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# Synapse 3D V4.1US

## Base Tools
## Cardiac Tools (option)
## Brain Perfusion (option)
## Lung and Abdomen Analysis (option)
## Liver and Kidney Analysis (option)
## Nodule Analysis (option)
## Colon Analysis (option)
## Tensor Analysis (option)

Product Specifications

September 2014

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# Revision History

| Date | Comment |
|---|---|
| March 25, 2014 | First version |
| July 16, 2014 | Second edition |
| September 29, 2014 | Third edition |



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(Note) The name Synapse 3D is the system name of related products. The “Synapse 3D Base Tools” product is the baseline product package of Synapse 3D. This Product Specification is created specific for “Synapse 3D Base Tools” and other packages, such as Cardiac Tools. However throughout this specification, the name “Synapse 3D” is used generally where product name needs to be referred except where the full product name “Synapse 3D Base Tools” or " Synapse 3D Cardiac Tools " is necessary.

**Export Restrictions Applying to Synapse 3D**

For models to which export restrictions apply, government approval obtained through due procedure is required in order to export or otherwise remove such models from Japan.
Note that the same restrictions apply not only to the main unit but also to after-sale parts, service manuals and service training (for exporting or transferring technology) when such items are dispatched or shipped to foreign countries and when service training is given for trainees from foreign countries.

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## Scope of this Document

This document serves as the product specification for Synapse 3D Base Tools and other packages for the version specified on the front page. This specification includes features of Synapse 3D Base Tools, requirements for the off-the-shelf hardware and software platforms used with Synapse 3D, important feature limitations, and safety notifications for implementing and using Synapse 3D.

## Indications for Use for Synapse 3D Base Tools

Synapse 3D Base Tools is medical imaging software that is intended to provide trained medical professionals, with tools to aid them in reading, interpreting, reporting, and treatment planning. Synapse 3D Base Tools accepts DICOM compliant medical images acquired from a variety of imaging devices including, CT, MR, CR, US, NM, PT, and XA, etc. This product is not intended for use with or for the primary diagnostic interpretation of Mammography images. Synapse 3D Base Tools provides several levels of tools to the user:

- Basic imaging tools for general images, including 2D viewing, volume rendering and 3D volume viewing, orthogonal / oblique / curved Multi-Planar Reconstructions (MPR), Maximum (MIP), Average (RaySum) and Minimum (MinIP) Intensity Projection, 4D volume viewing, image fusion, image subtraction, surface rendering, sector and rectangular shape MPR image viewing, MPR for dental images, creating and displaying multiple MPR images along an object time-density distribution, basic image processing, CINE, measurements, annotations, reporting, printing, storing, distribution, and general image management and administration tools, etc.
- Tools for regional segmentation of anatomical structures within the image data, path definition through vascular and other tubular structures, and boundary detection.
- Image viewing tools for modality specific images, including CT PET fusion and ADC image viewing for MR studies.

## Indications for Use for Synapse 3D Cardiac Tools

Synapse 3D Cardiac Tools is medical imaging software used with Synapse 3D Base Tools that is intended to provide trained medical professionals, with tools to aid them in reading, interpreting, reporting, and treatment planning. Synapse 3D Cardiac Tools accepts DICOM compliant medical images acquired from a variety of imaging devices including, CT, MR, NM, and XA. This product is not intended for use with or for the primary diagnostic interpretation of Mammography images. Addition to the tools in Synapse 3D Base Tools, Synapse 3D Cardiac Tools provides the tools for specific clinical applications which provide targeted workflows, custom UI, targeted measurements and reporting functions including:

- Functional cardiac analysis for CT left ventriculography images: which is intended to evaluate the functional characteristics of heart.
- Functional cardiac analysis for non-contrast MR heart images: which is intended to evaluate the functional characteristics of heart.
- Coronary artery analysis for CT coronary arteriography images: which is intended for the qualitative and quantitative analysis of coronary arteries.



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- Coronary artery analysis for MR heart images: which is intended for the qualitative and quantitative analysis of coronary arteries.
- Calcium scoring for non-contrast CT heart images: which is intended for non-invasive identification and quantification of calcified atherosclerotic plaques in the coronary arteries using tomographic medical image data and clinically accepted calcium scoring algorithms.
- Cardiac Fusion: which is intended to analyze cardiac anatomy and pathology with a fused image of functional data (e.g. NM image, Bulls eye) and anatomical data.
- Aortic Valve Analysis for contrast CT heart images: which is intended for visualization of the heart, aorta regions, and contour of the aorta, measurement of the vicinity of the aortic valve, measurement of the calcification area in the aorta.

## Indications for Use for Synapse 3D Brain Perfusion

Synapse 3D Brain Perfusion is medical imaging software used with Synapse 3D Base Tools that is intended to provide trained medical professionals, with tools to aid them in reading, interpreting, reporting, and treatment planning. Synapse 3D Brain Perfusion accepts DICOM compliant medical images acquired from CT and MR. This product is not intended for use with or for the primary diagnostic interpretation of Mammography images. Addition to Synapse 3D Base Tools, Synapse 3D Brain Perfusion provides the parameter images by post-processing with dynamic scanned CT cerebral arteriography images and magnetic resonance images (MR) with contrast agent to aid the assessment of cerebral blood flow. The parameter images are Cerebral Blood Volume (CBV), Cerebral Blood Flow (CBF), Mean Transit Time (MTT), and Time To Peak (TTP).

## Indications for Use for Synapse 3D Lung and Abdomen Analysis

Synapse 3D Lung and Abdomen Analysis is medical imaging software used with Synapse 3D Base Tools that is intended to provide trained medical professionals, with tools to aid them in reading, interpreting, reporting, and treatment planning. Synapse 3D Lung and Abdomen Analysis accepts DICOM compliant medical images acquired from CT. This product is not intended for use with or for the primary diagnostic interpretation of Mammography images. Addition to Synapse 3D Base Tools, Synapse 3D Lung and Abdomen Analysis is intended to:

- use non-contrast and contrast enhanced computed tomographic images of the lung, provide custom workflows and UI, and reporting functions for lung analysis including boundary detection and volume calculation for pulmonary nodules in the lung based on the location specified by the user, segmentation of bronchial tubes in the lung, approximation of air supply region by the user specified bronchial tube, identifying, displaying and processing low absorption regions in the lung.
- use non-contrast CT images and calculate subcutaneous fat and visceral fat areas in 2D and both volumes in 3D.
- analyze a bronchus path to reach a lung nodule using the volume data collected with CT, and simulate insertion of bronchoscope into the path.



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## Indications for Use for Synapse 3D Liver and Kidney Analysis

Synapse 3D Liver and Kidney Analysis is medical imaging software used with Synapse 3D Base Tools that is intended to provide trained medical imaging professionals, including Physicians and Radiologists, with tools to aid them in reading, interpreting, reporting, and treatment planning. Synapse 3D Liver and Kidney Analysis accepts DICOM compliant medical images. This product is not intended for use with or for the primary diagnostic interpretation of Mammography images. Addition to Synapse 3D Base Tools, Synapse 3D Liver and Kidney Analysis uses contrast enhanced images of the body and provides custom workflows and UI, and reporting functions for liver and kidney analysis including, liver and peripheral organ segmentation, and tumor segmentation. Also segmentation of intrahepatic and peripheral vessels as well as the approximation of vascular territories is provided using contrast enhanced computed tomographic images.

## Indications for Use for Synapse 3D Nodule Analysis

Synapse 3D Nodule Analysis is medical imaging software used with Synapse 3D Base Tools that is intended to provide trained medical professionals, with tools to aid them in reading, interpreting, reporting, and treatment planning. Synapse 3D Nodule Analysis accepts DICOM compliant medical images acquired from CT and PT.
This product is not intended for use with or for the primary diagnostic interpretation of Mammography images. Addition to Synapse 3D Base Tools, Synapse 3D Nodule Analysis is intended to;

- use non-contrast and contrast enhanced computed tomography (CT) images, provide custom workflows and UI, and reporting functions for nodule analysis including boundary detection of nodules based on the location specified by the user, measurement of nodules, temporal comparison of nodule images, and fusion of a CT nodule image on a PT nodule image.
- use positron emission tomography (PT) images, provide custom workflows and UI, and reporting functions for nodule analysis including SUV measurement of nodules with sphere VOI based on the location specified by the user, temporal comparison of nodule images, and fusion of a PT nodule image on a CT nodule image.

## Indications for Use for Synapse 3D Colon Analysis

Synapse 3D Colon Analysis is medical imaging software used with Synapse 3D Base Tools to accept, display, and process DICOM compliant 2D and 3D medical images acquired from CT for the purpose of viewing of a colon to detect polyps, masses, cancers, and other lesions. It is intended to be used by trained medical professionals in reading, interpreting, reporting and screening. Addition to the general 2D and 3D image processing and measurement tools available in Synapse 3D Base Tools, Synapse 3D Colon Analysis provides custom workflows, UI, and reporting functions for colon analysis, including colon segmentation, detection of the centerline of colon, fly-through of the entire colon, various rendering and visualization of colon, comparing both prone and supine views, and electronic cleansing.

## Indications for Use for Synapse 3D Tensor Analysis

Synapse 3D Tensor Analysis is medical imaging software used with Synapse 3D Base Tools to accept, display, and process DICOM compliant 2D and 3D medical images acquired from MR for the purpose of viewing of local water diffusion properties and directional dependence of the diffusion in the white matter. It is intended to be used by trained medical professionals in reading, interpreting, reporting, screening and treatment planning.



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Addition to the general 2D and 3D image processing and measurement tools available in Synapse 3D Base Tools, Synapse 3D Tensor Analysis provides custom workflows, UI, and reporting functions for tensor analysis with neck and head MR images. It includes display of diffusion and FA color map images, white matter tractography, dynamic review in MR, vessel and body visualization with registration of MR, CT, XA, PET and NM.

**Contraindications**

None known.



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## For Safe Operation

In this document, there are three types of explanatory notes as indicated by the marks shown below with their respective meanings. Observe these warnings and cautions when using Synapse 3D.

| | | |
|---|---|---|
| ⚠Warning | Warning | Indicates an instruction that a user must follow to use the product safely. |
| ⚠Caution | Caution | Indicates an operation that requires caution to use the product safely. |
| Note | Note | Indicates operational information, additional information, detail information, specifications, or other information that may be helpful. |

## 1. Precautions Before Operating This Workstation

**⚠Warning**

Before using this workstation, please read “For Safe Operation” carefully so that you can operate it correctly. Whenever you operate this workstation, be sure to observe all precautions. Failure to do so may subject you to injuries or cause property damage.

**⚠Warning**

The medical institution where the equipment is installed is responsible for its use and maintenance. This workstation should not be used by persons other than suitably trained physicians or staffs.

**⚠Caution**

Rx only in the United States (Federal law restricts this device to sale by or on the order of a physician)

## 2. Precautions When Using Electrical Equipment

**⚠Caution**

Synapse 3D (workstation) must operate on the specified computers and monitors that satisfy the Safety Standards and Regulations, Electromagnetic Interference Standards and Regulations, as well as Environmental Regulations valid in each country or region where Synapse 3D is used. When discarding the hardware, the user must comply with environmental regulations valid in each country or region. The environmental regulations include, but not limited to, the EC directive 2002/96/EC of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE Directive).

**⚠Caution**

Computers and monitors specified in the Synapse 3D product specification are designed to meet the requirements of IEC60950 or equivalent standards but not in accordance with IEC60601-1 required for medical



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equipment installed in an environment where a patient may accidentally touch the equipment. To use the workstation in such an environment, specific safety measures related to the computer to be used are necessary. Consult the computer dealer for measures to be taken.

The computer to be used with Synapse 3D is classified as electrical equipment. To use the equipment correctly and prevent any danger, please observe the following electrical equipment use precautions:

**⚠Caution**

1. Observe the following precautions when installing the computer.
   (1) Install the equipment in a dry place away from water.
   (2) Install the equipment where it will not be adversely affected by atmospheric pressure, temperature, humidity, ventilation, sunlight, dust or the presence of salt, sulfur or like substances in the air.
   (3) Make sure the equipment will remain stable on a level surface and not be subjected to vibration or shock.
   (4) Do not install the equipment in places where chemicals are stored or gases emitted.
   (5) Supply the frequency, voltage and amperage specified for the computer.
   (6) Connect the ground wire correctly.
   (7) Connect all cables correctly and completely.
   (8) If the computer is installed in a dusty environment, dust will accumulate in the power supply section, possibly causing smoke or fire. Install the equipment in a place free from such influence.

**⚠Warning**

2. If there is trouble with the computer, do not attempt to fix it randomly. Instead, indicate the problem as appropriate and entrust repairs to a professional.

**⚠Warning**

3. The supply voltage to the computer is 100 - 240 V depending on the model and region. Do not remove the cover or remodel the computer.

**⚠Warning**

4. Explosion Precautions
   Since this equipment is not explosion-proof, do not use combustible and explosive gases near the equipment.

**⚠Caution**

5. Electromagnetic Interference Precautions
   The computer used for the workstation complies with the Electromagnetic Compatibility (EMC) standard for general computers. However, there is no guarantee that interference will not occur in a particular installation. If the computer is used in an environment such as in the vicinity of devices not compliant with the EMC standard, interference may occur and cause the computer or other devices to malfunction.

