		Texture Type is 3D, I can be used when 32 to 512 Resolution
4	Auto / File	Specifying transfer function default of Point-Based Volume
	(Radio Button)	Rendering by selecting Volume Rendering from [Auto] or [File]
5	Default	Selecting shape of the transfer function graph of volume rendering.
	Transfer function	When you select a Modality, to determine the type automatically
	List	when you load the DICOM image
6	Default	Specifying transfer function of the default of the volume rendering
	Transfer function	
	File	
$\overline{\mathcal{O}}$	File Opening	File selection dialog to select the transfer function of the default
	Button	opens
8	Color / File	Selecting "Color" from the "File" the default settings of the transfer
	Radio Button	function graph of index image
9	Min Color	Indicate the minimum brightness of index image
	(Index Image	
	Minimum	
	Brightness)	
10	Default	Specifying the transfer function of the default of the index image
	Index Image File	
1	File Opening	Open the DIALOG of default transfer function file selection
	Button	(Index Image)
(12)	Histogram Line	Paint histogram line color
	Color	
13	Alpha Line Color	Paint color between the initial values

No.	Items	Descriptions
(14)	Preset Folder	Specify folders containing list of various forms such as volume
		rendering, point-based volume rendering and index image
(15)	File Opening	Open the DIALOG of the specified file
	Button	
(16)	Shading	Specifying intensity of the light at the time of shading
	Brightness	

○ Item 『Measure Manager』



Figure 6.8 Measure Manager Item

No.	Items	Descriptions
1	Distance Color	Indicate the display color of measured distance
2	Angle Color	Indicate the display color of measured angle
3	Area Color	Indicate the display color of measured area
4	Opacity	Indicate the transparency of measured area
5	Reference Color	Indicate reference color
6	Moving Color	Indicate moving color of measurement
$\overline{\mathcal{O}}$	Selected Color	Indicate selecting color on measurement list
8	Coordinate Display	Indicate selecting coordinate color of distance start point
		and end point
9	Unit System	Indicate the unit of measurement results

○ Item 『DICOM Manager』

DICOM Root Folder 1	
D:¥DICOM	
	Browse
🗌 Patient Check (3)	
🗖 DICOM Tag Check 🔇	
Image Sorting ID Slice Position Image Number	
Image Direction • As-is • reverse Z	

Figure 6.9 DICOM Manager Item

No.	Items	Descriptions
1	DICOM Root	Indicate the folder route of DICOM managing tool
	Folder	
2	Browse	Open the selection form of window standard folder
	(Folder Reference)	
3	Patient Check	When loading DICOM images, specify whether to
		check the patient's information(name, birthday, gender,
		modality and checking date)
4	DICOM Tag Check	When loading DICOM images, specify whether to
		check the following items
		.Study Instance UID
		.Series Instance UID
		.Series Number
5	Image Sorting ID	When reading DICOM images, specify whether the
		standard sort of slice
		Slice Sort by a slice position (asc)
		Position (Default)
		Image Sort by an image number (asc)
		Number
6	Image Direction	When reading DICOM images, specify whether the
		row order of slice are reversed
		As-is Not Reversed (Default)
		reverse Z Reversed

○ Item 『Wireframe Color』



Figure 6.10 Wireframe Color Item

No.	Items	Descriptions
1	Default Box Color	Specify area color of 3D image
2	Clipped Area Color	Specify the outline color in Clipping WorkForm
3	Voxel Paint Color	Specify the outline color in Voxel Paint WorkForm
4	Volume Carving	Specify the outline color in Volume Carving WorkForm
	Color	
5	Cross Section Color	Specify the outline color in Cross Sections WorkForm
6	Mask Area Color	Specify the outline color in Volume Segment WorkForm

6.1.3 Operation Guide

- Create the Iso-Surface by MarchingTetrahedra method
 - 1. Click [Iso-Surface] in Setting Mode ①
 - 2. From radio button ② item [Iso-Surface Algorithm]. Select the [MarchingTetrahedra] and apply
 - 3. Create the Iso-Surface by the **[**Iso-Surface] dialog

• Change the Volume Rendering texture type

- 1. Click [Volume Rendering] in Setting Mode 1.
- 2. Change the value of any ② item [Resolution] and apply
- 3. Check the volume rendering of ③ WorkForm
- \circ Preset settings folder of the Transfer Function
 - 1. Click [Volume Rendering] in Setting Mode ①
 - 2. Enter the path to item [Preset Folder] or press the [...] button, select the folder from the form and then select the target folder
 - 3. If there is a .rpf file in the folder that was ③ Settings on the left side of the various rendering form. It appears as a preset of the transfer function.

• Change DICOM Root Folder

- 1. Click [DICOM Manager] in Setting Mode ①.
- 2. Setting Mode ② turns into [DICOM Manager].
- 3. Input root folder into [DICOM Manager] ① or click [DICOM Manager] ② and select the folder in folder selection mode.

Chapter 7 Appendix

7.1 Message Display

In VolumeExtractor3.0, application message display can be switched between Japanese and English.

7.1.1 How to switch message display between Japanese and English

(XAttention) This operation does direct editing directly, so the file backup must be obtained.

- 1. Confirm if the Volume Extractor 3.0 has got started or not.
- 2. Open the documents folder. As usual, the installment is performed at the following location.

C:\Users\<UserName>\Documents\i-Plants\Volume Extractor 3.0

- 3. Select "Settings.xml" in the folder. *The file backup must be obtained.
- Open "Settings.xml" Change <Language> into the desired value. "ja" : Japanese "en": English
- 5. Save "Settings.xml" and close this file.
- 6. Start Volume Extractor 3.0 and confirm the displayed message.

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