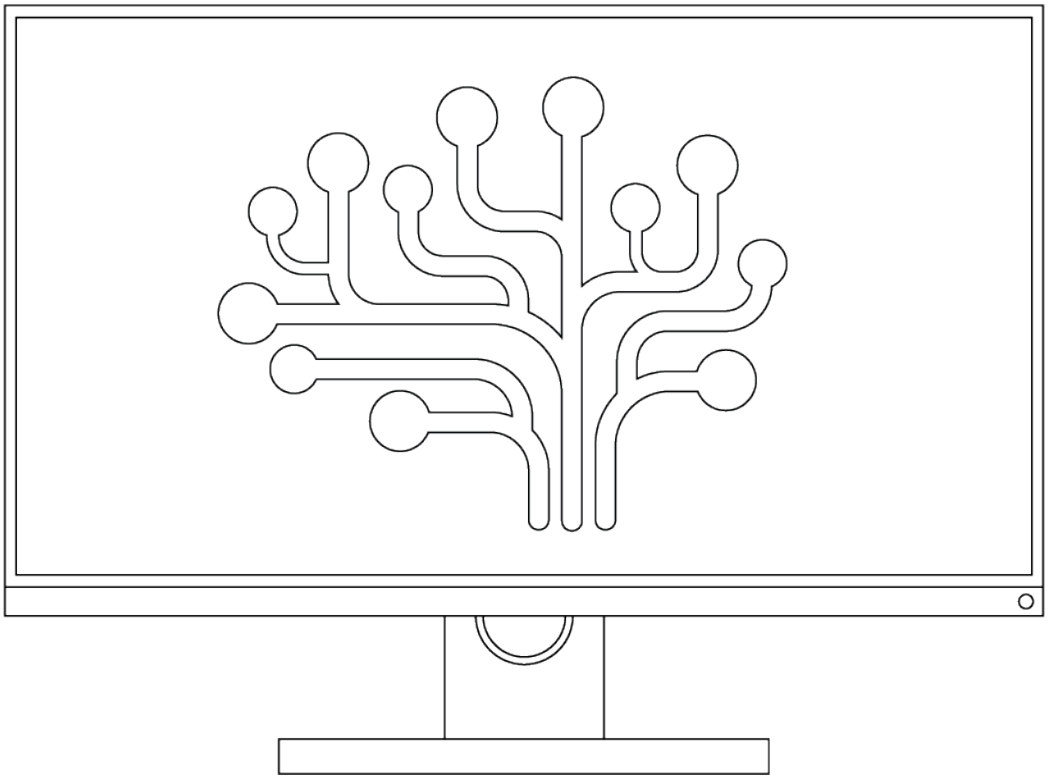
# Modus Plan™ 2.0
# User Manual

MAN-0681 Revision B



Synaptive

# User Manual

## Synaptive™ Modus Plan™ 2.0

SYN-0866

MAN-0681 – Revision B issued on May 06, 2021.



These instructions for use are also available in electronic form at www.synaptivemedical.com/elFU. The electronic instructions for use may be viewed on any device that can access the internet and display PDF files. Access to the electronic instructions for use requires a password; to obtain the password, contact Synaptive Customer Service.

The Modus Plan fulfills all the relevant provisions in European Union Council Directive 93/42/EEC, as amended by Directive 2007/47/EC. Based on this directive, the CE mark is hereby affixed:

CE 2797

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# 1.0 Introduction

Welcome to Synaptive™ Modus Plan™, advanced surgical planning software. Modus Plan provides real-time 3D rendering of medical image scans such as MRIs, and provides tools for reviewing, manipulating and annotating those images.

Modus Plan can be used in two modes: Plan and Investigate.

- Use Plan mode to create surgical plans based on diffusion data registered to anatomical structures.
- Use Investigate mode to review and annotate images, and to view an exported surgical plan created in Plan mode.

**NOTE: The graphics and medical images in this manual are examples only. The actual design and display on your system may vary.**

## 1.1 Product and Safety Symbols

**Table 1 ISO 7000 - Graphical symbols for use on equipment - Registered symbols and ISO 15223-1 - Medical devices - Symbols to be used with medical device labels, labeling and information to be supplied**

| Symbol | Title | Reference | Description |
|---|---|---|---|
|  | Caution | ISO 7000-0434A | To indicate that caution is necessary when operating the device or control close to where the symbol is placed, or to indicate that the current situation needs operator awareness or operator action in order to avoid undesirable consequences. |
|  | Manufacturer | ISO 7000-3082 | To identify the manufacturer of a product. |
|  | Consult instructions for use | ISO 7000-1641 | To identify the location where the operator's manual is stored or to identify information that relates to the operating instructions. To indicate that the operating instructions should be considered when operating the device or control close to where the symbol is placed. |
|  | Catalog number | ISO 7000-2493 | To identify the manufacturer's catalog number, for example on a medical device or the corresponding packaging. |
|  | Serial number | ISO 7000-2498 | To identify the manufacturer's serial number, for example on a medical device or its packaging. |

Table 2 Product Safety Certification Marks

| Symbol | Title | Reference | Description |
|---|---|---|---|
| CE | CE mark | N/A | Conformity with the essential requirements set out in the European Directives. |
| EC REP | European Community Representative | N/A | Appears next to the European Community representative's name and address. |

Table 3 Other Symbols

| Symbol | Description |
|---|---|
| Rx only | U.S. Federal law restricts this device to sale by or on the order of a licensed healthcare provider. |
| MD | Medical Device |

## 1.2 Indications for Use

Modus Plan's indications for use are the viewing, presentation and documentation of medical imaging, including different modules for image processing, image fusion and image segmentation, where the output can be used for image guided surgery.

Example procedures include but are not limited to:

- Planning and simulation of cranial surgical procedures such as:
  - lesionectomies or lesionotomies of epileptogenic foci
  - resection of lesions including tumors
  - shunt placement
  - vascular procedures and segmenting the vasculature
  - biopsy
  - corridor based procedures
  - planning and simulation of trajectories for stimulation and electrode recording.
- Reviewing of existing treatment plans.

Typical users of the software are medical professionals, including but not limited to surgeons and radiologists.

## 1.3 Contraindications

Modus Plan should not be used to create a surgical plan unless the data series has been reviewed by a radiologist or surgeon.

The data review functionality of Modus Plan should be used to first review the data series by a radiologist or surgeon prior to development of a surgical plan.

Modus Plan is not designed as a primary tool for disease detection or diagnosis.

Additional contraindications include scenarios where processing errors occur such as noisy scan data, partial skull mask, incorrect skull mask, poor registration, or poor diagnostic image quality. Modus Plan may not generate processed data series (e.g. tractography) for these scenarios. Modus Plan has input file checks that warn the user or provide an error message for some of these contraindications.

## 1.4 Intended Use Environment

The Modus Plan system is intended for use in hospitals, clinics, and other medical institutions.

## 1.5 Clinical Benefits

Modus Plan's surgical planning and tractography features provide clinical benefit by minimizing risk of injury to normal cortex and white matter. This is achieved by enabling minimally invasive approaches[1,2,3], maximizing resection[4,5,6], enabling functional preservation[4,6,7,8,9,10,11], providing access to inoperable lesions[12,13,14], and reducing length of stay[15].

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1. Chakravarthiet al., Awake Surgical Management of Third Ventricular Tumors: A Preliminary Safety, Feasibility, and Clinical Applications Study: Physics and Evolution of Optical Chains Supplement. Operative Neurosurgery, 2019
2. Doers, Initial Experience with a Robotics Guided Optics Platform in Spine Surgery. Presented at NASS, 2016
3. Banczerowskiet al., Minimally invasive spine surgery: systematic review. Neurosurgery Review, 2015
4. Agarwal et al., Tractography for Optic Radiation Preservation in Transcortical Approaches to Intracerebral Lesions. Cureus, 2017
5. Glenn et al., Common Disconnections in Glioma Surgery: An Anatomic Description. Cureus, 2017
6. Wu et al., Clinical evaluation and follow-up of diffusion tensor imaging-based functional neuro-navigation: A prospective, controlled study in patients withgliomas involving pyramidal tracts. Neurosurgery, 2007
7. Eliyaset al., Minimally Invasive Transsulcal Resection of Intraventricular and Periventricular Lesions Through a Tubular Retractor System: Multicentric Experience and Results. World Neurosurgery, 2016
8. Weiner et al., Resection of a Pediatric Thalamic Juvenile Pilocytic Astrocytoma with Whole Brain Tractography. Cureus, 2017
9. Brown et al., Transcortico-subcortical approach for left posterior mediobasaltemporal region gliomas: a case series and anatomical review of relevant whitematter tracts. World Neurosurgery, 2020
10. Monroy Sosa et al., White Matter-Governed Superior Frontal Sulcus Surgical Paradigm: A Radioanatomic Microsurgical Study—Part I. Operative Neurosurgery, 2020
11. Kassam et al., White Matter-Governed Superior Frontal Sulcus Surgical Paradigm: A Radioanatomic Microsurgical Study—Part II. Operative Neurosurgery, 2020
12. Zucker, Left Intracerebral hematoma case study. Presented at SSG, 2017
13. Pradilla, High Grade Glioma Case Study. Unpublished case study, 2017
14. Pradilla, Glioblastoma Multiforme Case Study. Unpublished case study, 2017
15. Jennings et al., The Surgical White Matter Chassis: A Practical 3-Dimensional Atlas for Planning Subcortical Surgical Trajectories. Operative Neurosurgery, 2017

The tractography produced by Modus Plan is patient specific, enabling individualized medicine, as variability in fiber location requires an individualized approach[1,2,7,16,17,18]. With Modus Plan, tractography is easily accessible due to automation that saves hours of surgeon or radiology time[2,12,13,14], enabling surgeons to use accurate[12,14,16] and integrated tractography for more procedures[13,15].

# 1.6 Important Information

Caution: Federal law restricts this device to sale by or on the order of a physician.

## 1.6.1 Medical Professional Responsibilities

Modus Plan has been designed for use by trained, qualified, medical professionals. Decisions made by the medical professional during planning should be based on sound clinical (e.g., anatomical) knowledge.

- Modus Plan does not choose or recommend any particular planned trajectory. It is the responsibility of the medical professional to choose the most effective trajectory based on clinical knowledge.
- Modus Plan does not detect high-risk trajectories. It is the responsibility of the medical professional to choose the most effective trajectory based on clinical knowledge.
- Manually adjusting the registration of tractography also affects ADC, FA and RGB registration. Use caution during manual adjustment, as improving a local registration can have negative results elsewhere in the volume.

## 1.6.2 Use Caution when Interpreting Images

- Tract information displayed in Modus Plan is based on diffusion data; it does not necessarily correspond to nerve bundles.
- The diffusion tract colors are based on the axes of the scanner. If the patient's head is not aligned with the scanner, the colors will not map to the patient axes.
- Image data received from the scanner may be oriented incorrectly (left and right may be reversed). Always review the data labeling in Modus Plan before creating a surgical plan.