**⚠Caution**

6. Product media storage Precautions
   Product media disc of Synapse 3D must be stored into media case. The media should not be stored at a high temperature, high humidity or direct exposure to the sunlight place.



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## 3. Precautions Synapse 3D (Workstation) usage

1. ⚠Caution

   Synapse 3D is intended for use only as a supplement to traditional methods for interpreting radiological images. Synapse 3D is only an aid or adjunct to processes or decisions that can be made without the use of Synapse 3D. No diagnostic or treatment decisions or other decisions that may affect patient care should be based exclusively on Synapse 3D.

2. ⚠Caution

   For exported images;

   For images exported from Synapse 3D using e-mail, printing or any other mechanism, users must ensure that recipients of exported images are familiar with this material. The precise appearance of the image is dependent on the characteristics and settings of the hardware, including monitors, used. The notes and cautions in this document related to the interpretation of displayed images apply equally to these exported images.

3. ⚠Caution

   For studies to be used;

   Users must be fully conversant with the limitations of the basic imaging modality and of ensuing image processing. This includes understanding the limitations of the initial series acquisition, image processing technology used, and image display methods. Also, be aware that medical imaging is valid only when appropriate measures have been taken to obtain optimal images with correct orientation and correct patient identifiers.

4. ⚠Caution

   For Image processing;

   a. The user must keep the limitations of 3D image processing in mind when viewing 3D images. Small pathologies may go undetected because the interslice distance is too great relative to the size of the pathology. The creation of a 3D image using interpolation of data points between image slices based on the original image can create a smooth-looking 3D image. The user must interpret the apparent lack of pathology in the context of the inherent limitation in the resolution of the original slice images as scanned.

   b. Artifacts may appear in the image depending on the amount of image processing. When using an image processing method, fully understand its characteristics.

   c. The visualization settings of the 3D views may cause some anatomical features to be completely transparent and therefore invisible. Synapse 3D allows users to hide anatomical features to emphasize anatomy of interest. Users must take into account any actions and software behaviors of this type when interpreting displayed images.



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5. **⚠Caution**

When installing, servicing and administrating Synapse 3D;

a. Set and install medical imaging equipment connected to the workstation properly, using the installation specifications. If not, some errors may occur.

b. The installation, upgrade, system maintenance, system administration, and administration shall only be performed by trained personnel.

c. Training materials must be created or updated using the correct version of service manual, user manual, or other formal documents released as a part of the Synapse 3D product.

6. **Note**

While operating Synapse 3D;

a. Check the workstation before use to make sure that it operates normally.

b. In extended use of the workstation, take a 10 to 15 minute break after every hour to rest your eyes and hands.

c. Do not turn off the power to the computer while using the workstation.

d. Perform the shutdown procedure specified in the operating system to end operation.

e. Do not change settings of the pre-installed Windows.

f. If the computer is forcibly terminated while using the system due to a power outage or other reasons, data may be lost. It is recommended to use an uninterruptible power supply system. If a power outage occurs and an uninterruptible power supply system is in use, terminate the workstation as soon as possible.

g. When leaving an image displayed for a long time during operation, use the screensaver. If it does not start running, contact your service engineer. If an image has been displayed for a long time, even after the display changes, the image may be visible as a residual image on the next display. The video card may become quite hot depending on the screensaver in use, causing a malfunction.

7. **⚠Caution**

For Hardware and software being used with Synapse 3D;

a. Do not install any hardware onto the workstation other than those designated by FUJIFILM Corporation.

b. Do not install any software onto the workstation other than those designated by FUJIFILM Corporation.

c. Do not uninstall originally installed software. Do not install any software other than that originally installed.



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8. **Note**
Since the backlight (fluorescent tube) of the LCD monitor has a limited lifetime, the luminance (emitted light amount) of the screen decreases as running time increases, and it may eventually make viewing difficult. Check that the emitted light amount of the LCD backlight is appropriate before starting operation. If not, contact your service engineer.

9. **⚠Caution**
When using a monitor or a LCD monitor;

a. White or black spots may appear on the LCD monitor. This is part of the normal wear and tear of an LCD, and it is not a failure of the LCD monitor. These spots caused by LCD characteristics appear in the fixed place at any time. Recognize their existence to prevent misinterpreting them as possible medical abnormalities.

b. When the display resolution is too low, it may make viewing difficult. Make sure the settings are appropriate for use.

c. When the luminance or contrast of the screen is set excessively high or low, it may make viewing difficult. Make sure the settings are appropriate for use.

d. A color image may not be displayed with the correct gradation (grayscale) when viewed on a grayscale monitor. Use a monitor that is appropriate for handling the images.

e. When interpreting an image on the monitor, be aware of the purpose and differences in the image on the film. Image interpretation should be performed at responsibility of the user. For image interpretation via the monitor, use high-definition and high-quality monitors as much as possible.

f. If the angle of view is not appropriate for image interpretation, it may affect correct image interpretation. Check the angle of view, and adjust the monitor angle if necessary.

10. **⚠Caution**
Before interpreting an image, operate the workstation so that images are displayed at the appropriate size. Always check the image size in the display scale.

11. **⚠Caution**
Regarding the direction and the object orientation in image;

a. The image display direction depends on the DICOM information attached to the image by the medical equipment used to produce the image. When interpreting an image, make sure the direction of the image is correct.

b. When displaying images in which it is hard to differentiate the left from the right (such as images of kidneys and head), use the "L" or "R" displayed with the cube to confirm the orientation of the image.

The following image is displayed by reversing the right and left orientation of original image.



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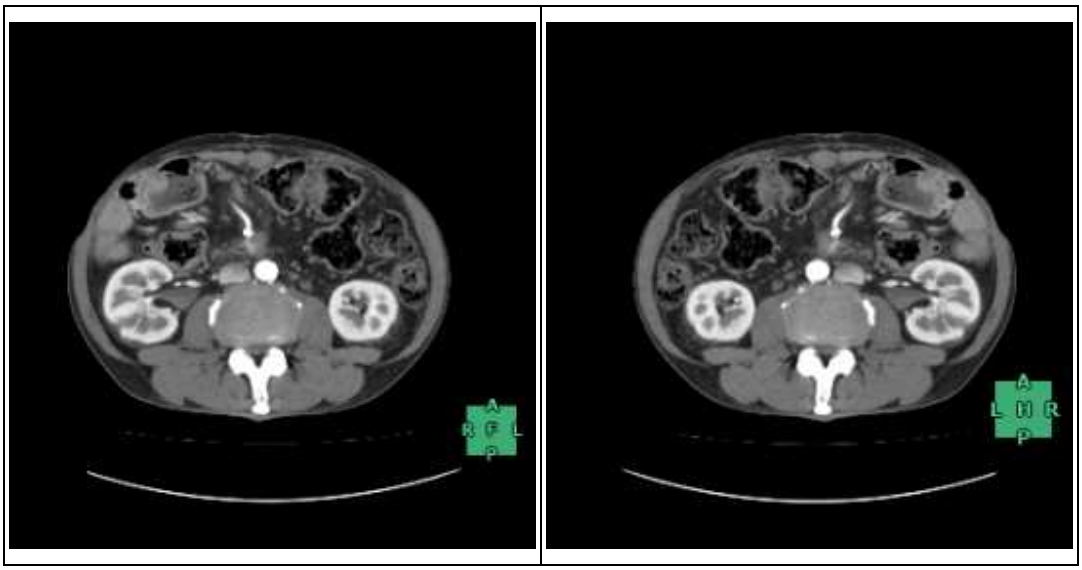

12. **⚠Caution**
For measurements;

    a. Inappropriate analysis results and measurements may be output if inappropriate points or lines are used for the basis of analysis or measurement in applications. Set them appropriately.

    b. When performing measurement, specify the coordinates and the units carefully.

    c. For measurement, the workstation uses the DICOM information attached to the image by the medical equipment used to produce the image. Medical practice using the measurement results should be performed at the user's own responsibility.

    d. Use the workstation taking into account errors between an image and the measurement result. An image used for measurement may have errors in the length of the subject depending on the image capturing method.

    e. Note that if you measure the distance or other things on a saved image of CPR, the measurement is performed on a curved surface.

    f. Accuracy of the measurement functions is described in the measurement section in the User Manual. Read and understand the accuracy and limitation information of measurement before use.

13. **Note**
Operate the security functions and procedures as specified to protect the workstation or patient information from an unauthorized access.

14. **Note**
For installation environment;



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a. When disposing of the computer, make sure to erase patient information that may be recorded in the magnetic disk (HDD) before disposal.

b. Installing the monitor in a place where strong light is emitted may prevent correct viewing because the display is either directly exposed to the light or reflects the light. Install the equipment in a place free from such influence.

c. Using the computer in a place where a strong magnetic field is present may cause the displayed image to be distorted. Install the equipment in a place free from such influence.

d. A plasma monitor constitutively emits a small amount of infrared radiation from the panel surface. Therefore, any equipment operating near the monitor that uses infrared rays may be affected. When installing a plasma monitor, check that it does not affect neighboring devices. If the monitor interferes with devices nearby, change the orientation of their transmitting/receiving section to prevent the interference.

15. ⚠Caution

When an error occurs;

a. If the workstation malfunctions, take action by following the messages displayed on the screen.

b. If an error occurs in the workstation, turn off the power, indicate that the equipment is faulty by posting a notice or other means, and then contact your service engineer.



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# 1 Product overview

The product “Synapse 3D Base Tools” is a system that receives and retrieves DICOM data from modalities including CT, MR, PET, XA, etc. and constructs 3D images and performs image analysis.

The product has the following features.

- **Optimum operability**

  Users can configure a wide range of settings to enable optimum operations. They can enjoy stable operations at an optimal speed without noticing any slowdowns thanks to optimized processing based on the latest multi-core CPU and native 64-bit OS for data loading and 3D reconstruction.

- **3D image processing**

  The 3D processing is optimized to the sub-voxel level to achieve the best imaging performance while providing the freedom to set object surface textures, 3D ray directions, and light attribute settings. Useful operations, such as clipping and interactive processing, can be performed in real time. Rendering can be performed at multiple resolutions.

- **Various applications**

  Various, useful applications are available to use for different body parts and images from many modalities. Extremely large images and image series (e.g. cardiac images) can be loaded directly into memory. Operation is simple and easy using Image Intelligence™, Fujifilm’s proprietary image processing technology.

- **Query/Retrieve (Q/R) and image transfer**

  Q/R can be performed with Q/R compliant modalities and PACS, and images created and captured on the product can be transferred to other DICOM servers.



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# 2 Product configurations

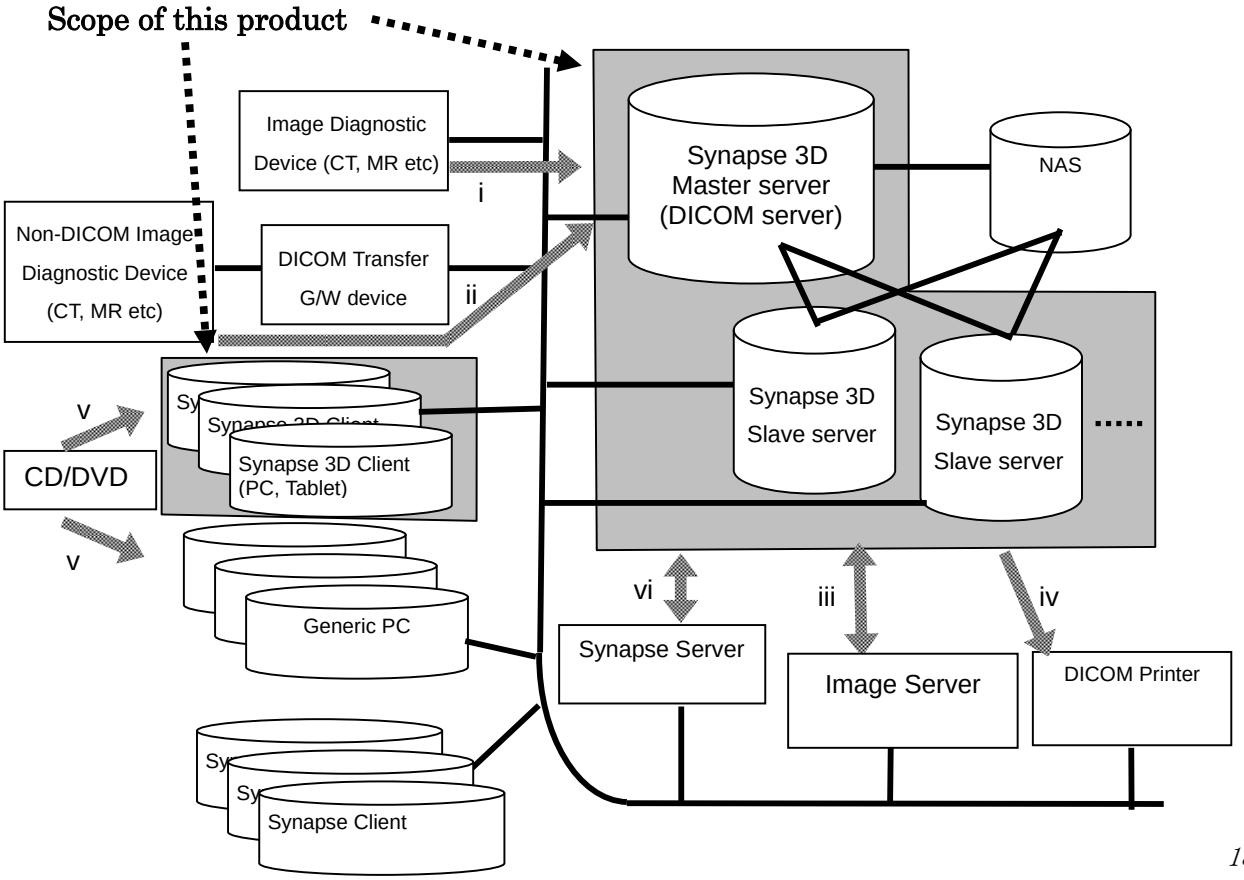
The product “Synapse 3D Base Tools” consists of the following two modules: Synapse 3D Server or Synapse 3D Standalone for 3D image construction and analysis, and Synapse 3D Client.
(Standalone type is newly-included from ‘Synapse 3D V4.x’.)

There are two types of Synapse 3D client, one is dedicated client software which can launch Synapse 3D directly, another is Synapse integration client software which can launch Synapse 3D through Synapse integration.

The following configuration is a connection example among Synapse 3D Server or Synapse 3D Standalone, image modalities, Synapse Server (image data server) and Synapse 3D Client.

The number of Synapse 3D Servers varies according to the maximum number of concurrent connections. In the case of multiple servers, high performance is realized with a server cluster where one machine works as the master server and the others work as slave servers. When the master server receives a login request from a Synapse 3D Client, the master server can select a login server automatically by confirming each server’s login status.

<Server and Client Configuration>



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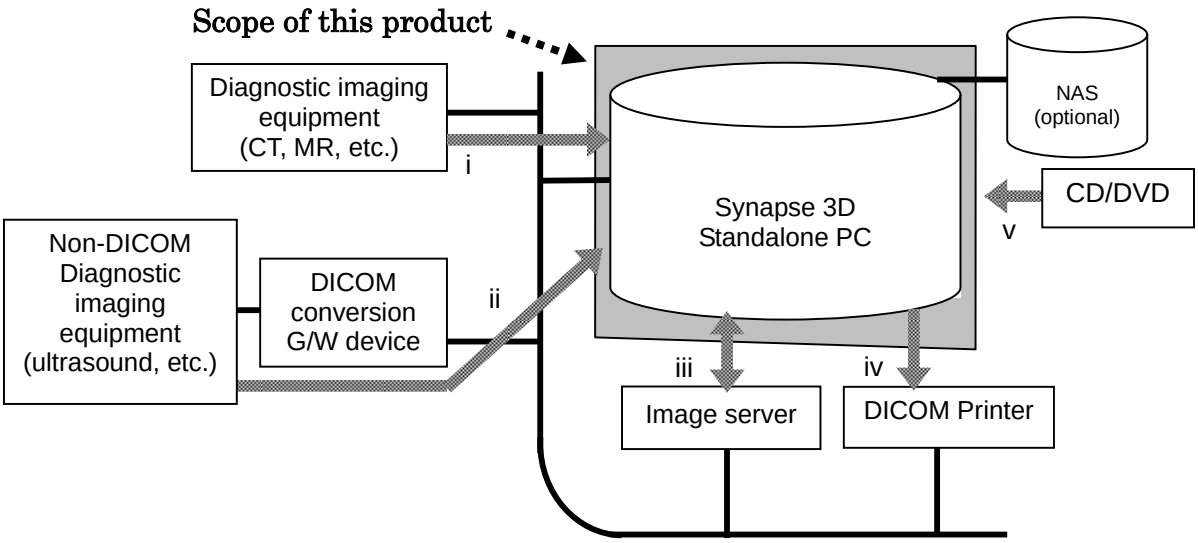
i. DICOM Storage
Receive DICOM-compliant images such as CT and MR images
ii. Receive images through interface
For modalities that do not support the DICOM standard, separate DICOM conversion GW device is required
iii. DICOM Q/R Storage
Display and analyze images by DICOM query and retrieval
iv. DICOM Printer
Enables DICOM printing
v. Local Data Import
Import DICOM data from CD/DVD
vi. Integration with Synapse
Refer DICOM database of Synapse

<Standalone Configuration>




i. DICOM Storage
Receive DICOM-compliant images such as CT and MR images
ii. Receive images through interface
For modalities that do not support the DICOM standard, separate DICOM conversion GW device is required
iii. DICOM Q/R Storage
Display and analyze images by DICOM query and retrieval
iv. DICOM Printer
Enables DICOM printing
v. Local Data Import
Import DICOM data from CD/DVD

Notes
- With respect to connections to other systems, this covers those devices confirmed in advance by connection testing etc.
- The standalone model does not support connections from tablet clients.



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# 3 Product package configurations

The following are product package configurations for Synapse 3D

□ Installation CD

- Synapse 3D Base Tools software and related software
- Synapse 3D Cardiac Tools (option)
- Synapse 3D Brain Perfusion (option)
- Synapse 3D Lung and Abdomen Analysis (option)
- Synapse 3D Liver and Kidney Analysis (option)
- Synapse 3D Nodule Analysis (option)
- Synapse 3D Colon Analysis (option)
- Synapse 3D Tensor Analysis (option)
- License manager application
- Service manual
- User manual
- Product specifications
- Upgrade kit

□ License key

License key is NOT included in following product package configurations.
Intended to be used for upgrades where dongles already exist.

□ Installation CD

- Synapse 3D Base Tools software and related software
- Synapse 3D Cardiac Tools (option)
- Synapse 3D Brain Perfusion (option)
- Synapse 3D Lung and Abdomen Analysis (option)
- Synapse 3D Liver and Kidney Analysis (option)
- Synapse 3D Nodule Analysis (option)
- Synapse 3D Colon Analysis (option)
- Synapse 3D Tensor Analysis (option)
- License manager application
- Service manual
- User manual
- Product specifications
- Upgrade kit



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# 4 Requirements

The following are the off-the-shelf software and hardware requirements used for Synapse 3D Base Tools.

| **Server(*1)** | Recommended requirements | Minimum requirements(*6) |
|---|---|---|
| OS | Microsoft® Windows Server® 2012 R2<br>Standard Edition (x64) | Microsoft® Windows Server® 2008<br>Standard Edition SP2 (x64) (*7) |
| CPU (*5) | Intel® Xeon® processor E5-2630 v2<br>2.6GHz or greater, 2CPUs or more | Quad-core Intel® Xeon® processor<br>2.0GHz or greater, 2 CPUs or more |
| Main memory | 64GB | |
| HDD | SAS 10000rpm | SATA 7200rpm |
| | For OS and software: 80GB or greater<br>For setting: 100GB or greater<br>For images: depends on the image storage (*2) | |
| Network adaptor (*4) | 1000BASE-T or faster | 100BASE-T |
| USB | 1 port(*3) | |
| Graphic | VRAM : 1.0GB or more<br>DirectX 11 is needed. | VRAM : 512MB<br>DirectX 11 is needed. |
| Monitor | SXGA (1280*1024) or larger<br>Single screen | |

| **Client** | Recommended requirements | Minimum requirements(*6) |
|---|---|---|
| OS | Microsoft Windows 8.1 (x64) | Microsoft Windows 8.1 (x86)<br>Microsoft Windows 7 Professional (x86, x64) SP1<br>Microsoft Windows Vista Business (x86, x64) SP1 or later<br>Microsoft Windows XP Professional (x86, x64) SP2 or later |
| CPU (*5) | Intel® Core™ i5-4570<br>CPU 3.2GHz or greater | Intel® Core2Duo<br>CPU 2.0GHz or greater |
| Main memory | 4GB or more | 1GB |
| HDD | For OS and software : 80GB or greater | |
| Network adaptor (*4) | 1000BASE-T or faster | 100BASE-T |
| Graphic | VRAM : 512MB or more | VRAM : 512MB |
| Monitor | SXGA (1280*1024), UXGA (1600*1200), WUXGA (1920*1200)<br>Single or dual screen | |



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| **Tablet client** | Recommended requirements | Minimum requirements(*6) |
|---|---|---|
| OS | Microsoft Windows 8.1<br>iOS 6.0 or later<br>Android 4.1.1 or later | Microsoft Windows 8.1<br>iOS 6.0 or later<br>Android 4.0 or later |
| CPU | Intel® Atom™ Z2760<br>CPU 1.8GHz or greater<br>Intel® Atom™ 1.8GHz or greater for Windows<br>Apple A5X or greater for iOS<br>NVIDIA Tegra 3 1.6GHz or greater for Android | Intel CPU 1.6Ghz or greater<br>Apple A5 or greater for iOS<br>NVIDIA Tegra 3 1.0GHz or greater for Android |
| Web browser | Internet Explorer 10.0 for Windows<br>Safari for iOS<br>Google chrome for Android | |
| Main memory | 2GB or more | 1GB or more |
| HDD | For OS and software : 64GB or greater | 16GB or greater |
| Wireless LAN | IEEE802.11a/b/g/n Wireless LAN | IEEE802.11a/b/g/n Wireless LAN |
| Monitor | 2048x1536, 1920x1080,<br>1280x800, 1024x768 | 1024 x 768 |

| **Standalone** | Recommended requirements | Minimum requirements(*6) |
|---|---|---|
| OS | Microsoft® Windows 8.1(x64) | Microsoft® Windows 8.1(x64) |
| CPU (*5) | Intel® Xeon® processor E5-2630 v2<br>2.6GHz or greater, 2CPUs or more | Intel® Xeon® processor E5-2630 v2<br>2.6GHz, 2CPU |
| Main memory | 16GB | |
| HDD | 1TB SATA 6.0Gb/s NCQ HDD (7200rpm)<br>RAID1 | 500GB SATA 6.0Gb/s NCQ HDD (7200rpm)<br>RAID1 |
| Network adaptor | 1000BASE-T or faster | 100BASE-T |
| Graphic | VRAM : 1.0GB or more<br>DirectX 11 is needed. | VRAM : 512MB<br>DirectX 11 is needed. |
| Monitor | SXGA (1280*1024), UXGA (1600*1200), WUXGA (1920*1200)<br>Single or dual screen | |

*1 Please connect uninterrupted power supplies (UPS) to servers if necessary.

*2 Images will be stored in lossless compression format with about a 1/3 compression ratio with Synapse 3D default settings.

[For example, in the case of 1000 CT image (512*512), 0.5 (MB/slice) * 1000 (slices) * 1/3 = 167 (MB) will be used.



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Image storage capacity can be expanded by using extra network attached storage (NAS)].

*3 This requirement is only for the master server. The slave server doesn't need to satisfy this requirement.

*4 Configuration using a 1Gbps network is recommended. If the network load is high, performance may drop significantly.

*5 Only Intel CPUs are supported.

*6 Other software or problems specific to hardware might affect this software behavior.

*7 This requirement is only for upgrade from V2 to V4.



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# 5 Function specifications summary

## 5.1 Function specifications summary for "Synapse 3D Base Tools"

The following is the function specifications summary for "Synapse 3D Base Tools".

| **Image management** |
|---|
| • DICOM input: Receives images from DICOM devices<br>• DICOM output: Sends images to DICOM devices<br>• DICOM Q/R: Query/Retrieve image data to/from DICOM devices<br>• Study list display: Shows a multi-level study list including: Study, Series, Instance<br>• Search: Search by patient ID, patient name, study date, modality, comment, and body part examined<br>• Add comments: Adds comments to Study, Series<br>• Search condition preset: Sets up search conditions customizable for each user<br>• Referencing DICOM headers: Displays DICOM data elements of images and outputs them in CSV format<br>• Data protection: Data protection at Study and Series level to prevent unintended data deletion<br>• Import and export: import DICOM files from HDD and optical drive, export DCIOM files to HDD<br>• Anonymization of patient information: Exports image data with anonymous patient information<br>• Export of converted image data: Converts DICOM images to general file format images (JPEG, etc.)<br>• Image storage: Converts created movie, captured images to DICOM image, general image files, or general movie file and stores them<br>• User-customizable settings: Stores settings for each Synapse 3D login user account<br>• Online help: Displays a help file corresponding to the current operations and key word search<br>• Print: Prints to DICOM and Windows printers |

| **Image processing and display function** |
|---|
| • 3D display: display in VR, SSD, MIP, MinIP, Ray summation, CPR<br>• VR color template: Changes rendering parameters, provides live template<br>• Changing window width and window level: Sets up window width/level, gamma, edge enhancement, and smoothing<br>• Measurement: Measures distance, angle, area, volume, and profile, displays histogram, and stores measurement results<br>• Annotation: Annotate by arrows, dots, text, and balloons<br>• 3D clipping: Clipping the range being displayed in the format of cross section, sight-line, and sphere<br>• Mask editing: Smart cut, smart select, smart tracking, organs extraction, preset register and edit<br>• Multi mask: Stores mask information for up to 12 layers. Perform ADD/AND etc. operations between masks<br>• Reformat: Reformats by line, sector, and circle<br>• SUV evaluation: Displays SUV of the inside of sphere VOI on PET images |