## 1.6.3 Risks Associated with Poor Image Quality or Missing Data

- Accepting poor quality series may impede location of appropriate surgical targets and regions of interest.
- Accepting a series with missing slices may prevent you from locating appropriate surgical targets and regions of interest. Before working with a series in a study retrieved from a DICOM server, always review the entire series to ensure that all slices have been retrieved from the server.

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16. Briggs et al., A Connectomic Atlas of the Human Cerebrum—Chapter 18: The Connectional Anatomy of Human Brain Networks. Operative Neurosurgery, 2018
17. Alizadeh et al., Hemispheric Regional Based Analysis of Diffusion Tensor Imaging and Diffusion Tensor tractography in Patients with Temporal Lobe Epilepsy and Correlation with Patient outcomes. Nature Scientific Reviews, 2019
18. Henry Ford Health System, Henry Ford Patient Story. https://youtu.be/nCD9j_0v8Mg?t=135, 2018

- Image artifacts may distort anatomy and visualizations such as tractography. Use caution and clinical judgment when planning on a series with distorted images.
- Using image data that does not cover the complete brain may prevent selection of the optimal surgical plan.
- Accepting an image series with low resolution will impact the accuracy of the surgical plan.

- If you do not accept the diffusion data, you will not be able to use tractography for trajectory planning.

### 1.6.4 Risks Associated with Accepting Modus Plan Visualizations

- Accepting series with poor registration will lead to inaccuracy in plans and surgery.
- Accepting a brain mask that excludes part of the brain may result in a trajectory that originates beneath the surface of the brain.
- Accepting a brain mask that includes part of the skull may result in diffusion tracts located outside of the brain. Depth to target calculations may be incorrect and sulci may be occluded in certain phases of planning.
- The window/level settings may cause sulci to appear wider and deeper than they are.

### 1.6.5 Always Verify Patient Data and Orientation

- Using data from the wrong patient will lead to an incorrect surgical plan. Always verify that the patient name and demographic data in the study are correct.
- Modus Plan permits two views: radiological and surgical. Misunderstanding the view you are using could result in a surgical plan on the wrong side of the body. Always confirm the orientation of the patient using the orientation labels when creating and editing a trajectory.

### 1.6.6 Image Storage and Retrieval

It is possible for errors to occur when images are transported across a network, or on import into the Modus Plan local database. Never assume that these operations have completed successfully. Always verify the success of the operation before working with the images in a study.

#### 1.6.6.1 DICOM Query/Retrieve

Due to limitations in the DICOM format, when a study is sent to the Modus Plan workstation from another DICOM device, the Modus Plan workstation is not able to determine whether or not it received all the images in the study.

If you manually initiate the retrieval of one or more imaging studies from another DICOM device to the Modus Plan workstation, it is important to check the Activity Monitor for any errors that may occur during the transport (for more information, see 8.1 Working in the Activity Monitor on page 93). For each study retrieved, there will be one work item for the retrieve operation which, if successful, will indicate the number of images retrieved along with the number expected; these numbers should be the same. There will be a second work item for importing the received images into the local database. If both work items completed successfully, and the number of expected, received, and imported images are all the same,

then the entire study was retrieve successfully. Note, however, that the number of expected images comes from the remote DICOM device, over which the Modus Plan workstation has no control. If this number is not provided accurately by the remote device, then the success of the retrieval cannot be known.

You can use the Modus Plan workstation to retrieve individual series within a study, which will result in a partial study in the local database possibly leading to an incorrect plan due to incomplete information. Use this feature with care. If there is any doubt about the suitability of retrieving only part of a study, then retrieve the entire study.

Studies opened for viewing before they have been completely retrieved remain incomplete; they are not updated as new images are received or imported.

You are responsible for ensuring that all necessary images have been successfully retrieved and imported into the local database before using a study to create a plan.

#### 1.6.6.2 DICOM Send

When sending studies to another device, always verify that the entire study was sent successfully.

Work items for studies being sent to a remote device can be canceled in the Activity Monitor. However, the operation must either be restarted and allowed to complete successfully, or the study should be manually deleted from the destination device. Canceling a send operation will result in a partial study on the destination device, which, depending on how the study is being used, could lead to patient misdiagnosis due to incomplete information.

Individual series in a study can also be sent to a remote DICOM device, which will result in a partial study on the destination device. Use this feature with care. If there is any doubt about the suitability of sending only part of a study, then send the entire study.

#### 1.6.6.3 Importing Images into the Local Database

When importing images to the local database, always check the Activity Monitor to ensure that all the number of images imported matches the expected number of images.

#### 1.6.6.4 Deleting Studies and Series

If you delete a study from the local database, any planning workflow data associated with that study is also deleted from the Modus Plan workstation. It will not be possible to resume that workflow (even if the study is re-imported into the local database) unless Modus Plan is configured to synchronize with ImageDrive Clinical.

Individual series can be deleted from studies in the local database. Use this feature with care as it can result in a partial study, which could result in an inaccurate plan due to incomplete information.

### 1.6.7 Dedicated Installation

Do not install any other software on the Modus Plan workstation. Installing other software in the system or modifying the hardware will invalidate the tests conducted by the manufacturer to prove that the device is safe and effective.

### 1.6.8 Installation and Service

Only personnel approved by Synaptive Medical may install, alter, or otherwise provide service for the Modus Plan software.

### 1.6.9 Data Backup

The plans created by Modus Plan should always be exported to a picture archiving and communication system (PACS). Consequently, it is not necessary to back up the data on the Modus Plan workstation. To improve performance, regularly delete studies that are no longer needed from the workstation file store. For more information, see 2.4 Working with Studies on page 19.

## 1.7 Synaptive Customer Service Information

For 24-hour access to clinical and technical support, contact Synaptive customer service.

| | |
|---|---|
| Phone: | 1-844-462-7246 (North America) |
| | 1-647-925-3435 (International) |
| Email: | service@synaptivemedical.com |

# 2.0 Getting Started

## 2.1 Opening Modus Plan and Logging In

To open Modus Plan, double-click the Modus Plan icon on the desktop.

All users must log in to Modus Plan. Enter your password and click **Login**.

**NOTE: Your Modus Plan password is the same as your Windows account password. If you do not know your password, contact your IT administrator.**


**Figure 1 Modus Plan login dialog**

You do not need to log out of Modus Plan. You will be automatically logged out when you close the application.

## 2.2 About the Study Explorer

Modus Plan opens in the study explorer where you can locate and work with studies.

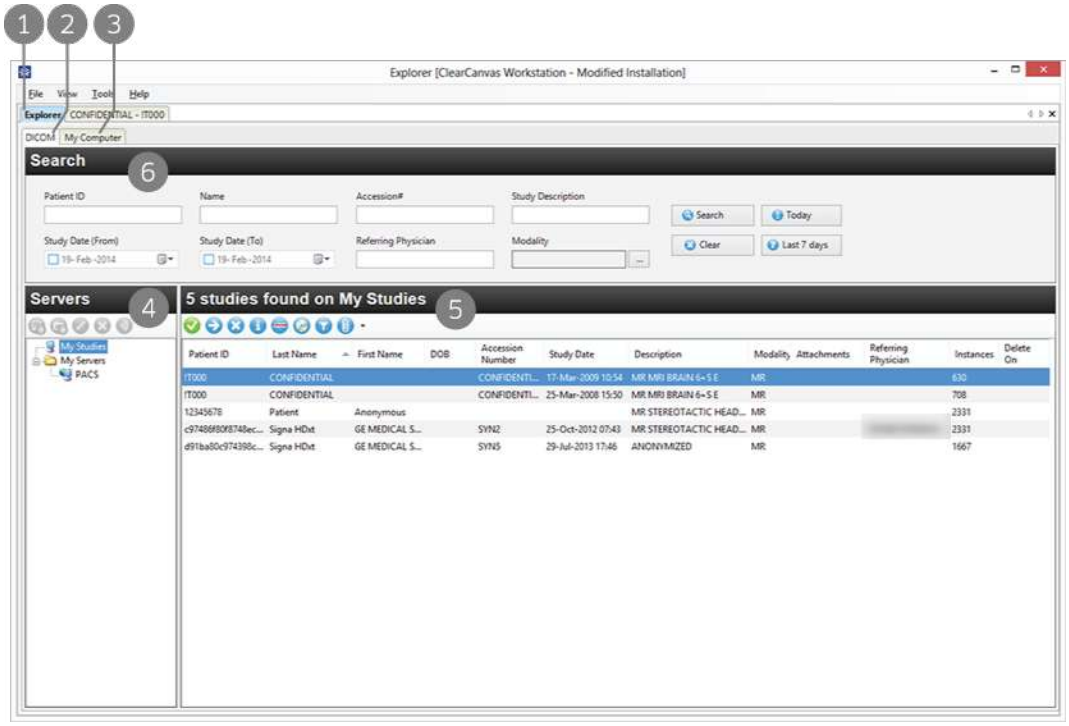



Figure 2 Study explorer interface

1 Explorer tab. If you are working with a study in Investigate mode, you can access the study explorer by clicking the Explorer tab. In Plan mode, you must exit Plan mode to return to the study explorer.

2 The DICOM tab displays studies in the local database (My Studies) and any remote DICOM servers Modus Plan is configured to communicate with, such as a PACS.

3 The My Computer tab displays an explorer view of the workstation. Use this tab to locate studies on the workstation or to import studies from external media such as a flash drive.

4 The Servers pane lists the local database and the remote DICOM servers Modus Plan is configured to communicate with. For more information about working with servers, see 8.3 Server Configuration on page 100.

5 The Studies pane displays the studies on the selected server.

6 Use the fields in the Search pane to locate studies on the selected server.

## 2.2.1 About the Local Database (My Studies)

The My Studies item in the Servers pane displays the studies in the local database. When you import a study from a remote DICOM server or from an external media source such as a DVD or flash drive, the study appears in the My Studies pane.

## 2.2.2 Searching for Studies

Use the Search pane to search for studies in the local database or on a DICOM server.

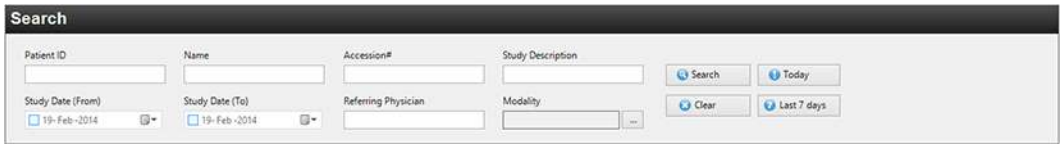



**Figure 3 Search pane**

To search for studies:

1. In the Servers pane, select the location you want to search in: either the local database (My Studies) or a DICOM server.
2. Enter your search criteria, or click **Today** or **Last 7 Days** to search for studies with a study date of today or within the last seven days.