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- Report: Creates, stores, and prints reports
- Snapshot: Stores and restores working status
- Surface rendering: Display polygon model and output polygon model to external files
- Offline VR: create offline content that can be displayed in pseudo-3D in a Web browser

| **Image application** |
|---|
| • 2D Viewer: Simple viewer for 2D reading<br>• 3D Viewer: Displays 2D cross sections, 3D images<br>• 4D Viewer: Displays 4D cine play of multi-phase images, e.g., cardiac images, edits phase time information<br>• 3D Comparison: Compares multiple series images in 2D cross section and 3D display<br>• Slicer: Application for observation of arbitrary cross section<br>• Dynamic Data: Displays profile curve and color map of dynamic images<br>• Fusion: Viewer superimposes two 3D intra/intermodality images<br>• 3D Compositor: Viewer displays multiple 3D images in the same coordinate space<br>• Vessel Extraction: Uses images pre-contrast and post-contrast agent, extracts and displays cerebral blood vessels<br>•Nuclear Medicine Viewer: Overlay display of CT images with NM or PET images<br>• Combination: Combines multiple CT or MR images taken in two or more times.<br>• Sector MPR: Using single/multiple phase CT, MR images, observes sector or rectangular MPR images<br>• Dental MPR: Using CT image, creates and displays panorama image along dental arch and cross section of Alveolar bone<br>• ADC Viewer: Using MR diffusion image, calculates and displays ADC map<br>• 2D Fusion: Viewer superimposes two 2D intra/intermodality images<br>•General CPR: Extraction and CPR display of vessel paths and the aorta; stenosis rate and color mapping analysis; virtual stent graft<br>• MPR Reformat: Observation of arbitrary cross sections along the reference line using either line, sector, or circle<br>• Tx Map: Creates a T2* Map using T2 images |

## 5.2 Function specifications summary for "Synapse 3D Cardiac Tools (option)"

The following is the function specifications summary for "Synapse 3D Cardiac Tools (option)".

| **Image application** |
|---|
| • Coronary Artery Analysis (CT): Using cardiac CT image, extracts coronary artery, displays CPR, and measures stenosis and plaque<br>• Coronary Artery Analysis (MR): Using cardiac MR image, extracts coronary artery, displays CPR, and measures stenosis<br>• Functional Cardiac Analysis (CT): Using single or multiple phase cardiac CT images, evaluates cardiac function<br>• Functional Cardiac Analysis (MR): Using single or multiple phase cardiac MR images, evaluates |



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| |
|---|
| cardiac function<br>• Calcium Scoring: Using cardiac CT image, displays color mapping of calcifications of the coronary arteries , and calculates Agatston score<br>• Cardiac Fusion: Displays fusion image between cardiac structure image and cardiac function image<br>• Aortic Valve Analysis: Using single or multiple phase cardiac CT images, measure an aortic valve<br>• MR Flow Analysis: Calculates the blood flow volume and the flow velocity per heart rate velocity of an arranged ROI<br>• 4-Chamber Analysis: Evaluates cardiac function in the four chambers using a single cardiac CT image or multiple phase images<br>• Cardiac Ablation Analysis: Pre-operation simulation for ablation and post-operation observation |

### 5.3 Function specifications summary for "Synapse 3D Brain Perfusion (option)"

The following is the function specifications summary for "Synapse 3D Brain Perfusion (option)".

| **Image application** |
|---|
| • Brain Perfusion (CT): Using cerebral CT image, displays cerebral bloodstream parameter images and measures ROI<br>• Brain Perfusion (MR): Using cerebral MR image, displays cerebral bloodstream parameter images and measures ROI<br>• 4D Perfusion: Using multi-phase 3D whole-brain CT images, analyzes cerebral blood flow over time (in 4D) |

### 5.4 Function specifications summary for "Synapse 3D Lung and Abdomen Analysis (option)"

The following is the function specifications summary for "Synapse 3D Lung and Abdomen Analysis (option)".

| **Image application** |
|---|
| • 2D Fat Analysis (CT): Calculates percentage of visceral fat and subcutaneous fat<br>• 3D Fat Analysis (CT): Using abdominal 3D CT image, calculates volume and percentage of visceral fat and subcutaneous fat<br>• Lung Analysis (CT): Using CT image, calculates volume of lung nodules and displays low attenuation areas<br>•Lung Analysis Scope (CT): Extracts the bronchus from CT chest images and find the shortest path to the tumor<br>•Lung Analysis Resection (CT): Using contrast-enhanced CT images, extract the lung, bronchus, PA, and PV and display the results in 3D. |

### 5.5 Function specifications summary for "Synapse 3D Liver and Kidney Analysis (option)"

The following is the function specifications summary for "Synapse 3D Liver and Kidney Analysis (option)".

| **Image application** |
|---|
| • Liver Analysis (CT): Using contrast CT image, extracts liver and blood vessel regions and displays results in 3D<br>• Liver Analysis (MR): Viewer and analysis dedicated to captured images using an EOB contrast agent |



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| |
|---|
| •Kidney Analysis (CT): Using contrast-enhanced CT images of the kidney, extract the kidney and each vessel area and display the results in 3D |

### 5.6 Function specifications summary for "Synapse 3D Nodule Analysis (option)"

The following is the function specifications summary for "Synapse 3D Nodule Analysis (option)".

| **Image application** |
|---|
| • RECIST tracker: Using CT image, observes temporal changes of a tumor and creates report<br>• PERCIST tracker: Using PET image, observes temporal changes of a tumor and creates report |

### 5.7 Function specifications summary for "Synapse 3D Colon Analysis (option)"

The following is the function specifications summary for "Synapse 3D Colon Analysis (option)".

| **Image application** |
|---|
| • Colon Analysis: path creation and observation of the colon using CT images |

### 5.8 Function specifications summary for "Synapse 3D Tensor Analysis (option)"

The following is the function specifications summary for "Synapse 3D Tensor Analysis (option)".

| **Image application** |
|---|
| •Craniotomy Simulator/Tensor Analysis: Tractography extraction and craniotomy simulation |



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# 6 System restrictions

The following are restrictions for “Synapse 3D Base Tools.”

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Number of modality connections</td><td>The maximum number of modality connections is 30,<br>And the maximum number of concurrent connections is 10.</td></tr>
<tr><td>Client connections</td><td>In case of multiple servers’ configuration, the number of slave servers can be expanded to three units.<br>The number of servers and the maximum number of concurrent connections are as follows.
<table>
<tr><th>Number of servers</th><th>Maximum number of concurrent connections</th></tr>
<tr><td>1 unit</td><td>8</td></tr>
<tr><td>2 units</td><td>16</td></tr>
<tr><td>3 units</td><td>24</td></tr>
<tr><td>4 units</td><td>32</td></tr>
</table>
* Clients exceeding the maximum number of concurrent connections can not connect to the server concurrently.<br>For example, in case of 2 servers and 16 maximum concurrent connections, if there are 32 Synapse 3D clients in total, the connection possibility is 50%.<br>* Each Synapse 3D Client can handle over 10000 slices (assuming standard CT slice resolution (512*512)). (The limit depends on the physical memory capacity.)</td></tr>
<tr><td>Number of accounts</td><td>The number of user accounts on the server is restricted to fewer than 500.<br>However, on the condition that tracing of the workstation log level is turned off, the limit is fewer than 2000 accounts.<br>Furthermore, by changing the DICOM data storage location to NAS, and then changing the storage location user settings, the limit becomes fewer than 1000 accounts.<br>It is not possible to set up accounts for more than 10,000 people.</td></tr>
<tr><td>Tablet client connections</td><td>To use a tablet client, a wireless network connection is needed.</td></tr>
<tr><td>Tablet client license</td><td>The user must have a license to use a tablet client. Purchase of a user client access license is required for the user who will use the tablet separately from</td></tr>
</table>



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| | |
|---|---|
| | the terminal. |

*Confirms next chapter ‘7 Upgrade’ about upgrade of this software from ‘Synapse 3D V2.x’ and ‘Synapse 3D V3.x’.

It is possible to connect to this product by installing dedicated client software on a pre-existing generic PC in the facility.



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### 6.2 Spec requirements for generic PCs

The minimum specifications for a generic PC used as a client are listed below. These are minimum requirements. However, even if the PC meets these requirements, it might not work due to hardware-specific issues, compatibility with other software, etc.

(Minimum specifications for a generic PC)

| Component | Contents |
|---|---|
| OS | Windows 8 (32-bit, 64-bit)<br>Windows 7 (32-bit, 64-bit)<br>Windows Vista SP1 or later (32-bit, 64-bit)<br>Windows XP SP2 or later (32-bit, 64-bit) |
| CPU | Pentium 4 or higher |
| Web browser | Internet Explorer 7.0 or later |
| Memory | 1GB or more |
| Monitor resolution | 1024 x 768 |

(No special requirements beyond these are specified. Nonetheless, the PC configuration may not work in some cases.)

The recommended specifications for a general-purpose PC are listed below. Even if the PC meets these requirements, it might not work due to hardware-specific issues, compatibility with other software, etc.

(Recommended specifications for a generic PC)

| Component | Contents |
|---|---|
| OS | Windows 8 (32-bit, 64-bit) |
| CPU | Dual core CPU |
| Web browser | Internet Explorer 9.0 or later |
| Memory | 2GB or more |
| Monitor resolution | 1920 x 1200, 1920 x 1080, 1600 x 1200, 1280 x 1024 |

(No special requirements beyond these are specified. Nonetheless, the PC configuration may not work in some cases.)

If these requirements are met by existing PCs in the medical facilities, they can be used after the following checks are performed:

- Confirmation of the above specifications
- Actual operational verification

Note that a separate license must be purchased in order to install the software on a PC in the facilities.



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## 6.3 Operational limitations on tablet devices

The workstation software that runs on a tablet device is intended to be used for observing snapshots, reports, and movies that were created on a dedicated client and stored on the server. Therefore, the functionality and user interface differ from the dedicated client.

### 6.3.1 Snapshots that can be observed on a tablet device

The following applications permit the observation of snapshots on a tablet device:

- 2D Viewer (for observation of the original images)
- 3D Viewer
- 4D Viewer
- Nuclear Medicine Viewer
- Fusion
- 3D Compositor
- 2D Fat Analysis
- 3D Fat Analysis
- Sector MPR
- Liver Analysis
- Kidney Analysis
- Vessel Extraction
- Lung Analysis Scope
- 3D Viewer with VE
- Sector MPR
- Coronary Artery Analysis (CT)
- Lung Analysis Resection
- Colon Analysis
- Craniotomy/Tensor Analysis

## 6.4 Operational limitations of offline VR

Offline VR lets you observe 3D images in a standard Web browser without requiring special software. However, because it requires loading and displaying a large number of images captured at specific intervals, incidents such as memory shortages or images failing to display may occur depending on the operating environment.



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# 7 Upgrade

It is possible to upgrade to ‘Synapse 3D V4.x’ from ‘Synapse 3D V2.X’ or ‘Synapse 3D V3.X’.
An upgrade option needs to be purchased certainly for the upgrade.

- The upgrade kit is included in the installation CD

It is possible to upgrade not only the software itself but also the software environments.

- DICOM images could be migrated by a script attached with the upgrade kit.
- A part of user setting (e.g. Color Template) could be taken over to ‘Synapse 3D V4.x’ by a script attached with the upgrade kit.
- Snapshot created in previous version ‘Synapse 3D V2.x’ can be analyzed on ‘Synapse 3D V4.x’ by using dedicated application based on ‘Synapse 3D V2.x’, if original DICOM image are migrated. In this case, not the latest communication method but the previous communication method using Terminal Service is applied.
  (Snapshots created in ‘Synapse 3D V3.x’ can be loaded directly in ‘Synapse 3D V4.x’.)