   You can enter partial values in the search criteria fields (for example only the first few letters of the patient's name) or use the asterisk (*) wildcard to match multiple characters (for example, enter '*stereotactic' in the Study Description field to find all studies whose description ends in 'stereotactic').

   **NOTE: The search criteria fields are not case sensitive.**
3. Click **Search**. Studies matching your search criteria appear in the studies pane.

To view all the studies on the selected server, click **Clear** to empty the search criteria fields, then click **Search** again.

## 2.2.3 Opening a Study

To open a study, select it and click **Open** in the studies pane toolbar (or double-click on the study). In the Workflow Study Launcher dialog, click the mode you want to open the study in.

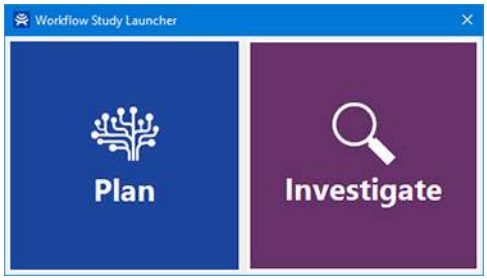



**Figure 4 Workflow Study Launcher dialog**

For other options for working with studies, see 2.4 Working with Studies on page 19.

**NOTE: If you are opening a workflow created in a previous version of Modus Plan containing regions with non-uniform slice spacing on the primary series, these regions will not be available. A message appears when you open this study in the Plan mode. You may continue opening the study but you must create new regions for the plan.**

### 2.2.4 Using PlanSync

If Modus Plan is connected to Synaptive's ImageDrive Clinical system and you open a study, a dialog appears giving you the option to select the session that you want to work on.

To start working with a study:

1. Open a study from the study explorer.
2. In the Load Session dialog, select one of the options.

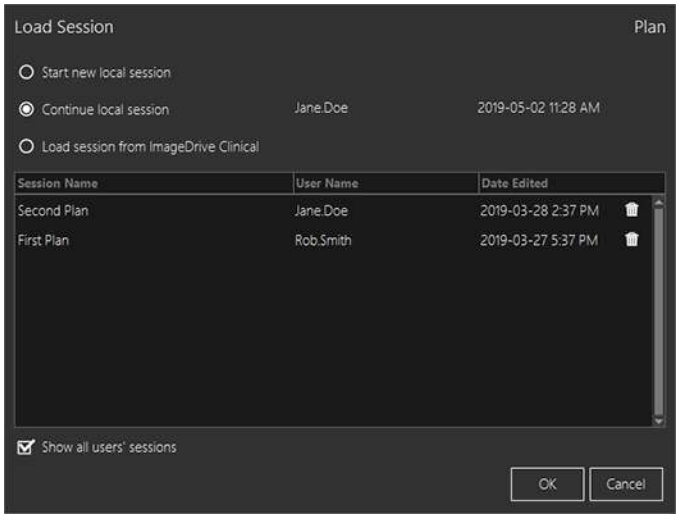



**Figure 5 Load Session dialog**

| | |
|---|---|
| **Start a new local session** | Starts a new plan workflow. If you select this option, the existing local session will be overwritten. |
| **Continue local session** | Resumes your previous plan workflow session.<br>If a previous session does not exist, this option is not available. |
| **Load session from ImageDrive Clinical** | Loads a plan workflow from ImageDrive Clinical. If you select this option, the existing local session will be overwritten.<br>Select the **Show all users' sessions** checkbox to display all sessions that other users have uploaded to ImageDrive Clinical. Clear the checkbox to display only the most recent sessions that you have uploaded to ImageDrive Clinical.<br>**NOTE: It is recommended that you use the same user name to log into both Modus Plan and ImageDrive Clinical. If you are using different user names, contact your system administrator to synchronize your login account for both systems.**<br>Select a session from the list. You can select a session created by other users and rename it as a new session when you exit Modus Plan. |

3. Click **OK**.

   The session that you have selected is loaded in Modus Plan.

# 2.3 Adding a Study to the Local Database

If the study you want to plan on is not already in the local database, there are two ways to add it.

- If the study exists on another DICOM server, you can retrieve it from that server. For more information, see Retrieving Studies from a DICOM Server below.
- If you have the study on a CD, DVD, or USB flash drive, you can import it into the local database. For more information, see 2.3.2 Importing from a CD, DVD, or USB Flash Drive on page 18.

When you add a study to the local database, Modus Plan automatically performs the processing necessary to visualize the diffusion and tractography data in Plan mode. This processing starts 60 seconds after the study has been added (to ensure that all available data has been copied to the local database) and appears in the Activity Monitor as "Process Study". If the processing completes successfully, the Activity Monitor displays the message "Neuro image processing completed successfully."

**NOTE: Processing may take up to 30 minutes to complete.**

## 2.3.1 Retrieving Studies from a DICOM Server

Only studies in the local database can be used to create a surgical plan in Plan mode. If the study you want to use is on a remote DICOM server, you must retrieve it.

To retrieve a study from a DICOM server:

1. In the Servers pane on the Explorer tab, select the server you want to retrieve from.
2. Select the study or studies you want to import in the studies pane (use the search fields to locate them if necessary).

   **NOTE: To select multiple studies hold down the SHIFT key or CTRL key when clicking in the studies pane.**
3. Click **Retrieve** in the study pane toolbar.

   A notification dialog appears indicating that the retrieval process has begun. You can view the progress of the retrieval in the Activity Monitor. For more information, see 8.1 Working in the Activity Monitor on page 93.

Depending on the size and number of studies you selected, it may take some time to fully retrieve them. As soon as the first images from a study are retrieved, the study appears in the My Studies list. You can open the study in Investigate mode immediately, but only images that have been retrieved will be visible. The study must be fully retrieved before you can work with it in Plan mode.

## 2.3.2 Importing from a CD, DVD, or USB Flash Drive

Use the My Computer tab to locate and import study data stored on an external media source such as a CD or USB flash drive.

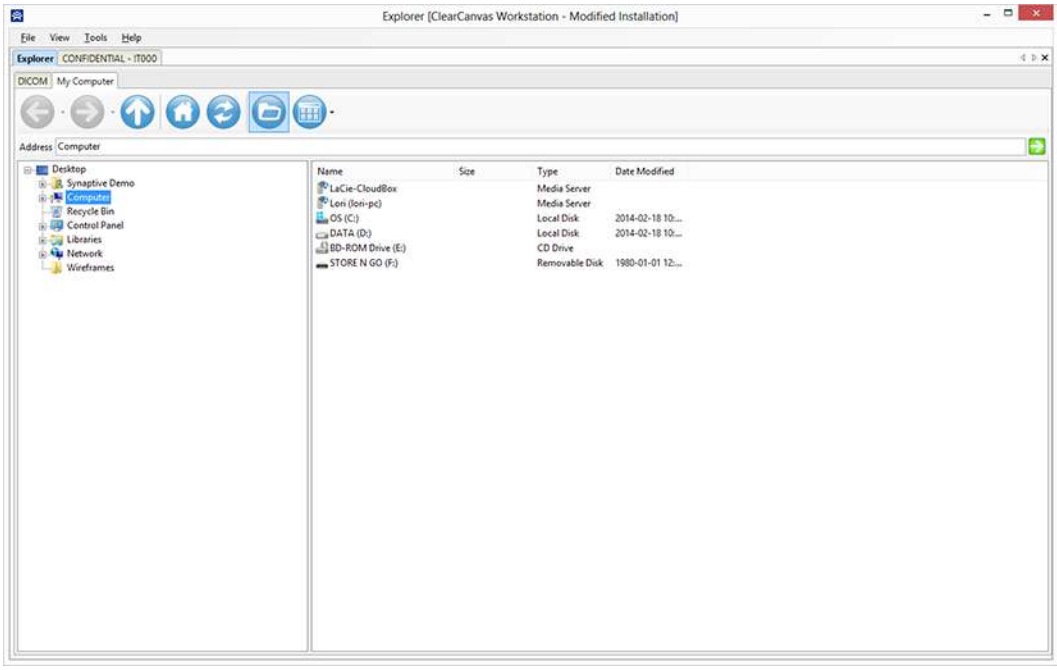



**Figure 6 My Computer tab**

To import a study from a CD, DVD, or USB flash drive:

1. Insert the CD, DVD or USB flash drive into the optical drive or USB port on the Modus Plan computer.
2. If you want to import all the files on the CD, DVD or USB flash drive, select **Yes** in the dialog that appears.

   If you want to import only some of the files, select **No** and continue to the next step.
3. On the Explorer tab, click the **My Computer** tab.
4. In the tree view on the left, navigate to the location of the study.
5. In the right pane, right-click on the folder or individual image you want to import and select **Import.**

# 2.4 Working with Studies

The toolbar at the top of the studies pane contains tools for working with studies.

**TIP: These tools are also available from the context menu when you right-click on a study.**

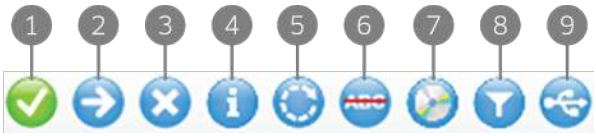



**Figure 7 Study explorer tools**

1 Open the selected study or studies.

2 Send the selected study or studies to a remote DICOM server.

3 Remove the selected study or studies from the local database. It is a good idea to remove unneeded studies regularly to ensure there is sufficient disk space available for new studies.

NOTE: When a study is removed from the local database, any planning workflow data associated with the study is also deleted from the Modus Plan workstation. You will not be able to resume the planning workflow, even if the study is imported into the local database again.

4 Display information about the series in the selected study. For more information, see 2.4.1 Series Details on page 20.

5 Process the study for use in Plan mode.

6 Anonymize the selected study. For more information, see 2.4.2 Anonymizing a Study on page 21.

7 Write the selected study or studies to a portable media device such as a DVD or Blu-ray disc. For more information, see 2.4.3 Writing a Study to a CD, DVD, or Blu-ray Disc on page 21.

8 Open the Study Filters tab where you can quickly locate specific images in the selected study or studies using filter criteria. For more information, see 2.4.5 Using Study Filters on page 25.

9 Export the selected study or studies to a USB flash drive. Note that this icon is only available when a USB flash drive is connected to the Modus Plan computer. For more information, see 2.4.4 Exporting to a USB Flash Drive on page 23.

## 2.4.1 Series Details

Click **Series Details** in the studies pane toolbar to view information about the selected study and the series it contains. The Series Details dialog that appears also contains tools for sending individual series to a remote DICOM device, deleting series in the study, and processing series for use in Plan mode.

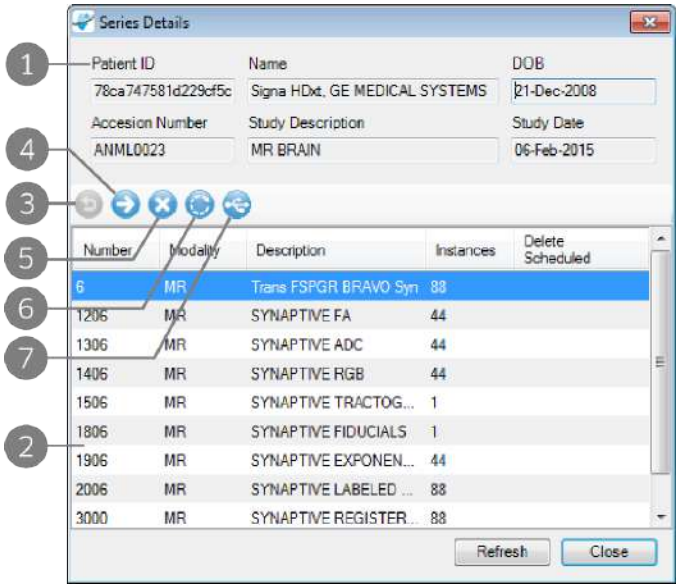



Figure 8 Series Details dialog

1 Information about the study appears here.

2 The series in the study are listed here.

NOTE: In the exported plan, if there are any accepted merged series with existing Synaptive priors that are manually adjusted, the system will append a suffix number at the end of the series description to easily distinguish between different series.

3 Retrieve the selected series from a remote DICOM device (if the study is not already in the local database).
4 Send the selected series to a remote DICOM device.
5 Delete the selected series from the study.
6 Export the selected series to a USB flash drive. Note that this icon is only available when a USB flash drive is connected to the Modus Plan computer. For more information, see 2.4.4 Exporting to a USB Flash Drive on page 23.
7 Process the selected series for use in Plan mode. For more information, see 4.1.1.3 Using an Alternate Series for Planning on page 44.

**TIP: The series tools are also available from the context menu when you right-click on a series.**

**NOTE: The context menu also contains a Define MR Protocol option. This feature is for Synaptive Service use only.**

## 2.4.2 Anonymizing a Study

To create an anonymized copy of a study:

1. Right-click the study in the My Studies list and select **Anonymize** from the context menu.
2. In the Anonymize Study dialog, enter the information to replace the actual study information. If you leave a field empty, that field will be blank in the anonymized study.
3. Select the **Preserve Series Data** option if you want to preserve the series level data, as per DICOM 3.0 standard.
4. Select the **Keep Private Tags** and/or **Keep Reports and Attachments** options if you want to retain that information in the anonymized study.

   **NOTE: You must select the Keep Private Tags option if you want to use the study in Plan mode; however, Modus Plan does not anonymize patient data in private tags or in attached reports or files. This creates a risk of exposing protected health information (PHI). It is recommended that you do not keep reports and attachments in the anonymized study.**

   In the confirmation dialog that appears, click **Yes** to retain the selected information.
5. Click **OK**. A new study is generated and appears in the My Studies list.
6. If necessary, delete the original, non-anonymized study.

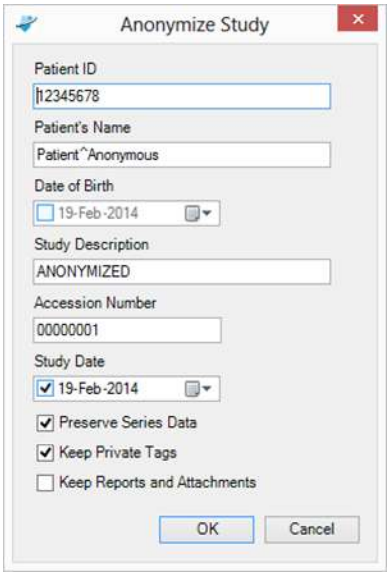



**Figure 9 Anonymize Study dialog**

## 2.4.3 Writing a Study to a CD, DVD, or Blu-ray Disc

If you need to share a study, you can write it to a portable media device such as a CD, DVD, or Blu-ray disc. If necessary, you can also include a DICOM viewer on the media along with the study so that it can be viewed on a computer that does not have a DICOM viewer already installed.

NOTES:

- **Distributing studies on portable media presents a risk to patient privacy. Ensure that studies are only made available to appropriate parties.**
- **Although re-recordable media formats such as DVD-RW and BD-RE are supported, data erased from these media can sometimes be recovered, which may lead to breaches in patient privacy. For this reason it is not recommended that you copy data to re-recordable media formats.**

To write a study to a portable media device:

1. Right-click the study (or studies) in the studies pane and select **Write to Media** in the context menu.
2. In the Media Writer panel, specify the settings for writing to the media, then click **Write**.

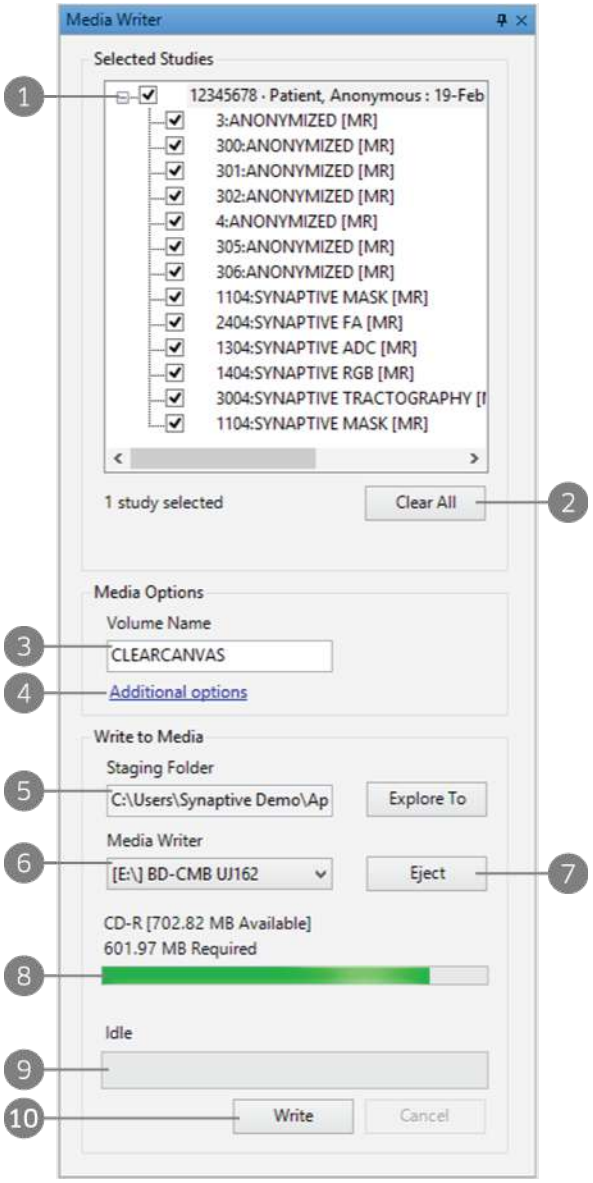



Figure 10 Media Writer panel

1 Select the items to write to the disc. Expand a study node to select individual series in the study.

2 Click **Clear All** to remove all studies from the Selected Studies list.

3 The media will be identified by the value in the Volume Name field when the recipient inserts it into their computer. Enter a new name or leave the default name.

4 Click **Additional options** to configure Media Writer options. For more information, see 2.4.3.1 Media Writer Options on page 23.

5 Before writing to the media, Modus Plan copies the study images to a staging folder. If the Media Writer feature is not configured to delete the files in the staging area after writing them to the disc, click **Explore To** to open the staging folder and view the files. For more information about configuring the Media Writer feature, see 2.4.3.1 Media Writer Options on page 23.

6 Select the disc drive to write to.

7 Click **Eject** to eject the disc in the selected drive.

8 The amount of disc space available and the amount of space required for the selected studies is displayed here.

9 The write progress is displayed here.

10 Click **Write** to write the selected studies to the disc.

3. To make multiple copies of the media, eject the disc from the drive, insert a blank disc and click **Write** again.

**NOTE: Do not close the Media Writer panel while writing is in progress. If necessary, you can unpin the panel and work in the workspace while writing is in progress.**

### 2.4.3.1 Media Writer Options

Click **Additional options** in the Media Writer panel to configure how the Media Writer feature behaves.

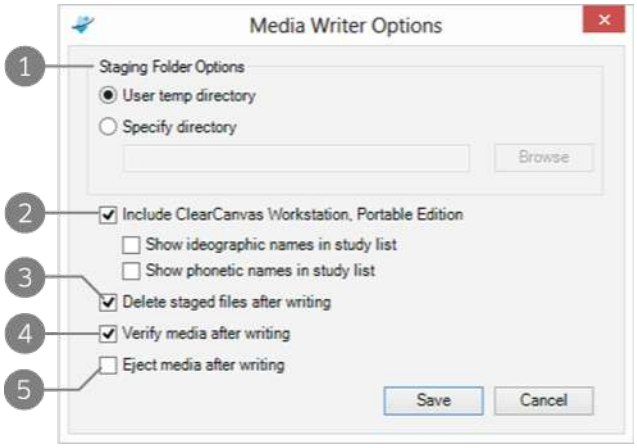



**Figure 11 Media Writer Options dialog**

1 Specify where the files should be copied before they are written to the disc.

NOTE: The staging folder may require considerable disk space. To avoid exceeding the maximum disk usage (which would cause the workstation to stop importing or receiving studies) it is preferable to configure the staging folder on a drive not used by the local file store. For more information about configuring the local file store, see Figure 93 Study Storage options on page 98.

2 Select **Include ClearCanvas Workstation, Portable Edition** if you want to include the ClearCanvas DICOM viewer on the disc.

You can also configure whether the ClearCanvas DICOM viewer should display ideographic and/or phonetic names in the study list.

3 Specify whether to delete the staged files after they are written to the disc.

4 Specify whether to verify whether the files were correctly written to the disc. Note that verification can take a long time.

5 Select **Eject media after writing** if you want Media Writer to eject the disc when writing is complete.

## 2.4.4 Exporting to a USB Flash Drive

You can export studies, series, and support packages to a USB flash drive.

**NOTE: To reduce the risk of exposing protected health information (PHI), it is recommended that you use an encrypted USB device when transferring data.**

#### 2.4.4.1 Exporting Studies or Series

**NOTE: The Export to USB option is only enabled in the toolbar when a USB flash drive is connected to the Modus Plan computer. When you connect a USB flash drive, a dialog appears asking whether you want to import the studies on the drive; click No unless you want to import the studies on the drive.**

To export a study to a USB flash drive:

1. In My Studies, select the study or studies you want to export to the USB flash drive then click the **Export Study to USB** button in the toolbar.

   A dialog appears showing the progress of the export.
2. When the export is complete, click **OK** to close the dialog.