A comparison of main configuration between ‘Synapse 3D V3.x’ and ‘Synapse 3D V4.x’ is shown as follows.

| Item | Synapse 3D V3.x | Synapse 3D V4.x |
|---|---|---|
| Server OS | Windows Server 2008 R2 Enterprise Edition (64 bit) | Windows Server 2012 Standard Edition (64 bit) |
| Standalone OS | Windows 7 64-bit Edition | Windows 8 64-bit Edition |
| Client OS | Windows 7 64-bit Edition | Windows 8 64-bit Edition |
| Tablet OS | - | Windows 8 32-bit Edition |
| Tablet support | N/A | Available (with feature limitations) |
| Features | - | Added new features below.<br>-MR Flow Analysis<br>-4D Perfusion<br>-Liver Analysis MR<br>-Tx Map<br>-4-Chamber Analysis<br>-Cardiac Abration Analysis<br>-Craniotomy/Tensor Analysis<br>-Kidney Analysis |



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| | | |
|---|---|---|
| | | -Lung Analysis Resection |



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# 8 Function specifications detail

## 8.1 Detailed functional specifications for "Synapse 3D Base Tools"

The following are the detailed functional specifications for “Synapse 3D Base Tools.”

| **General** |
|---|
| Multi-user environment |
| • Different settings can be specified per user. The users can share the database |
| DICOM communication as a service |
| • DICOM communications can run as a service, and can work without users logging in |
| Online help |
| • Displays a help file corresponding to the current operations |
| |
| **Server/Client** |
| Setting up login method |
| • In the case of multiple servers, the login server can be selected automatically according to the server’s operating status |
| Restricting functions available to the client |
| • Ability to restrict functions. Major functions that can be restricted are:<br>setting of available printers, adjusting screen resolution, storage of images/reports/snapshots, image import/delete/transfer/export |
| Monitoring client connections status |
| •Server’s login status can be checked through a Web monitor |
| • Ability to send a message to a connected client and to force a connection to close |
| Access from tablet devices |
| • Snapshots can be observed using a tablet-specific UI. |
| • When communication is disconnected, it can be re-connected and the operating state restored. |
| |
| **DICOM server** |
| Data management with SQL Server |
| • PostgreSQL Server 2005 manages database |
| • Database backup and restoration can be performed using SQL Server Management Studio |
| Setting of local AE |
| • AE title and port can be configured |
| Maximum number of concurrent connections |
| • The number can be configured |
| Maximum P-DATA-TF length |
| • Can be specified for receive and send operations separately |



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| |
|---|
| Authorization of SOP Class for communication |
| • SOP Class can be specified for communication authorization. UID of the SOP Class can be input arbitrarily |
| Setting of remote AE |
| • MOVE-SCP, C-STORE-SCP, C-FIND-SCP, C-STORE-SCU, and C-FIND/MOVE-SCU can be set up separately |
| •Transfer syntax for acceptance can be selected from implicitVRLittleEndian, explicitVRLittleEndian, and losslessJPEG. Priority can also be configured |
| • Transfer syntax for proposal can be selected from implicitVRLittleEndian (always proposed), explicitVRLittleEndian, and losslessJPEG |
| • Printer settings: color, print priority, print media, film output destination, magnification type, structure information, smooth type, edge density, blank image density, edging, resolution (width, height, length/pixel) |
| • Character code settings: Receive setting (C-FIND-RQ, C-FIND-RSP, C-STORE-RQ) and send setting (C-FIND-RQ, C-FIND-RSP, C-STORE-RQ) can be set up separately. |
| Log |
| • Output level, storage period, maximum number of files, and automatic log deletion time can be specified |
| Setting of storage path |
| • Ability to specify primary storage and reserve storage. (Data can be automatically moved to reserve storage at specified time when usage of primary storage reaches a certain point or after a certain period of time) |
| Automatic deletion |
| • Automatically deletes DICOM files in case of space shortage or after a specific period of time |
| • Recycling function. |
| Link with Synapse |
| • Specifies whether to show data in Synapse in study list when Synapse is connected |
| Auto sending |
| • Ability to send capture and snapshot images |
| Automatic retrieve |
| • Images that match certain criteria can be automatically retrieved from specified AE. |
| |
| **Data management** |
| Local data search |
| • Search by patient ID, patient name, study date, modality, body part examined, and comment |
| Add comments to local data |
| • Adds comments to Study, Series |
| Preset search items for local data |
| • Search conditions can be set up by user |
| Display of DICOM header information of local data |



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| |
|---|
| • Ability to show DICOM header information |
| Local data protection |
| • Protects the data from unintended deletion by the user and automatic deletion. Protection can be set up to the level of Study, Series |
| Export of local data to fixed-drive |
| • Ability to export DICOM files (including DICOM-conversions of snapshot/movie/report ) to fixed-drive (e.g., HDD) |
| • Ability to select DICOM tags whose information will be deleted to anonymize patient information by using a settings file |
| • Exports simple viewer |
| • Exports DICOMDIR |
| Import image from CD/DVD/HDD |
| • Direct importation of DICOM files from a specified folder |
| Image export format |
| • Converts DICOM images to general format files and exports them<br>Image: JPEG, BMP, PNG<br>Movie: AVI, MPEG, WMV |
| Transfer, Q/R |
| • Image transfer from local data to another AE (C-STORE) |
| • Search (C-FIND) and retrieve (C-MOVE) from another AE<br>Search by patient ID, patient name, start date, end date, modality, comment<br>(Search function by comment is available only between two Synapse 3D DICOM Servers)<br>Retrieve data at the level of Study, Series, and Instance |
| Automatic image processing |
| • Generate automatic snapshot. |
| • Generate application auto start launcher. |
| |
| **Print** |
| Print to DICOM printers |
| • Settings specified at time of print: page range, number of copies, print direction, film<br>Prior settings by service engineers: color, print priority, print media, film output destination, magnification type, structure information, smooth type, edge density, blank image density, edging, resolution (width, height, length/pixel) |
| Print to Windows printers |
| • Settings specified at time of print: page range and number of copies |
| Print preview |
| • Ability to print in additional arbitrary layouts by using a settings file |
| • Manages print queue of DICOM printers (display of data transfer status, cancellation of print requests) |
| • Image adjustment from preview by WL/magnification |



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|---|
| • Sets up ON/OFF of scale bar and cube |
| • Sets up ON/OFF of image border |
| • Inserts scan lines on reference image |
| • Inserts arbitrary image into footer |
| • Adds left margin to create space for punch holes for filing |
| • Edits preview image |
| |
| **Common functions to all applications** |
| 2D cross section display |
| • Axial, coronal, sagittal cross section views |
| • Oblique cross section view at an arbitrary point |
| |
| CPR display |
| • Straightened CPR |
| • Stretched CPR |
| • Projected CPR display |
| • Multi-path CPR display |
| • Automatic/manual extraction of path |
| • Automatic/manual extraction of path diameter |
| • Displays of graphs of average diameter, projected length of radius, area, and average intensity |
| • Measures size of stenosis of blood vessels, etc. by specifying at least one normal diameter |
| • Assigns up to four colors to blood vessels according to intensity values to overlay plaque portions |
| • SMIP display: MIP rendering display calculated from areas near surface regions |
| • Ability to change CPR display mode among MIP, MinIP, and Ray summation modes |
| • Orthogonal cross section view of image with smoothing filter or edge enhancement filter applied |
| • Connection of path |
| 3D display |
| • Volume rendering (VR) |
| • Shaded surface rendering (SSD) |
| • Maximum intensity projection (MIP) |
| • Minimum intensity projection (MinIP) |
| • Ray summation (Raysum) |
| VR color template |
| • Changes parameters (ambient light, diffuse light, specular light, shininess, decay level, opacity, color mixture, light source orientation, self shadow) |
| • Sets up the shape of opacity function (freehand, increase toward right, decrease toward right, concave type, convex type) |
| • Copy and paste of color templates |
| • Displays 2D cross section in colors specified by the color templates |
| • Registers color templates as a group |



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|---|
| • Displays live color templates (Thumbnail images of the current 3D image after applying registered templates) |
| • Export and import color templates |
| • Share color templates among users |
| Changing window width and level |
| • Applies to MIP, MinIP, Ray summation of 2D and 3D views |
| • Gamma conversion |
| • 2D cross section view with smoothing filter or edge enhancement filter applied |
| • Pseudo-color settings such as normal display, reverse display, and individual pseudo-colors can be specified |
| • Preset registration and recall of window width, window level, and pseudo-color |
| • Shared presets among users |
| Movie creation |
| • Creates movies by paging 2D cross sections in specified range |
| • Creates 3D movies by registering key frames based on changing parameters, e.g., orientation, magnification rate, clipping, color template. Key frames can be registered one by one or automatically registered when a parameter changes. Selectable presets can be created |
| • Registers key frames as a preset |
| • Offline VR: can generate files that enable simple VR operations on any device using a Web browser |
| • Converts created movies to private DICOM data and stores them. Can transfers them to other servers |
| 3D filtering |
| • Removes noise with a low-pass filter and smoothly displays images in 3D |
| Measurement |
| • Measures lines, projected line, polygonal lines, angles, intensity values, rectangles, ellipses, polygons, freehand, boxes, spheres |
| • Calculates volume of mask region, and average/max/min/standard deviation of intensity values in 3D images |
| • Calculates volume of mask region, and average/max/min/standard deviation of intensity values in 2D images |
| • Displays profile curve or histogram of each measurement |
| • Semi-automatic measurement of half-width |
| • Stores measurement results and graph in text file (.csv, .txt) or in capture image |
| • Ability to create ROI along the contour of an image by detecting contours during freehand measurement |
| Annotation |
| • Annotation by arrows, points, line, cylinder, text, and balloons |
| • Ability to set up font, color, background color, and frame for text. Ability to register key words |
| • Ability to set up font, color, and background color for balloons. Ability to register key words |



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| |
|---|
| 3D clipping |
| • Specifies display range for X/Y/Z directions and specifies inside or outside clipping |
| • Plane clip, sight-line clip, sphere clip, local observation clip |
| • Centering<br>Magnifies using visible 3D areas as rotation center |
| • Ability to paste 2D cross section image on the plane of the border region of clipping |
| • Mask extraction of clipped areas |
| Mask editing |
| • Overlay mask region on 2D cross section view |
| • Undo/Redo up to 8 times |
| Extraction/removal of body parts: bone removal, bone extraction, bed removal, heart extraction, colon extraction, lung field extraction, bronchus extraction, liver extraction, region search, vessel tracking (all except blood vessel tracking are available for CT images only), spinal extraction, body surface extraction, tube extraction, presets (registers extraction mode, target mask, and color template to apply as one job) |
| • Smart cut (mask extraction/removal by surrounding a region) using polygon, curve, or freehand |
| • Smart select (extraction/removal by selecting an object) |
| • Smart tracking (extraction/removal by region growing) |
| • Dilation, Erosion |
| • Extracts a region within a specified threshold range as a mask. Applied to the whole image or an ROI |
| • Extract a region with a specified opacity range as a mask. Applied to the whole image or an ROI |
| • Deletes continuous regions that have smaller volume than a specified mask value. Applied to the whole image or an ROI |
| • Surface digger (removes surface mask, which is specified by ROI or point, along view direction) |
| • Adds/Deletes mask region from 2D cross section by using circle cursor |
| • Adds/Deletes a sphere mask on a clicked position |
| • Adds/Deletes mask corresponding to the regions created by interpolating multiple ROIs set on the cross sections |
| • Function to fill in a mask on a 2D slice |
| Multi mask |
| • Registers and displays simultaneously up to 12 layers |
| • Status confirmation (current mask status) in real time |
| • Ability to reverse mask, perform ADD, SUB, AND, XOR operations between two layers |
| • Up to 8 layers can be used as additional mask storage (registration only) |
| Reformat |
| • Ability to reformat by line, sector, circle |
| • Plays cine of reformatted slices |
| • Saves reformatted slices as sequential images or a movie |
| SUV evaluation |



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| |
|---|
| • Displays SUV (max, min, standard deviation) of sphere VOI of PET images<br>Supported manufacturers: Siemens, Philips, Shimadzu, GE |
| Report |
| • Ability to create reports<br>Ability to create and save reports as private DICOM data |
| Snapshot save |
| • Saves operation status<br>When the status is saved as private DICOM data, it can be transferred to another server for restoration |
| Surface display |
| • Display polygon model and output polygon model to external files |
| |
| **2D Viewer** |
| Simple viewer for 2D reading |
| • Displays cine play |
| • Allows switching among cross section display types (e.g. axial, sagittal, coronal, etc.) |
| • Real time stack reconstruction (Joins multiple cross-sectional slices together and displays the result in Ray summation, MIP, or MinIP mode) |
| • Links coordinates between series |
| • Applies the same display position, window width and level, and magnification rate to specified images while displaying them |
| • Captures each slice of entire selected series |
| • Can browse a series list of related study data |
| • Stores and restores image layout |
| |
| **3D Viewer** |
| Display of 2D cross sections, 3D images and virtual Endoscopy views |
| • Displays 2D cross sections |
| • 3D view, edit |
| • Binocular stereo<br>Simultaneous display of 3D views with small difference in angle |
| • Inserts image plane<br>Inserts 2D cross section planes into 3D view and synchronizes with 2D cross section view |
| • Effective use of 3D display area.<br>Can be used as an additional MPR slice without using 3D display |
| Comparative observation using analysis results from past studies |
| • Can compare saved snapshots of past studies side by side with current study viewer. |
| • WW/WL, current position, pan, rotation, and zoom rate can be switched between SYNC/ASYNC. |
| • Series registration of CT images using position recognition. |
| Virtual endoscope |



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| |
|---|
| • Show MPR navigator.<br>Display small versions of axial, coronal, sagittal, and orthogonal planes in the corner, synchronized with the camera position. |
| • Automatic fly-through.<br>Automatically detecting the lumen walls, guide the camera through the center of the lumen just by turning the mouse wheel. |
| • Create path movie.<br>Can record a camera path that moves as directed by the mouse, and create a movie that traverses the path. |
| Report |
| • Outputs observations and images to a report |
| Macro |
| • Records and plays based on user operation |
| |
| **4D Viewer** |
| Performs 4D play/edit of multi-phase images, e.g., cardiac images |
| • Cine play with synchronization between 2D cross sections and 3D images |
| • Ability to specify display time for each phase in milliseconds or % of the total play time |
| • Creates movies of all images or only 3D images |
| |
| **3D Comparison** |
| Compares multiple series images in 2D and 3D display |
| • 2D cross section cine play with synchronization among multiple series |
| • 3D image synchronization among multiple series |
| • VOI sphere measurement, view comparison, results capture, ability to save measurement values and graphs to text file(.csv, .txt) |
| • 3D viewing, editing, measurement |
| • Real time stack reconstruction (Joins multiple cross-sectional slices together and displays the result in Ray summation, MIP, or MinIP mode) |
| • Registration between series using bed position or spine recognition |
| • Ability to set up synchronization options |
| • When using multiple monitors, can synchronize study to be analyzed with selected study on study list. |
| |
| **Dynamic Data** |
| Display of individual parameter images or time-intensity curves of slices of multi-phase data |
| • Loads single or multiple slice cine images |
| • Displays time-intensity curves |
| • Display histogram |
| • Displays parameter images (difference, time to peak, max-min, area underneath curve) |