To export one or more series to a USB flash drive:

1. In My Studies, select the study that contains the series you want to export and click the **View Series Details** button in the toolbar.
2. In the Series Details dialog that appears, select the series you want to export then click the **Export Study to USB** button in the toolbar.

   A dialog appears showing the progress of the export.
3. When the export is complete, click **OK** to close the dialog.

**NOTE: Do not remove the flash drive from the Modus Plan computer before the export is complete. Due to the limitations inherent in the FAT32 file system, it is not recommended that you use a USB flash drive formatted with that file system.**

#### 2.4.4.2 Exporting Support Packages

A support package may contain information like logs and workflows related to a specific study. Synaptive Service will use this feature to help troubleshoot any issues that you may encounter with the system.

To export a support package to a USB flash drive:

1. Plug a USB flash drive into the Modus Plan computer.
2. In My Studies, right-click the study or studies that you want to export, and then select **Export to USB** > **Support Package**.
3. In the USB Support Package Export Tool dialog, select your export options. You can also set up a password to secure the files.
4. Click **Export**.

   A dialog appears showing the progress of the export.
5. When the export is complete, click **Done** to close the dialog.

   The support package is exported as a ZIP file. If you set up a password before the export, you have to provide the password when you open each file in the folders.

## 2.4.5 Using Study Filters

If you need to locate a specific image within a study, use the Study Filters utility to quickly filter the study images by their DICOM data. To use the Study Filters utility, right-click the study you want to filter in the studies pane and select Filter Study in the context menu. The Study Filters utility opens in a new tab.

**NOTE: To use the Study Filters utility to filter studies on the workstation but not in the local database, choose Tools > Utilities > Study Filters. Browse to the location of the study and click OK.**

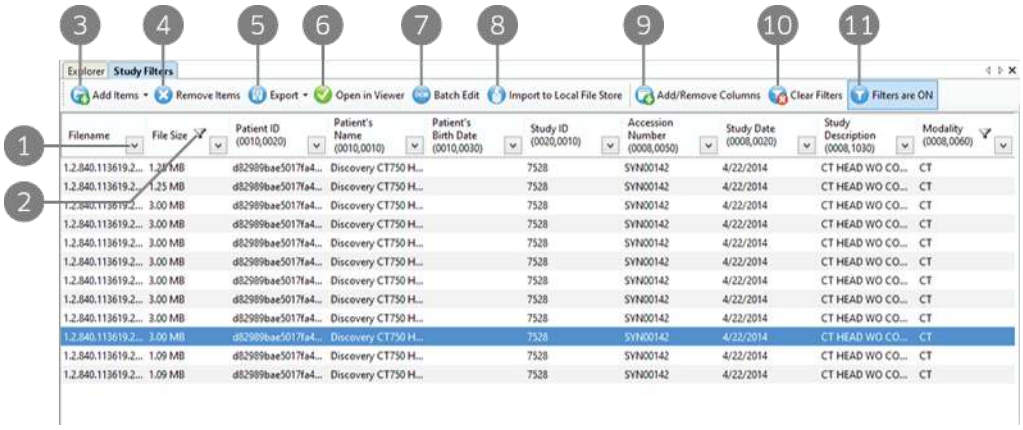



**Figure 12 Study Filters utility**

1 Click the drop-down arrow to add or remove a filter on this column. In the drop-down menu that appears, specify the value you want to filter by, or select **Clear Filters** to remove the filter on this column.

2 This icon indicates that the column has a filter applied to it.

3 Add individual files or a folder of files to the Study Filters list.

4 Remove the selected item or items from the Study Filters list.

5 Export the selected item or items to a directory on the workstation. If you select the Export Anonymized option, a dialog opens where you can specify the values to use in place of the study data.

6 Open the selected image or images in the Investigate mode workspace.

7 Open the selected file or files in the DICOM editor.

8 If the files are not already in the local database, click **Import to Local File Store** to import them.

9 Customize the available columns. You can select any DICOM tag available in the open studies to filter by.

10 Remove all filters. To remove only the filter on a particular column, click the drop-down arrow for the column and select **Clear Filters**.

11 Toggle between viewing the items with and without filters applied.

# 3.0 Working in the Planning Interface

The planning interface is designed to help you create an accurate, effective, surgical plan. The planning process follows a well defined workflow.

This chapter gives a general overview of the planning interface. For information about creating a plan, see 4.0 on page 40.

## 3.1 About the Planning Workflow

The planning workflow is divided into phases, each phase covering an aspect of creating a surgical plan. You might work on some phases while other users complete other phases. Some phases, like the Review phase, require you to complete certain tasks before you can proceed to the next phase. Some phases can be skipped, but to produce the most accurate plan, it is recommended that you complete each phase in the workflow.

### 3.1.1 Saving Your Progress

Modus Plan automatically saves your progress on a plan. When you open a study, it opens at the point where you, or the last user who worked on the study, left off.

**NOTE: If power is lost while you are working in Modus Plan, or while Modus Plan is transferring data to another DICOM device, the data may be unrecoverable.**

## 3.2 About the Planning Interface

The planning interface consists of the workflow ribbon, one or more viewports, and the phase panel.

### 3.2.1 The Workflow Ribbon

The workflow ribbon shows the phases in the workflow for creating a plan.


**Figure 13 Workflow ribbon for port procedure planning**

The phase color indicates the phase state:

- Blue indicates the current phase
- Black indicates that some work has been done in the phase and any required tasks have been completed, or that the phase was skipped (if there were no required tasks in the phase). You can go

back and add or change values in these phases.

- Grey indicates that the phase has not been started, or that the work in that phase is not complete.

## 3.2.2 Viewports in Plan Mode

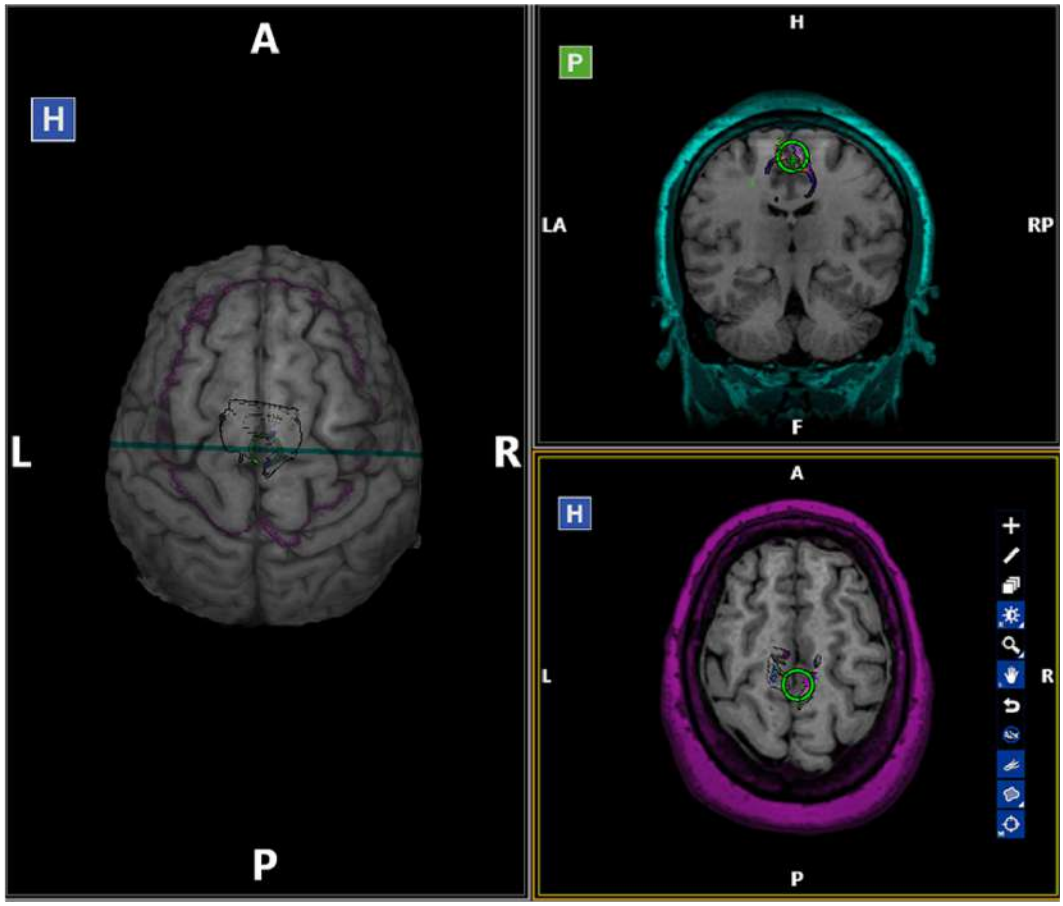



**Figure 14 Viewports in the Trajectories phase**

The number of viewports and the series they contain is set for each phase. These arrangements provide the best view of the data to complete the tasks for each phase. Viewports are often synchronized so that actions performed in one viewport (for example zooming in, or showing tractography) are replicated in the other viewports.

The tools available in each phase appear in the active viewport.

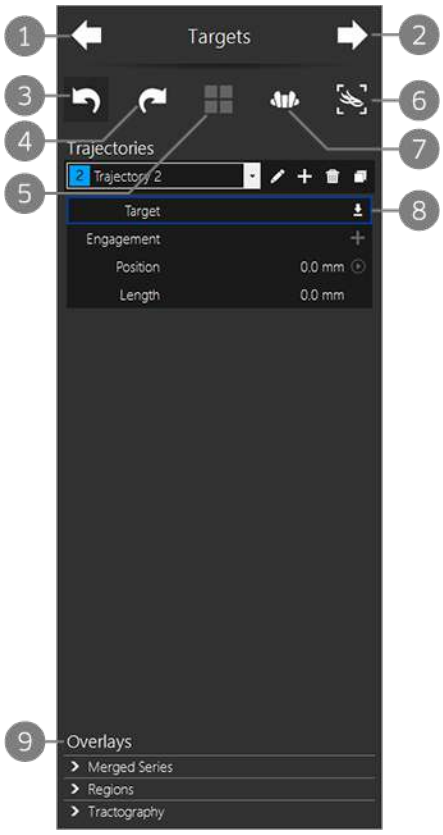
TIPS:

- To expand a viewport to fill the whole workspace, double-click in the viewport or press the X key on the keyboard. Double-click or press the X key again to restore the viewport to its original size.
- In 2D views where the spatial locator is visible, you can quickly center the image around the spatial locator by right-clicking in the viewport and selecting Center on Locator. This functionality is synchronized across all viewports containing a 2D image.

- Right-click in the viewports to display a context menu that allows you to perform other tasks like toggling on and off the brain mask and craniotomy visualizations.
- The planning interface includes several tools for changing the visibility of the information overlaid on the series images in the viewports. Hide the viewport overlays and visualizations such as tractography, regions, and tool graphics when necessary to obtain an unobstructed view of the anatomy.

## 3.2.3 The Phase Panel

The phase panel contains information and options relevant to the task you are currently performing in the phase.




1 Move to the previous phase in the workflow.

2 Move to the next phase in the workflow. Note that in some phases, this icon is unavailable until you complete the required tasks in the phase.

3 Undo the last action.

NOTE: Not all actions can be undone. For any action that cannot be undone, a dialog box appears asking you to confirm that you want to perform the action.

4 Redo an action after clicking **Undo**.

5 Change layout icon. Click to switch to an alternate viewport layout in the workspace.

NOTE: This icon is currently only enabled in the Trajectories phase.

6 Export Tractography icon. Click to export tractography as a new DICOM series for use in third-party systems. This icon is available in all phases except the Merged Series phase.

For more information, see 4.8 Exporting Tractography on page 74.

7 Change the patient orientation in the viewports. For more information, see 3.3 Viewport Orientations on page 30.

8 This area displays content relevant to the current phase.

9 Viewport overlay options. For more information, see 3.2.4 Overlays Options on page 28.

**Figure 15 Phase panel in the Targets phase**

## 3.2.4 Overlays Options

Use the Overlays section of the phase panel to show or hide the merged series, trajectory, region, and tractography overlays. Note that the overlays options available in the phase panel are limited to those overlays that are appropriate to the phase you are currently working in.

### Merged Series Overlays Options

Click on a series name in the Merged Series overlay options to show that series in the viewports.


**Figure 16 Merged Series overlay options**

To view the details of a merged series, right-click on a series from the list.

## Trajectory Overlays Options

The Trajectory overlays options appear in the Trajectories phase.

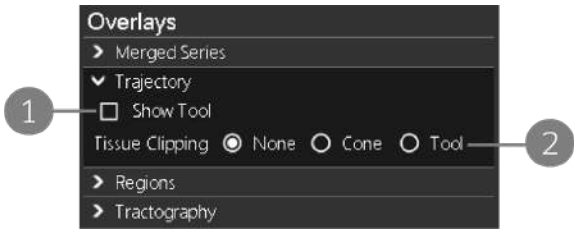



**Figure 17 Trajectory overlay options**

1. Select **Show tool** to display the interventional device in the viewports. You can click and drag the tool 'grip ring' in the viewports to view tracts that will be impacted by a possible trajectory.
2. The **Tissue Clipping** options hide parts of the brain around the tool in the viewports displaying a solid view. Hiding the tissue can make it easier to view affected tracts.

## Regions Overlays Options

The Regions overlays options become available when one or more regions have been added to the series.

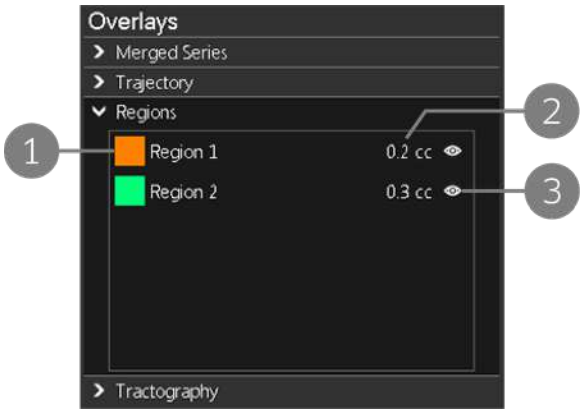



**Figure 18 Regions overlay options**

1. Displays each region you created in the Segmentation phase.
2. Displays the region volume in cubic centimeters (cc).
3. Click the show/hide icon to show or hide this region in the workspace.

To change the region's color, click on the colored square and select a new color from the options that appear. To change the region's name, double click on the name and enter a new one.

## Tractography Overlays Options

The Tractography overlays options are available if you accepted the tractography in the Review phase.

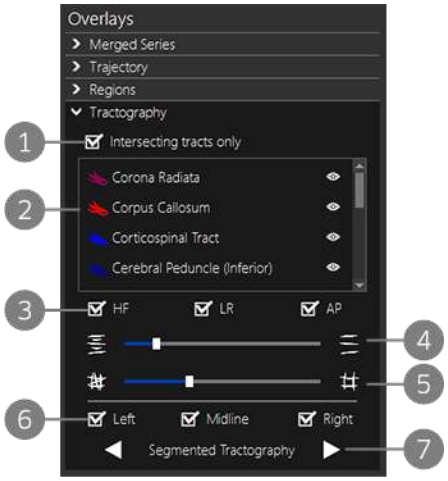



Figure 19 Tractography overlay options

1 Select the **Intersecting tracts only** option to show only those tracts that intersect a trajectory. (This option becomes available when a trajectory has been created.) The size of the area considered for tract intersection is based on the size of the tool you have selected for the trajectory. When reviewing tract intersection for the trajectory, always verify that you have the correct tool selected.

2 Any tract bundles that have been created for this series are displayed here.

TIP: Right click on the name of a tract bundle and select **Show only this bundle** to view the bundle in isolation in the viewports.

3 Show tracts based on direction. Select the options to show or hide tracts running in the Head-Foot (HF), Left-Right (LR), or Anterior-Posterior (AP) direction.

4 Move this slider to adjust the number of unbundled tracts displayed in the viewports based on their FA value and length. As the slider moves to the right, only longer tracts are displayed.

NOTE: This only applies to unbundled tracts. Tracts in bundles are not affected by this slider.

5 Move this slider to adjust the number of tracts displayed in the viewports based on their directionality. As the slider moves to the right, only tracts that are strongly aligned with the scanner's axial, sagittal, and coronal planes are displayed.

NOTE: This only applies to unbundled tracts. Tracts in bundles are not affected by this slider.

6 Show tracts based on the brain hemisphere.

7 Click the arrows to toggle between viewing the whole brain tractography and segmented tractography (tract bundles).

**NOTE: Modus Plan retains the last specified tractography culling slider positions in the Targets and Trajectories phases. When you move between these phases, a notification appears indicating that some tracts are not being displayed due to the tractography culling settings.**

## 3.3 Viewport Orientations

**IMPORTANT: Modus Plan permits two views: radiological and surgical. Misunderstanding the view you are using could result in a surgical plan on the wrong side of the body. When creating a plan, always confirm the orientation of the patient using the orientation labels.**

Modus Plan can display images in two orientations: foot-to-head (radiological view) and head-to-foot (surgical view). When you open a study, you must select the orientation you want to use.

Click on each of the two orientation representations and read the description of each orientation carefully. Be sure to select the correct orientation for the type of work you will be doing on the plan.

If necessary, you can change the orientation when you are working in Plan mode by clicking the orientation selection icon in the phase panel.


Figure 20 Orientation Selection dialog

## 3.4 Reference Lines in Plan Mode

In several phases, when the workspace contains a solid view of the brain in one viewport, and a 2D slice view in another viewport, Modus Plan indicates the location of the current slice in the 2D view as a colored line in the solid view. Different colors indicate the current slice when there are multiple 2D views open in the workspace.

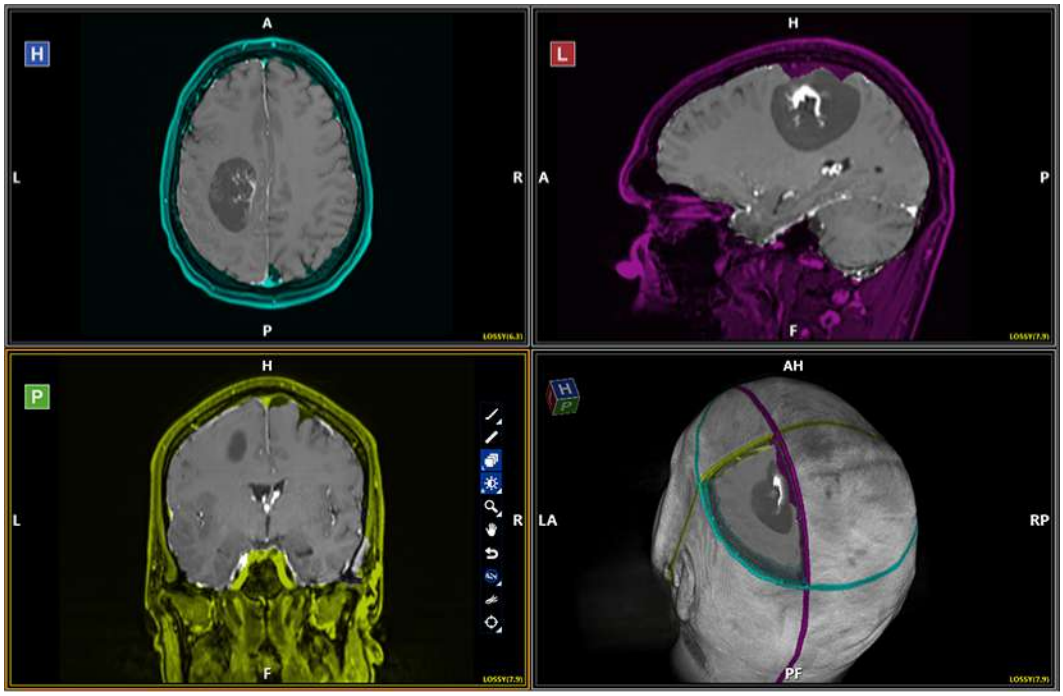



Figure 21 Colored reference lines in Plan mode

# 3.5 Viewport Tools

The tools applicable to the tasks in each phase appear in the active viewport. The tools available depend on the task you will perform in that viewport. For example, the Rotate tool is only available in viewports that contain a solid volume rendering of the anatomy.

You can also access tools and options applicable to the active viewport by right-clicking in the viewport and selecting them from the context menu that appears.

Tools that involve using the mouse can be assigned to a mouse button. For more information, see 7.1.1 Assigning a Tool to a Mouse Button on page 83.