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| |
|---|
| • Point measurement and ROI measurement as a circle, rectangle, control point, or freehand. Output of measurement results in .csv format |
| • Displays and edits time |
| |
| **Fusion** |
| Viewer superimposes two 3D intra/intermodality images |
| • Comparison reading |
| • Reference reading |
| • MPR reading |
| • Overlay or blending is configurable |
| • Automatic rigid registration |
| • Manual rigid registration by translation and rotation |
| • Registration by specifying reference points |
| • Composites two images using rigid body registration and supports the following post-processing reconstructions for 3D viewing: rigid body registration (applied only to overlaid image), subtraction value, absolute subtraction value, addition value, average value, maximum value, minimum value<br>In case of different modalities, WL conversion can be specified for reconstruction |
| • Composites two images using rigid body registration and supports the following post-processing reconstructions for saving as a DICOM image: rigid body registration (applied only to overlaid image), subtraction value, absolute subtraction value, addition value, average value, maximum value, minimum value<br>In case of different modalities, WL conversion can be specified for reconstruction |
| Comparative observation using analysis results from past studies |
| • Can compare saved snapshots of past studies side by side with current study viewer. |
| • WW/WL, current position, pan, rotation, and zoom rate can be switched between SYNC/ASYNC. |
| • Series registration of CT images using position recognition. |
| |
| **Nuclear Medicine Viewer** |
| Viewer that specializes in fusion display of CT and PET or NM images |
| • Correlation reading |
| • Reference reading |
| • MPR reading |
| • Overlay or blending is configurable |
| • Automatic rigid registration |
| • Manual rigid registration by translation and rotation |
| • Registration by specifying reference points |
| Comparative observation using analysis results from past studies |
| • Can compare saved snapshots of past studies side by side with current study viewer. |
| • WW/WL, current position, pan, rotation, and zoom rate can be switched between SYNC/ASYNC. |
| • Series registration of CT images using position recognition. |



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| |
|---|
| **3D Compositor** |
| 3D viewer which displays up to five 3D images in the same coordinate frame |
| • Automatically or manually adjusts the position of overlay images in reference to a base image |
| • Registration by specifying reference points |
| • Perform series registration of CT images using non-rigid registration and display deformed images |
| • Displays multiple overlain 3D images in the VR view |
| • Displays volume mapping |
| • Synchronizes all 3D views |
| • Edits masks for each 3D view |
| • Inserts 2D MPR cross section planes into each 3D image and synchronizes them with the 2D slice view display |
| • Stereoscopic view |
| |
| **Slicer** |
| Observes and prints arbitrary cross sections based on set-up slice line |
| • Creates arbitrary cross sections by a single slice, multiple slices along a line or a curve |
| • Sets up slice interval, slice thickness and FOV |
| • Inserts inset image into each images |
| ● Sorting multiple slices according to position |
| ● Sets up lines for intervertebral and centrum automatically by spinal detection |
| ● Outputs Windows/DICOM printer |
| ● Transfers obtained cross sections to capture box or saves in DICOM format |
| ● Displays CPR along slices |
| • Enter and display related images |
| |
| **Combination** |
| Combines data taken widely as multiple series and creates compound image |
| ● Signal transformation (density adjustment) for pixels |
| • Manual rigid registration by translation and rotation |
| ● Specifies range of combination |
| ● Displays orthogonal cross section and MIP of compound image |
| ● Processes by 3D Viewer using compound image |
| ● Saves compound image as other series in DICOM dicom format |
| ● Selects direction on saving in DICOM format from axial direction, sagittal direction, coronal direction or same direction on reading |
| Settings |
| ● Selects processing method for overlapped region from maximum value or average value |
| ● Specifies size of shortest side of saved image |



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| |
|---|
| **Vessel Extraction** |
| Extracts blood vessels using both pre-contrast and post-contrast CT, and displays the extraction result |
| • Runs bed removal on loading the image |
| • Adjustable mixing ratio of pre-contrast images and post-contrast images for displaying 2D cross section view and 3D view |
| • Automatic or manual rigid registration |
| • Can perform registration by specifying reference points |
| • Can perform non-rigid registration |
| • After vessels are extracted, they can be viewed as vessel 3D, vessel MIP, vessel+bone, vessel+calcification, or stereoscopic display |
| • After extraction, blood vessels are displayable in 3D view, MIP view, or stereoscopic view. Both blood vessels and bone are displayed in the 3D view |
| • Saves vessel image to DICOM data |
| • 3D Viewer is available to open a view of the vessel image |
| • Can extract cerebral arteries and veins from vessel image |
| • Can insert image plane into 3D display |
| |
| **Dental MPR** |
| Displays and prints panorama image along dental arch and cross section of Alveolar bone using CT image |
| • Sets up position and direction of horizontal cross section |
| • Displays panorama image |
| • Displays cross section of Alveolar bone |
| • Prints using Windows/DICOM printer |
| • Saves all images (orthogonal cross section, panorama image and cross section of Alveolar bone) in DICOM format or transfers to capture box |
| • Can display virtual implant and nerve and set margin of nerve |
| • VR display of LR view and AP view |
| |
| **ADC Viewer** |
| Calculates and displays ADC Map from MR Diffusion image |
| • Reads diffusion weighted image |
| • Reads background image |
| • Perform registration automatically or manually |
| • Displays ADC Map and eADC Map<br>Supported manufacturers: GE, Philips |
| • Displays maximum and minimum value of ADC |
| • Measurement of circular, rectangle and freehand ROIs |
| • Display computed DWI |



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| |
|---|
| **2D Fusion** |
| Viewer superimposes two 2D intra/intermodality images |
| ● Fuse 2D or 3D images |
| ● Save created fusion images as a DICOM file |
| |
| **Sector MPR** |
| Observation of sector or rectangular MPR images using CT and MR images with single or multiple phases |
| ● For images with multiple phases, plays them in cine mode in 2D slice, 3D, or creates sector or rectangular MPR. Duration of each phase is editable |
| ● Displays a sector shaped cross section MPR image based on specified position and orientation |
| ● Reversible display of gray-scale images |
| ● Applies specified image processing and displays pseudo-shadow behind the region that has signal value outside the threshold |
| ● Positional link of sector or rectangular MPR image to 2D cross section |
| ● Displaying an overlay of the cross section image of sector or rectangular MPR onto the 3D view |
| ● The target display can be selected from skin surface, heart, and liver. While the overlay image display can be selected from skin surface, heart, liver, and bone |
| ● Enables changes in the range of the slab thickness in the sector or rectangular MPR view |
| ● Provides a choice of view plane types: sector or rectangle |
| ● Measurement of angle and distance between the puncture position and the target point in centesis mode |
| |
| **General CPR** |
| Extract vessel path and observe and analyze vessels by CPR. |
| ♦ Display straightened CPR. |
| ♦ Display stretched CPR. |
| ♦ Display projected CPR. |
| ♦ Display multi-path CPR. |
| ♦ Automatic path search, and manual settings. |
| ♦ Semi-automatic path search, and manual settings. |
| ♦ Display graph of mean diameter, projection diameter, area, and mean intensity on the path. |
| ♦ Specify one or more normal diameters and measure stenosis rate of vessels, etc. |
| ♦ Color mapping analysis by assigning colors to signal values of up to 6 levels on the vessel. |
| ♦ SMIP display: MIP rendering display of only vicinity along multiple paths. |
| ♦ Can change CPR display to MIP, MinIP, or RaySum. |
| ♦ Orthogonal view of applying smoothing filter or edge enhancement filter. |
| ♦ Connect path route. |
| ♦ Stenosis measurement. |



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| |
|---|
| ♦ Virtual stent graft. |
| Extract and display aorta |
| ♦ Automatically extract aorta. |
| ♦ Aortic stent placement. |
| ♦ Vessel information display for catheter implantation |
| Panorama CPR display |
| ♦ Panorama CPR display. |
| |
| **MPR Reformat** |
| Observe and save an arbitrary oblique plane based on scan line that was set |
| ♦ Create arbitrary cross section using axis, line, sector, or circle. |
| ♦ Set slice spacing, thickness, and FOV. |
| ♦ Sort multiple slices according to position. |
| ♦ Transfer obtained slice images to a capture box, or save as DICOM images. |
| |
| **Tx Map** |
| Calculate and display T2* map from MR images |
| ♦ Load diffusion-weighted images. |
| ♦ Display T2* map. |
| ♦ Display max and min T2* values. |
| ♦ ROI measurement using a point, ellipse, rectangle, polygonal line, or free-form shape. |
| ♦ Display time-intensity curve. |
| ♦ 3D display of map image |

## 8.2 Detailed functional specifications for "Synapse 3D Cardiac Tools (option)"

The following are the detailed functional specifications for “Synapse 3D Cardiac Tools (option).”

| **Coronary Artery Analysis (CT)** |
|---|
| Coronary artery analysis of cardiac CT images |
| • Cross section observation: set simple path, display SlabMIP of any slice thickness, display plaque overlay |
| • The phase to be analyzed can be selected from among multiple phases |
| • Automatically or manually extracts the heart region |
| • Set center axis of left ventricle |
| • Extracts coronary artery by either a classifying method or a tracking method |
| • Auto labeling of major arteries |
| • Extracts bypass blood vessels |
| • Edits central lines and contours |
| • Displays coronary arteries in each of the following views: VR, SMIP, angiography (left, right, left and right). Aorta segmentation result can be toggled |



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| |
|---|
| • Measures stenosis percentage |
| • Plaque measurement: Color-classified view of CT values in the plaque area of the coronary arteries and display of the plaque volume |
| • Virtual stent grafting |
| • Runs Cardiac Fusion using the nuclear medicine images |
| • Saves orthogonal cross section paging, CPR rotation, and CPR translation as a movie, a DICOM image, or multiple capture images |
| • Displays orthogonal cross sections with option of applying smoothing or edge enhancement filter |
| • Related XA Observation: Simultaneously displays 3D image and XA images of the same patient with the same orientation |
| • Normal view, slice view, MPR view, oblique view, cross section view, simple view layout, horizontal view layout, stretched CPR layout, customized layout |
| • CPR observation: Displays two stretched CPR views side by side and rotates them in sync while maintaining a 90 degree angle between them |
| • Chamber views (2 cavities, 3 cavities, 4 cavities, aortic valve) |
| • Plaque map (bull's eye plots) |
| • Creates reports |
| Displays CPRs of coronary arteries |
| • Creates magnified views of a selected area in the straightened CPR view and stretched CPR view |
| • Displays graph of average diameter, projected length of radius, area, and average signal value together with the straightened CPR view |
| • Graph view can be toggled |
| • Displays a list of cross sections that are orthogonal to given point in the blood vessel |
| • Displays stretched CPR and 3D views side by side with the same orientation |
| • Displays enlarged stretched CPRs in relation to the position of orthogonal cross sections |
| • Synthesizes and displays stretched CPRs of all branches of either left coronary artery or right coronary artery |
| Comparative observation using analysis results from past studies |
| • Can browse and compare current study with saved snapshots of past studies |
| • WW/WL, current position, pan, rotation, zoom rate, and straightened CPR can be switched between SYNC/ASYNC |
| • Can apply analysis results from past studies to current study using non-rigid registration |
| Macro |
| • Records and plays based on user operation |
| |
| **Coronary Artery Analysis (MR)** |
| Coronary artery analysis of cardiac MR images |
| • Cross section observation: set simple path, display SlabMIP of any slice thickness |
| • Automatically or manually extracts the heart region |



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| |
|---|
| • Extracts coronary artery by either a classifying method or a tracking method |
| • Extracts bypass blood vessels |
| • Edits central lines and contours |
| • Displays coronary arteries in each of the following views: VR, SMIP, angiography (left, right, left and right). Aorta segmentation result can be toggled |
| • Measures stenosis percentage |
| • Virtual stent grafting |
| • Runs Cardiac Fusion using the nuclear medicine images |
| • Saves orthogonal cross section paging, CPR rotation, and CPR translation as a movie, a DICOM image, or multiple capture images |
| • Displays orthogonal cross sections with option of applying smoothing or edge enhancement filter |
| • Related XA Observation: Simultaneously displays 3D image and XA images of the same patient with the same orientation |
| • Slice view, axial view, MPR view, oblique view, cross section view, simple view layout, horizontal view layout, stretched CPR layout, customized layout |
| • CPR observation: Displays two stretched CPR views side by side and rotates them in sync while maintaining a 90 degree angle between them |
| • Creates reports |
| Displays CPRs of coronary arteries |
| • Creates magnified views of a selected area in the straightened CPR view and stretched CPR view |
| • Displays graph of average diameter, projected length of radius, area, and average signal value together with the straightened CPR view |
| • Graph view can be toggled |
| • Displays a list of cross sections that are orthogonal to given point in the blood vessel |
| • Displays stretched CPR and 3D views side by side with the same orientation |
| • Displays enlarged stretched CPRs in relation to the position of orthogonal cross sections |
| • Synthesizes and displays stretched CPRs of all branches of either left coronary artery or right coronary artery |
| |
| **Functional Cardiac Analysis (CT)** |
| Cardiac function analysis with cardiac CT cine images |
| • Automatic extraction of heart region and manual modification |
| • Automatic long axis positioning |
| • 4D cine play |
| • Creates 4D movie |
| • Chamber views (2 cavities, 3 cavities, 4 cavities, aortic valve) |
| • Specifies cardiac base and apex for all phases or individual phase, then specifies the center position for each slice in the short axis views |
| • Auto-detect contour of left ventricle, myocardium, and right ventricle |



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| |
|---|
| • Manually set contour of left ventricle in a short axis image |
| • Manually set contour of myocardium, and right ventricle in a long axis image or short axis image |
| • Intermediate phase contours are interpolated based on setting of contours of ventricle and myocardium on one or more slices in the short axis view |
| • Results display: End-diastolic volume (EDV), end-systolic volume (ESV), end-diastolic volume index (EDVI), end-systolic volume infarction (ESVI), stroke volume (SV), cardiac output (CO), cardiac infraction (CI), peak filling rate (PFR), time to peak filling (TPF), ejection fraction (EF), body surface area, myocardium weight |
| • Display of bull's eye plots: Ventricular internal radius, region ejection fraction, wall thickness, amount of change in wall thickness, increase rate of wall thickness, momentum of wall motion, etc. |
| • Displays ventricular volume curve |
| • Displays overlay of the mapping image of each bull's eye plot onto the ventricular contours for surface rendering |
| • Displays myocardial region |
| • Displays volume data with highlighted left ventricle, left atrium, and cardiac vessels in 2D cross-sectional view |
| • Can specify how to handle papillary muscle volume (in ventricle or in myocardium) |
| • Outputs analytical values, bull's eye plots, ventricular volume curve, observations, and images to a report |
| • Calls Cardiac Fusion to overlay the Cardiac Function analysis results onto the heart surface together with the Coronary Artery analysis results |
| |
| **Functional Cardiac Analysis (MR)** |
| Cardiac function analysis with cardiac MR cine images |
| • 4D cine play |
| • Creates 4D movie |
| • Specifies cardiac base and apex for all phases or individual phase, then specifies the center position for each slice in the short axis views |
| • Automatic extraction of contours of left ventricle and myocardium |
| • Manual selection of contours of left ventricle and myocardium in the short axis views |
| • Intermediate phase contours are interpolated based on setting of contours of ventricle and myocardium on one or more slices in the short axis view |
| • Results display: End-diastolic volume (EDV), endsystolic volume (ESV), end-diastolic volume index (EDVI), endsystolic volume infarction (ESVI), stroke volume (SV), cardiac output (CO), cardiac infraction (CI), peak filling rate (PFR), time to peak filling (TPF), ejection fraction (EF), body surface area, myocardium weight |
| • Display of bull's eye plots: Ventricular internal radius, region ejection fraction, wall thickness, amount of change in wall thickness, increase rate of wall thickness, momentum of wall motion, etc. |
| • Displays ventricular volume curve |
| • Displays overlay of the mapping image of each bull's eye onto the ventricular contour for surface |



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| |
|---|
| rendering |
| • Displays myocardial region |
| • Can specify how to handle papillary muscle volume (in ventricle or in myocardium) |
| • Outputs analytical values, bull's eye plots, ventricular volume curve, observations, and images to a report |
| • Calls Cardiac Fusion to overlay the Cardiac Function analysis results onto the heart surface together with the Coronary Artery analysis results |
| |
| **Calcium Scoring** |
| Using non-contrast CT images, this plugin creates a color-classified view of plaque area in the coronary arteries and calculates the Agatston score |
| • Automatic extraction of heart |
| • Calculates the number of plaques for each vessel (LM/LAD/LCX/RCA), volume (area), Agatston score, integration score per voxel, mean CT value, and maximum CT value |
| • Specifies plaque region |
| • Supports creation of new vessel regions for scoring |
| • Saves the scoring result to a .csv file or a .txt file, or captures the result |
| • Outputs scoring results, observations, and images to a report |
| |
| **Cardiac Fusion** |
| Display a bull's eye and a mapping of the nuclear medicine image to the 3D heart surface, which are obtained by the cardiac function analysis system application |
| • Overlays bull's eye images onto the base image, making out of range pixels transparent |
| • Can perform Stress/Rest calculation and results mapping using nuclear medical images |
| • Displays coronary artery regions together with nuclear medical images |
| • Maps images of cardiac function or nuclear medicine onto the left ventricle image |
| • Selectable view of cardiac 3D images: the entire heart, the origins of arteries, or the left ventricle |
| • Displays an overlay of the images of cardiac function or nuclear medicine onto the CPR image |
| • Displays axial/sagittal/coronal/long-axis/short-axis views. When structure image is different from function image, fusion is available to display a superimposed image |
| • Registration |
| • Creates reports |
| Displays bull's eye |
| • Transforms bull's eye plots for display according to the length of the coronary arteries |
| • Inverse display of bull's eye |
| • Changes the range of colors by specifying the upper limit and the lower limit |
| • Displays Topographic map |
| |
| **Aortic Valve Analysis** |
| Using single or multiple phase cardiac CT images, measure an aortic valve |



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| |
|---|
| ♦ Cine play synchronized with 2D slice images and 3D images. |
| ♦ Can change specification of display time for each phase to be shown in milliseconds or as a percentage of overall playback time. |
| ♦ Create a 4D movie of the entire display image, or of the 3D view only. |
| ♦ Automatically extract heart. |
| ♦ Measurement near aortic valve function. |
| ♦ Plaque measurement: color-coded display of CT values. |
| ♦ Virtual valve placement. |
| ♦ Plaque measurement of internal virtual valve only. |
| ♦ Insert image planes. |
| ♦ Output various measurement values, analysis values, and images to report. |
| ♦ Observation using oblique three planes |
| ♦ Display body surface and ribs for transapical approach |
| ♦ Creates report based on measurement results in ST Junction, Sinus of Valsalva, Annulus and optional plane |
| |
| **Flow Analysis (MR)** |
| Analyze blood flow velocity using single or multiple cross-sectional multi-phase images |
| ♦ Display blood flow image. |
| ♦ Display original image, phase image, or absolute value image overlapped with the blood flow velocity image. |
| ♦ Display time-intensity curve. |
| ♦ ROI measurement in a circle, rectangle, or freehand curve. Measurement results can be output as CSV file. |
| ♦ Display and edit time. |
| |
| **4 chamber analysis** |
| Perform cardiac function analysis on the four chambers (left ventricle, right ventricle, left atrium, right atrium) in CT Cine images of the heart |
| ♦ Automatic extraction of heart with manual correction. |
| ♦ Automatic extraction of 4 chambers of heart with manual correction. |
| ♦ Automatic setting of long axis with manual correction. |
| ♦ 4D Cine play. |
| ♦ 4D movie creation. |
| ♦ Chamber list view (2-chamber, 3-chamber, 4-chamber, aortic valve). |
| ♦ Specify apex and base for each phase or all phases, and specify center position of each slice (short-axis image). |
| ♦ Auto-detect contour of left ventricle and myocardium. |



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| |
|---|
| ♦ Display results: end-diastolic volume (EDV), end-systolic volume (ESV), end-diastolic volume index (EDVI), end-systolic volume index (ESVI), stroke volume (SV), cardiac output (CO), cardiac index (CI), peak filling rate (PFR), time to peak filling (TPF), ejection fraction (EF), body surface area, myocardial mass. |
| ♦ Bull's eye display: ventricular radius, region EF, wall thickness, wall thickening rate, wall motion, etc. |
| ♦ Display EF curve of 4 chamber region. |
| ♦ Display surface of each 4 chamber region. |
| ♦ Surface display that maps each bull's eye color to surface of ventricle. |
| ♦ Display myocardial regions. |
| ♦ Choice of whether to include volume of ventricular papillary muscles in either ventricle or myocardium. |
| ♦ Output analysis values, bull's eye, EF curve, observation, and images to a report. |
| ♦ Non-rigid registration between phases. |
| ♦ Bull's eye display of parameters using information from non-rigid registration between phases. |
| ♦ Can start cardiac fusion in conjunction with results of coronary analysis, and map results of 4 chamber analysis onto surface of heart. |
| |
| **Cardiac Ablation Analysis** |
| • Automatic extraction of the heart |
| • Automatic extraction of ventricular, atrial, and myocardial regions |
| • Extraction of the pulmonary vein based on the left atrium region |
| • ROI-based extraction of the gullet region |
| • 3D view inside the pulmonary vein |
| • Virtual endoscopic view of inside the pulmonary vein |
| • Observation of display planes in a virtual endoscopic view |
| • Output cine movies |

## 8.3 Detailed functional specifications for "Synapse 3D Brain Perfusion (option)"

The following are the detailed functional specifications for “Synapse 3D Brain Perfusion (option).”

| **Brain perfusion (CT)** |
|---|
| CT cerebral perfusion analysis |
| • Loads and analyzes single or multiple slice images |
| • Automatic rigid registration of images of the same slice among different phases |
| • Automatic detection or manual selection of the positions of arteries and veins |
| • Plays cine of cross section images |
| • Calculates CBV/MTT/CBF/TTP images |
| • Superposes original image and parameter images |



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| |
|---|
| • Sets up removal rate of blood vessels |
| • ROI setting (symmetric ROI is available) |
| • Manage ROI templates |
| • Displays time-intensity curve |
| • Stores graphs in csv format |
| • Sets up whether to perform delay correction by bSVD |
| • Sets up pseudo-color of parameter image |
| • Set how to obtain time information |
| |
| **Brain Perfusion (MR)** |
| MR cerebral perfusion analysis |
| • Loads and analyzes single or multiple slice images |
| • Automatic rigid registration of images of the same slice among different phases |
| • Automatic detection or manual selection of the positions of arteries and veins |
| • Plays cine of cross section images |
| • Calculates CBV/MTT/CBF/TTP images |
| • Superposes original image and parameter images |
| • Sets up removal rate of blood vessels |
| • ROI setting (symmetric ROI is available) |
| • Manage ROI templates |
| • Displays time-intensity curve |
| • Stores graphs in csv format |
| • Sets up whether to perform delay correction by bSVD |
| • Sets up pseudo-color of parameter image |
| • Displays result image overlapped with ADC Map by reading Diffusion image (with or without MPG) together |
| • Displays other image (T2W and FLAIR et al.) overlapped with ADC Map by reading other image together |
| • Set how to obtain time information |
| |
| **4D Perfusion** |
| Perfusion analysis of 3D CTs of the head |
| ♦ Load and analyze three-dimensional images. |
| ♦ Automatically detect positions of arteries and veins, or set them manually. |
| ♦ Can perform Cine playing of slice images or 3D images. |
| ♦ Calculate CBV/MTT/CBF/TTP images. |
| ♦ Overlay display of a parameter image and original image. |
| ♦ Set vessel removal ratio. |
| ♦ Set ROI (can also set symmetrical ROI). |
| ♦ Display time-intensity curve. |



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| |
|---|
| ♦ Save graph in csv format. |
| ♦ Set delay correction with bSVD. |
| ♦ Set pseudo-color in parameter image. |
| |

## 8.4 Detailed functional specifications for "Synapse 3D Lung and Abdomen Analysis (option)"

The following are the detailed functional specifications for “Synapse 3D Lung and Abdomen Analysis (option).”

| **Lung Analysis (CT)** |
|---|
| Using CT images, this plugin calculates volume of lung nodules and displays low attenuation areas |
| • Semi-automatic extraction of 5 lobes of the lung |
| • Separates right and left lungs automatically |
| • Automatic extraction of lung field |
| • Automatic removal of airways |
| • Outputs nodule list, observation, images to the report |
| • Automatically extract contact surface between diaphragm and lungs |
| Lung nodule |
| • Semi-automatic extraction of nodules by selecting position or contours |
| • Displays the region around the nodule in the 2D cross section view or the 3D view, or displays the entire region |
| • Lists volume, maximum CT value, mean CT value, and standard deviation for each nodule |
| • Displays intensity histogram for each nodule |
| • Can capture the nodule list and histograms or save them to a file |
| Airway analysis |
| • Selects the paths of airway |
| • Adds and deletes paths and edits central lines and contours |
| • Displays CPRs of the paths of airway |
| • Displays diameter information of paths on CPR and graph |
| • Labels to airway on specified position |
| • Extracts lung field occupied by labeled airways |
| Displays low attenuation areas |
| • Displays an overlay of the color coded image onto the lung region in 2D view |
| • Individually displays the results of analysis for right and left lung, lung lobes and regions occupied by airways |
| • Calculates histogram of the inside of the lung field |
| • Displays an overlay of the low attenuation areas onto the surface of the lung |
| • Calculates the volume of the region specified by each intensity range as well as the percentage of the lung field made up by that region |
| • Allows registering and editing the color code of low attenuation areas |