**Table 4 Viewport Tools**

| | Tool | Description |
|---|---|---|
|  | Stack | Click and drag the mouse to stack through the slices and volumes in the series.<br>• Drag the mouse up or down to decrease or increase the slice index.<br>• Drag the mouse left or right to stack through volumes.<br>Alternatively, you can also use the mouse scroll wheel to stack. |
|  | Radial Stacking | Click in the image and drag the mouse up or down to stack around an axis.<br>Alternatively, you can also use the mouse scroll wheel to stack radially.<br>**NOTE: To quickly jump to the nearest orthogonal view in a radially stacked image, right-click in the image and select Snap to Nearest Plane. To switch to the alternate orthogonal view, right-click in the image (in orthogonal view) and select Snap to Perpendicular Plane.** |
|  | Trajectory Stacking | Click in the image and drag the mouse up or down to stack through image slices perpendicular to a trajectory. This tool is only available when a valid target and engagement point have been created for a trajectory and the Position slider is selected in the phase panel. For more information, see 4.5.4 About the Position Slider on page 69. |
|  | Window/Level | Click and drag the mouse in the image to adjust the window contrast and brightness.<br>• Drag the mouse left or right to adjust the window (contrast) value.<br>• Drag the mouse up or down to adjust the level (brightness) value.<br>If window/level presets have been configured, click and hold on tool to select a preset.<br>**IMPORTANT: The window/level settings may cause sulci to appear wider and deeper than they are.** |

Table 4 Viewport Tools (continued)

| | Tool | Description |
|---|---|---|
|  | Pan | Click and drag the mouse to move the image in any direction in the viewport. |
|  | Zoom | Zoom in or out of the image. The zoom level is applied to all 2D viewports.<br>• Drag the mouse up to zoom in.<br>• Drag the mouse down to zoom out.<br>**NOTE: Your system may be configured to reverse these directions.**<br>Click and hold on this tool to select a discrete magnification factor. |
|  | Rotate | Click and drag the mouse to rotate a 3D solid view. |
|  | Reset | Click to reset the image to its original parameters (zoom, pan, flip, rotation). |
|  <br>  | Hide Overlays / Show Overlays | Click to hide the viewport overlays. When this tool is active, it changes to the Show Overlays tool. Click it to show the viewport overlays.<br>Click and hold on this tool to select specific overlay elements to show or hide. |
|  | Region editing mode | Click to add or edit regions in the series. |
|  <br>  | Toggle Region Graphics | Click to hide or show regions that you have created.<br>Click and hold on this tool to select a specific region display option to show or hide. |
|  | Bundle editing mode | Click to add or edit tract bundles in the series. |
|  | Toggle Tractography | Click to show the tract information in the image in all viewports. Click again to hide the tracts. |
|  | Ruler | Draws a line on the image and displays its length. |
|  | Spatial Locator | Adds persistent crosshairs to all viewports. |

Table 4 Viewport Tools (continued)

| | Tool | Description |
|---|---|---|
|  | Spatial Locator in Targets Phase | The Targets and Trajectories phases use a custom spatial locator icon in the viewports for marking target and engagement points. The color of the icon corresponds to the color of the item in the phase panel.<br>If you move the spatial locator outside the allowed area (such as outside the defined brain tissue area) the icon changes to indicate that you cannot mark at point at that location. |
|  | Spatial Locator in Trajectories Phase | |
|  | Out of bounds Spatial Locator | |
|  | Add | Use the Add tool to add a target and engagement point. |
|  | Set Location | Click to move a target, or engagement point to the current spatial locator position. |
|  | Toggle Extracted Surface | Click to show a translucent image of the skin surface in the viewport. When this tool is active, click it again to hide the skin surface.<br>Click and hold on this tool to display other tools that allow you to see through and adjust the brain's cortical surface, and to improve the head mask in low intensity skin images.<br>For more information, see 3.6.1 Adjusting the Extracted Skin Surface on page 35 and 3.6.2 Adjusting the Brain's Cortical Surface Visualization on page 37.<br>**NOTE: This tool is only available in viewports that contain a 3D solid view. This tool is not available in the Merged Series phase. The extracted skin surface view is not available for gantry-tilted series.** |

When the lower-right corner of a tool icon is a white triangle, click and hold on the tool icon to open a context menu with additional options for using the tool.


Figure 22 Zoom tool context menu

# 3.6 Working with the Skin Surface and Cortical Surface Visualizations

In some phases of the planning workflow, Modus Plan displays a representation of the skin surface and cortical surface. You can show or hide these visualizations in any viewport that contains a 3D solid view. You can also edit these visualizations, if necessary. To access the tools for working with these visualizations, click and hold on the Toggle Extracted Surface tool in the viewport.

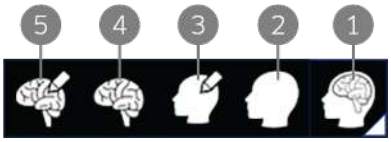



**Figure 23 Toggle Extracted Surface tool options**

1. Toggle Extracted Surface viewport tool. Click and hold to access tools for working with the skin surface and cortical surface visualizations
2. Toggle Skin Surface. Click to show or hide the skin surface visualization
3. Adjust Skin Surface tool. Click to display additional tools for adjusting the skin surface. For more information, see 3.6.1 Adjusting the Extracted Skin Surface below.
4. Toggle Cortical Surface. Click to show or hide the cortical surface visualization.
5. Adjust Cortical Surface tool. Click to display additional tools for adjusting the cortical surface. For more information, see 3.6.2 Adjusting the Brain's Cortical Surface Visualization on page 37.

## 3.6.1 Adjusting the Extracted Skin Surface

The quality of skin surface extraction is impacted by the quality of the scan images. Always carefully review the extracted skin surface and, if necessary, manually refine or adjust it to improve the head mask in low skin intensity images.

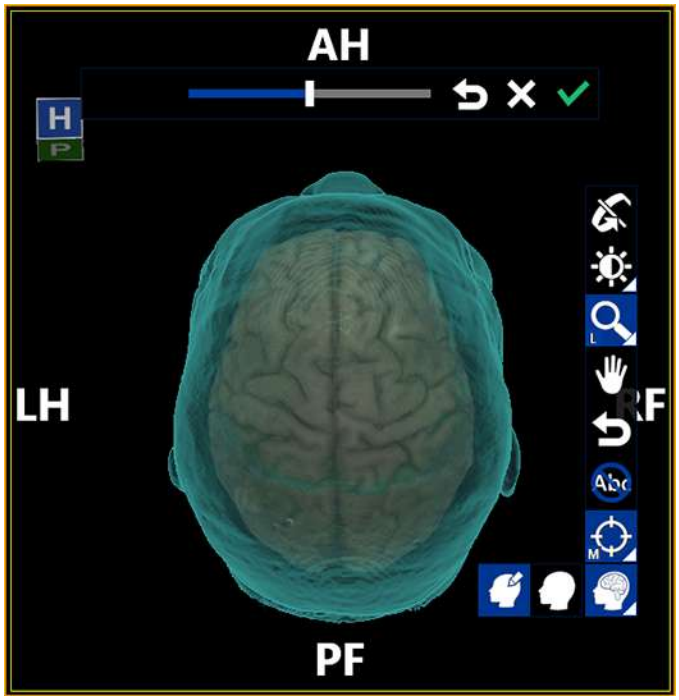



Figure 24 Adjusting the skin surface visualization

NOTES:

- **This feature is not available on a series processed in versions of Plan before 1.5.**
- **Changes you make to the skin surface are for visualization during the planning process only and will not be exported with the plan.**

This feature is only available when all the following conditions are met:

- The primary series is a T1 (the extracted skin surface is always generated from the primary series)
- The study is processed
- The viewport contains a 3D solid view
- The primary series is displayed in the viewport; if a merged series is overlaid on the primary series, you can toggle the skin surface visualization on and off but you cannot adjust it

To refine the skin surface visualization:

1. Select the 3D solid viewport.
2. Click and hold on the **Show Extracted Surface** tool.

**Figure 25 Tool icons for adjusting the skin surface visualization**

3. Select the **Adjust Skin Surface** icon.
4. In the toolbar that appears, drag the slider to adjust the skin surface as necessary.

You can also:

- Click the reset icon (curved arrow) to reset the slider to its original position (if you have made adjustments).
- Click the cancel icon (x) to discard any adjustments that you have made.

5. When done, click the checkmark icon to accept your adjustments.

## 3.6.2 Adjusting the Brain's Cortical Surface Visualization

You adjust the opacity of the translucent cortical surface visualization to better view regions and tracts.

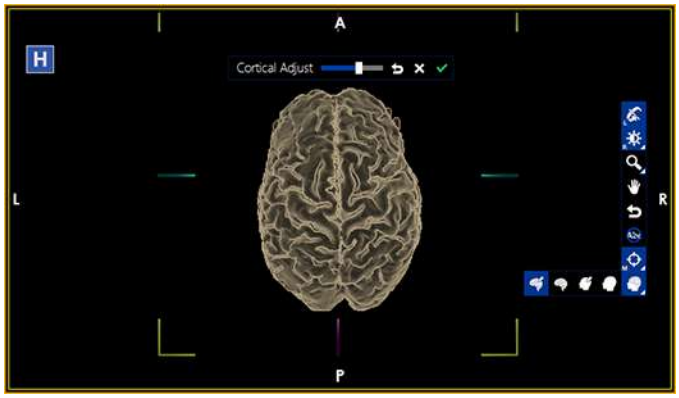



**Figure 26 Adjusting the cortical surface visualization**

This feature is only available when all the following conditions are met:

- The primary series is a T1 (the cortical surface is always generated from the primary series)

  **NOTE: Cortical surface adjustment works better on pre-contrast T1 series.**
- The study is processed and contains a brain mask
- The brain mask is accepted
- The viewport contains a 3D solid view
- The primary series is displayed in the viewport; if a merged series is overlaid on the primary series, you can toggle the cortical surface visualization on and off but you cannot adjust it

To adjust the cortical surface visualization:

1. Select the 3D solid viewport.
2. Click and hold on the **Show Extracted Surface** tool.

   **Figure 27 Tool icons for adjusting the cortical surface visualization**
3. Select the **Adjust Cortical Surface** icon.
4. In the toolbar that appears, drag the slider until you get your desired cortical surface view.

You can also:

- Click the reset icon (curved arrow) to reset the slider to its original position (if you have made adjustments).
- Click the cancel icon (x) to discard any adjustments that you have made (and have not accepted by clicking the checkmark icon).

5. When done, click the checkmark icon to accept your adjustments.

**NOTE: Changes you make to the cortical surface visualization are for visualization during the planning process only will not be exported with the plan.**

## 3.7 Capturing Screen Shots

To capture a screen shot of the viewports, click the camera icon.

**Figure 28 Camera icon**

**NOTE: To maintain the privacy of the patient's protected health information, before capturing a screen shot use the Show/Hide Overlays tool to hide the DICOM data displayed in the viewports.**

To access your screen shots, in the Plan Explorer window click **Tools** > **Explore Screen Captures**. A Windows Explorer window opens where you can view your screen shots and save them to a USB drive.

## 3.8 Exiting Plan Mode

To exit the Plan mode and return to the study explorer, click the exit icon in the workflow ribbon.

**Figure 29 Exit icon**

If Modus Plan is **not** connected to ImageDrive Clinical, your planning session is saved to the local computer.

If Modus Plan is connected to ImageDrive Clinical, the Save Session and Exit Application dialog appears.

- If you want to save your planning session to ImageDrive Clinical, enter a name for your workflow and enter the user name and password for the ImageDrive account you want to upload the plan to.

  **NOTE: The User Name field is populated with your user name by default. If you have previously uploaded a plan to ImageDrive Clinical during the current session, the password field is populated by default as well. You can change the values if necessary.**

- If you don't want to save your session to ImageDrive Clinical, de-select the **Save to ImageDrive Clinical** checkbox. Your session will be saved to the local computer.