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| |
|---|
| • Can capture the histogram and the volume list of each region or save them to a file |
| Cluster analysis |
| ● Classifies low attenuation areas by clustering |
| ● Clustering analysis based on 2D connection components |
| ● Clustering analysis based on 3D connection components |
| ● Overlays colors according to cluster size onto lung region on 2D cross sections |
| ● Displays spheres according to cluster size onto 3D image |
| ● Displays log-log graph made by horizontal axis corresponding to the volume and vertical axis corresponding to the number. |
| ● Displays regression line for log-log graph |
| Compare to analysis results of past studies |
| • Comparison of tumor over time |
| • Comparison of airway analysis over time |
| • Comparison of low attenuation area over time |
| • Comparison of cluster analysis over time |
| |
| **2D Fat Analysis (CT)** |
| Measurement of visceral and subcutaneous fat area by using a single abdomen CT image |
| • Automatic detection of subcutaneous fat and visceral fat |
| • Automatic recognition of umbilicus position on loading images |
| • Manual correction to the result of automatic detection of subcutaneous fat and visceral fat |
| • Calculation of the area of subcutaneous fat and visceral fat |
| • Calculation of circumference of body surface |
| • Calculation of BMI |
| • Output to reports: Total area of fat, area of subcutaneous fat, area of visceral fat, abdominal girth, BMI, diagnostic result, comments, and images |
| |
| **3D Fat Analysis (CT)** |
| Calculates volume and percentage of visceral fat and subcutaneous fat using 3D CT abdominal images |
| • Automatic detection of subcutaneous fat and visceral fat and psoas major |
| • Automatic recognition of upper surface of the diaphragm, pubic symphysis, and umbilicus position |
| • Manual correction to the result of automatic detection of subcutaneous fat, visceral fat and psoas major |
| • Calculation of the area of subcutaneous fat and visceral fat |
| • Calculation of fat percentage in the region for analysis |
| • Calculation of circumference of body surface |
| • Displays an overlay of the frequency distribution of both subcutaneous fat and visceral fat onto the surface of the 3D view |
| • Calculation of BMI |
| • Output to reports: Total area of fat, area of subcutaneous fat, area of visceral fat, abdominal girth, |



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| |
|---|
| BMI, volume of visceral fat, volume of subcutaneous fat, volume percentage of body fat, volume percentage of subcutaneous fat, diagnostic result, comments, and images |
| • Calculation of the specified region volume of the psoas major |
| |
| **Lung Analysis Scope (CT)** |
| Using CT images, find optimal bronchus path leading to lung nodule |
| ♦ Automatically extract lung region. |
| ♦ Automatically extract airway region. |
| ♦ Output observations and images to a report. |
| Extraction of lung nodules and optimal path |
| ♦ Specify diameter of lung nodules and perform semi-automatic extraction. |
| ♦ Extract optimal path leading to lung nodule. |
| ♦ Save optimal path list as a capture or file. |
| ♦ Add and remove paths. |
| ♦ CPR display of optimal path. |
| ♦ Set lymph nodes present in vicinity of path. |
| Checking optimal path |
| ♦ Endoscopic view of optimal path. |
| ♦ Can record any position on optimal path. |
| ♦ Create movie of endoscope advancing through optimal path. |
| ♦ Sheer display of endoscopic image. |
| ♦ Automatically update opacity of endoscopic image based on progress of endoscope. |
| |
| **Lung Analysis Resection (CT)** |
| Using CT images, extract lung, bronchus, tumor, and pulmonary vessels and simulate lung resection |
| ♦ Extract the 5 lobes semi-automatically. |
| ♦ Automatically separate left and right lungs. |
| ♦ Automatically extract lung region. |
| ♦ Automatically remove airway region. |
| ♦ Automatically extract contact surface between diaphragm and lungs. |
| ♦ Output nodule list, observations, and images to a report. |
| Extraction of tumor |
| ♦ Specify the contour or the position and diameter of tumor and perform semi-automatic extraction. |
| ♦ Local or overall view of 2D slice or 3D image near tumor. |
| ♦ For each tumor, list its volume, maximum CT value, minimum CT value, mean CT value, and standard deviation. |
| ♦ Histograms of each tumor. |
| ♦ Save tumor list and histogram as a capture or file. |
| Extraction of PV/PA and bronchus |



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| |
|---|
| ♦ Specify center of PV/PA. |
| ♦ Semi-automatically extract pulmonary vessels. |
| ♦ Add and remove portions while extracting PV/PA and bronchus. |
| ♦ Replace extracted PA and PV. |
| ♦ Show/hide the extracted path. |
| ♦ Save study list as a capture or file. |
| ♦ Automatically extract bone and body surface regions. |
| Division of the lung region |
| ♦ Extract lung field region occupied by specified sub-tree of PV/PA and bronchus. |
| ♦ Arbitrary division of lung region. |
| ♦ Edit occupied region and its border. |
| ♦ Surface rendering of region. |
| ♦ Insert image plane into 3D display. |
| ♦ Cut plane display: paste slice MPR in 3D image. |
| ♦ Measure distance between tumor and plane. |
| ♦ Can record division method |
| |
| **Lung Analysis Scope (CT)** |
| Using CT images, find optimal bronchus path leading to lung nodule |
| ♦ Automatically extract lung region. |
| ♦ Automatically extract airway region. |
| ♦ Output observations and images to a report. |
| Extraction of lung nodules and optimal path |
| ♦ Specify diameter of lung nodules and perform semi-automatic extraction. |
| ♦ Extract optimal path leading to lung nodule. |
| ♦ Save optimal path list as a capture or file. |
| ♦ Add and remove paths. |
| ♦ CPR display of optimal path. |
| ♦ Set lymph nodes present in vicinity of path. |
| Checking optimal path |
| ♦ Endoscopic view of optimal path. |
| ♦ Can record any position on optimal path. |
| ♦ Create movie of endoscope advancing through optimal path. |
| ♦ Sheer display of endoscopic image. |
| ♦ Automatically update opacity of endoscopic image based on progress of endoscope. |
| |

## 8.5 Detailed functional specifications for "Synapse 3D Liver and Kidney Analysis (option)"

The following are the detailed functional specifications for “Synapse 3D Liver and Kidney Analysis (option).”



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| **Liver Analysis (CT)** |
|---|
| Using contrast CT images, this plugin performs liver extraction and extraction of individual blood vessel regions. It displays the extraction results in the 3D view |
| • Loads artery images, portal images, and equilibrium images at the same time |
| • Manual and automatic rigid registration of each phase |
| • Automatic non-rigid registration |
| • Automatic extraction of liver |
| • Extraction of inferior vena cava by setting ROI in multiple slices |
| • Extraction of artery, portal, vein, and bile duct |
| • Extraction of high density and low density tumors |
| • Extraction of body surface, bone region and gallbladder |
| • Extraction of arbitrary region |
| • Displays the length of the segment specified in extracted blood vessels |
| Extraction of each region of the liver |
| • Divides the liver into multiple regions by either manual operation or automatic estimation of the blood vessels' affected regions |
| • Displays volume of each divided region of the liver |
| • Displays volume of each divided region of the liver after removing the surrounding organs such as blood vessels |
| • Performs mask operator calculations: reverse, addition, subtraction, logical conjunction, exclusive OR, and swapping among divided regions |
| • Saves methods of dividing regions |
| Liver observation |
| • Displays an image plane inserted in the volume image in the 3D view |
| • Surface smoothing is available in the 3D view |
| • Displays liver regions and blood vessel regions with surface rendering |
| • Displays cut planes: MPR cut plane in the 3D view |
| • Simulates removal of tumor region |
| • Display organs near cut plane of region division |
| • Display sector MPR images |
| • Output liver region information from the results of the region division to a report |
| |
| **Liver Analysis (MR)** |
| Perform observation and analysis of contrast-enhanced images using abdominal MR images |
| • Load multi-phase images of different times. |
| • Load non-contrast-enhanced images as reference images. |
| • Comparison display of local viewing areas. |
| • Simultaneous display of regions of interest for multi-phase images. |
| • Image registration between multi-phase images. |



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| |
|---|
| • Extract liver and spleen based on specified region. |
| • Display results of image calculation by user-specified formula. |
| • Pseudo-color display of calculation result image. |
| • Overlay display of calculation result image and original image. |
| |
| **Kidney Analysis (CT)** |
| Using contrast-enhanced CT images of kidney, perform extraction of kidney and each vessel region, and view results in 3D. |
| • Load artery images, corticomedullary images, nephrographic images, and excretory images at the same time. |
| • Manual and automatic rigid registration of each phase. |
| • Semi-automatic extraction of kidney. |
| • Extraction of cortex and medulla. |
| • Extraction of artery, portal, and bile duct. |
| • Extraction of tumor and calculus. |
| • Extraction of body surface and bone region. |
| • Extraction of arbitrary region. |
| Extraction of each region of kidney |
| • Divides the kidney into multiple regions by either manual operation or automatic estimation of the blood vessels' affected region. |
| • Displays volume of each divided region of the kidney. |
| • Displays volume of each divided region of the kidney after removing the surrounding organs such as blood vessels. |
| • Performs mask operator calculations: reverse, addition, subtraction, logical conjunction, exclusive OR, and swapping among divided regions. |
| • Saves methods of dividing regions. |
| Observation of kidney |
| • Displays an image plane inserted in the volume image in the 3D view |
| • Surface smoothing is available in the 3D view |
| • Displays kidney regions and blood vessel regions with surface rendering |
| • Displays cut planes: MPR cut plane in the 3D view |
| • Simulates removal of tumor region |
| • Displays cut planes of divided region |
| • Utilizes Sector MPR in Kidney Analysis |
| • Outputs information for each divided kidney to report |

## 8.6 Detailed functional specifications for "Synapse 3D Nodule Analysis (option)"

The following are the detailed functional specifications for “Synapse 3D Nodule Analysis (option).”



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| **RECIST tracker (CT, CT/PET)** |
|---|
| Using CT image mainly, tracks temporal changes of a tumor |
| ● Registration between PET image and CT image |
| ● Extracts a tumor by specifying diameter |
| ● Displays histogram of lesions |
| ● Registers, displays and evaluates tumors |
| ● Output to reports on each state of approve, determine and overall determine |
| ● Compares with previous study |
| ● Selects tumor evaluation criteria from WHO, RECIST1.0 |
| |
| **PERCIST tracker (PET, CT/PET)** |
| Using PET image manly, tracks temporal changes of a tumor |
| ● Registration between PET image and CT image |
| ● Calculates maximum averaged SUV on specified position using sphere VOI |
| ● Registers, displays and evaluates tumors |
| ● Output to reports on each state of approve, determine and overall determine |
| ● Compares with previous study |

## 8.7 Detailed functional specifications for "Synapse 3D Colon Analysis (option)"

The following are the detailed functional specifications for “Synapse 3D Colon Analysis (option).”

| **Colon Analysis (CT)** |
|---|
| Perform Observation by generating a path through the colon from CT image |
| • Load one or both of the supine and prone position images. |
| • Can automatically extract the colon, and add manually if that is not sufficient |
| • Can semi-automatically specify a path through the extracted colon. |
| • Show display region (whole or local), display method (colon near surface, AirWay, RaySum), surface display (airway surface, airway internal, external surface). |
| • Virtual endoscopy view of colon along the path. |
| • Walk-through function. |
| • Create movie for virtual endoscope. |
| • Unfolded cube view display. |
| • Display straight open view. |
| • Display straight cross-section view. |
| • Depth MIP display of thickness from wall for virtual endoscope and each straight open view. |
| • Can record positions of lesions such as a polyps. |
| • Digital cleansing. |
| • Simultaneous display of images before and after execution of cleansing. |
| • Can edit cleansing area. |



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| |
|---|
| • Synchronize two images. |
| • Can register recorded positions of a lesion between two images as a pair. |
| |

### 8.8 Detailed functional specifications for "Synapse 3D Tensor Analysis (option)"

The following are the detailed functional specifications for “Synapse 3D Tensor Analysis (option).”

| **Craniotomy Simulator/Tensor Analysis (CT, MR)** |
|---|
| From MR images of the head, perform tensor analysis, and visualize the white matter tractography<br>From MR images of the head, perform craniotomy simulation |
| • Load diffusion-weighted images. |
| • Calculate FA value and diffusion color map by tensor analysis. |
| • ROI measurement using an oval, rectangle, free-form shape, or sphere. |
| • Insert image planes. |
| • Place oval, rectangle, free form shape, or sphere, execute tractography, and then display results of tensor analysis as white matter tractography in 3D view. |
| • If multiple images were entered, align them. |
| Organ extraction from CT images |
| • Extract body surface, bone, brain, tumor, artery, vein, or arbitrary region |
| • Can extract multiple tumor regions and calculate the volume of each. |
| Craniotomy simulation |
| • Multi 3D display of extracted region. |
| • Specify region and then make incision in surface and bone. |
| • Can record division method |
| |



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