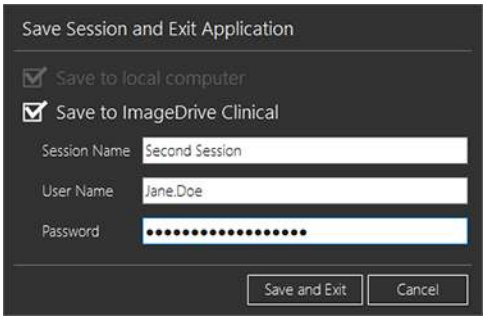



**Figure 30 Save Session and Exit Application dialog**

Click **Save and Exit**.

**IMPORTANT: It is recommended that you log out of Windows when you are done working with Modus Plan. This ensures that your login credentials will not be used by other users to upload a session to ImageDrive Clinical.**

# 4.0 Surgical Planning

To begin creating a plan, in the study Explorer, right-click a study and then select **Open**. The study you select must contain a primary series of the patient's brain (usually a T1 or T2 series) and a DTI series. In the Workflow Study Launcher dialog, click **Plan**.

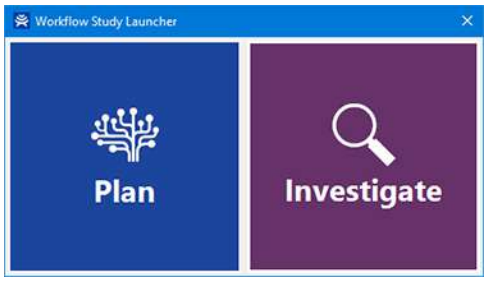



**Figure 31 Workflow Study Launcher dialog**

**NOTE: If the study does not contain the data necessary to create a plan, a notification appears in the phase panel.**

## 4.1 Review Phase

The Review phase ensures that the quality of the scan images and registered visualizations (brain mask, diffusion data, and tractography) is sufficient to create an accurate plan. At a minimum, you must indicate that you accept the image quality. It is not necessary to accept the brain mask and the diffusion and tractography registrations, but if you do not accept them, they will not be available in subsequent workflow phases.

If Modus Plan is not able to generate the visualizations, or if the visualizations are not adequate, you can still use the series to plan. For more information, see 4.1.1.2 Using a Series with No Brain Mask to Plan on page 43.

**NOTE: At any point during the planning workflow, you can return to the Review phase and revoke your acceptance of the image data and the visualizations. However, if you do so you will lose any plan data you created in subsequent phases.**

### 4.1.1 Reviewing the Primary Series and Brain Mask Quality

The accuracy of the plan depends on the quality of the images it is based on. The series used to create the plan should clearly show the complete brain.

The brain mask indicates the margins of the brain in the scan images. In the scan images, the brain is highlighted in brown and the skull and other areas outside the brain are cyan.

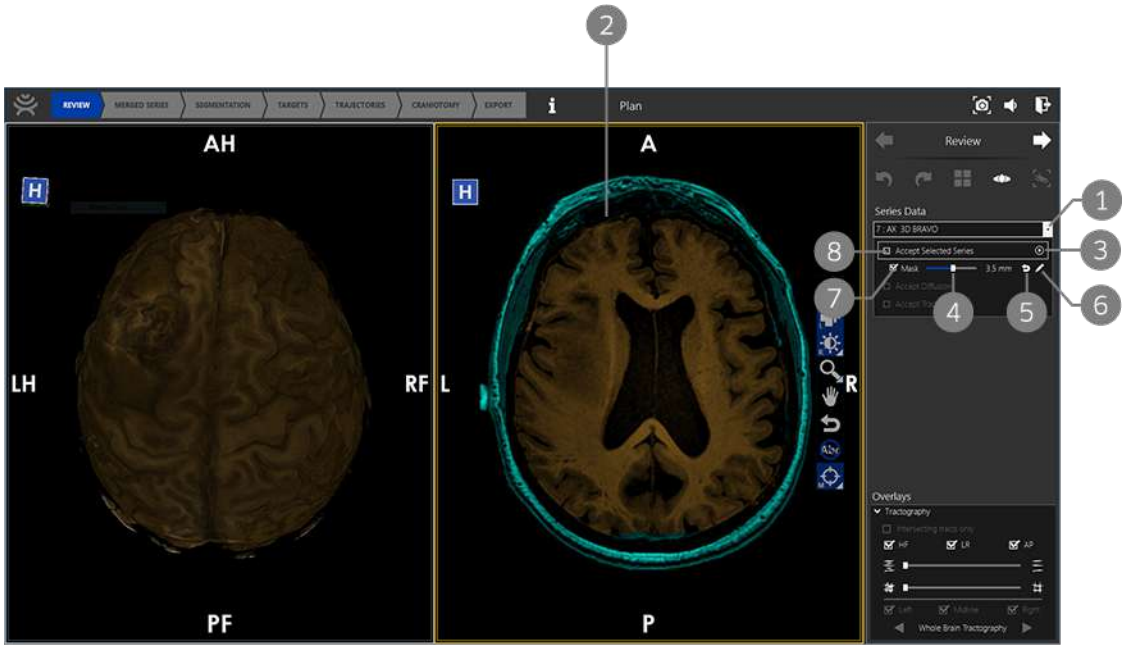



Figure 32 Workspace for reviewing image quality and the brain mask

1 Select the series you want to review. Series that have enhancement such as tractography associated with them appear in bold text in the list.

2 Stack through the images in the viewport and evaluate the quality of the images and the accuracy of the brain mask.

3 Optionally, click the **Play** icon to animate stacking through the slices.

4 If necessary, adjust the **Mask** slider to dilate or erode the brain mask until it more closely corresponds to the brain surface.

5 Reset the **Mask** slider to its original position.

6 Optionally, click the **Edit** icon to make specific edits to the brain mask. For more information, see 4.1.1.1 Editing the Brain Mask on page 42.

7 If the brain mask is inadequate, even after making adjustments, clear the **Toggle Brain Mask** checkbox to proceed without using a brain mask.

8 When you are satisfied that the image quality is acceptable and the brain mask is adequate (or you have decided not to use a brain mask for this plan), click the **Accept selected series** checkbox to proceed.

IMPORTANT:

- **Accepting poor quality series may impede location of appropriate surgical targets and regions of interest.**
- **Using image data that does not cover the complete brain may prevent selection of the optimal surgical plan.**
- **Accepting an image series with low resolution will impact the accuracy of the surgical plan.**
- **Accepting a brain mask that excludes part of the brain may result in a trajectory that originates beneath the surface of the brain.**

- **Accepting a brain mask that includes part of the skull may result in diffusion tracts located outside of the brain. Depth to target calculations may be incorrect and sulci may be occluded in certain phases of planning.**

To review the series for image quality and brain mask accuracy:

1. In the right viewport, stack through the images to ensure that they are sufficient to create a plan on.

   If the image quality is not adequate or the scan does not cover the whole brain, use a different series. If another series has already been processed, select that series from the **Series Data** list; if not, follow the instructions in section 4.1.1.3 Using an Alternate Series for Planning on page 44 to process another series.

2. Review the accuracy of the brain mask and adjust if necessary:
   a. In the right viewport, stack through the images and verify that the brain mask has been accurately generated.
   b. If necessary, adjust the **Mask** slider in the phase panel to dilate or erode the brain mask until it more closely corresponds to the brain surface, or click the **Edit** icon to edit only specific areas of the brain mask.

      This will set the default brain mask for the rest of the planning phases.

      **NOTE: The brain mask does not need to correspond exactly to the brain tissue on all slices. In the Trajectories phase, you will be able to further dilate or erode the brain mask to improve its accuracy in the areas relevant to the procedure before you specify an engagement point.**

   If the brain mask is not adequate, even after making adjustments, try using another series or another study. For information, see section 4.1.1.3 Using an Alternate Series for Planning on page 44. If no other series or study is available, clear the **Toggle Brain Mask** checkbox to proceed without a using a brain mask. For more information, see 4.1.1.2 Using a Series with No Brain Mask to Plan on page 43.

3. If you are satisfied with the image quality and brain mask (or are willing to proceed without brain mask), click the **Accept selected series** checkbox.

To hide the brain mask visualization, right-click in one of the viewports, and then select **Toggle Brain Mask**.

### 4.1.1.1 Editing the Brain Mask

If the automatically-generated brain mask is not accurate, and adjusting it globally using the Mask slider cannot correct the problem, you can make edits to specific areas of the brain mask.


**Figure 33 Brain mask editing tools**

1 Paint brush tool.
2 Eraser tool.
3 Tool size slider. Move the slider to adjust the size of the active tool (paint brush or eraser).
4 Auto-fill mode. When auto-fill mode is enabled, Modus Plan will connect the end point to the start point of a line you draw with the paint brush tool and automatically fill in the area.

5 Push/pull mode. Click this tool to set the tool mode based on the way you move the mouse.

When this tool is activated, when you click anywhere inside the mask and drag outside the mask, the tool acts like the paint brush and extends the mask. When you click anywhere outside the mask and drag inside the mask, the tool acts like the eraser and removes that part of the mask.

6 Interpolate Changes. Click this icon to incorporate the changes you made into the brain mask.

To edit the brain mask:

1. Click the **Edit** icon beside the Mask slider in the phase panel. The editing tools appear in the right viewport and new options appear in the phase panel.
2. In the right viewport, stack to the first slice where the brain mask is not accurate and use the editing tools to correct the mask.

   **NOTE: Correct only one area of the mask at a time. If multiple areas of the mask require correction, complete steps 2 to 4 for one area, then repeat the process for the next area.**
3. Stack to a subsequent slice where the mask is not accurate and use the editing tools to correct the mask. Repeat this process on a representative number of slices that cover the area you want to correct.
4. Click the **Interpolate Changes** icon in the toolbar. Modus Plan creates a new smooth brain mask surface by filling in the areas between the slices you edited based on your changes.
5. When you are done making edits, click **Accept Edits** in the phase panel. The left viewport updates to show the updated brain mask.

   Or, if you want to discard your changes, click **Cancel Edits** in the phase panel. This will discard any changes you have made and have not accepted.

   To discard all changes and restore the brain mask to its originally generated state, click **Reset** in the phase panel.

**NOTE: The edits you make to the brain mask will not be exported with the plan. Any engagement points you create based on the edited brain mask will be exported at the locations where you placed them, but they may not appear to be on the brain surface when viewed in BrightMatter Guide.**

#### 4.1.1.2 Using a Series with No Brain Mask to Plan

Under certain circumstances, a brain mask may not be available for the series you want to use to create a plan or Modus Plan may create a brain mask that is not adequate and cannot be fixed using the Mask slider or mask editing tools. In this case, you can choose not to accept the brain mask and create a plan without one.

If the series you want to plan on does not have a brain mask associated with it, the Mask slider and acceptance checkbox are not displayed.

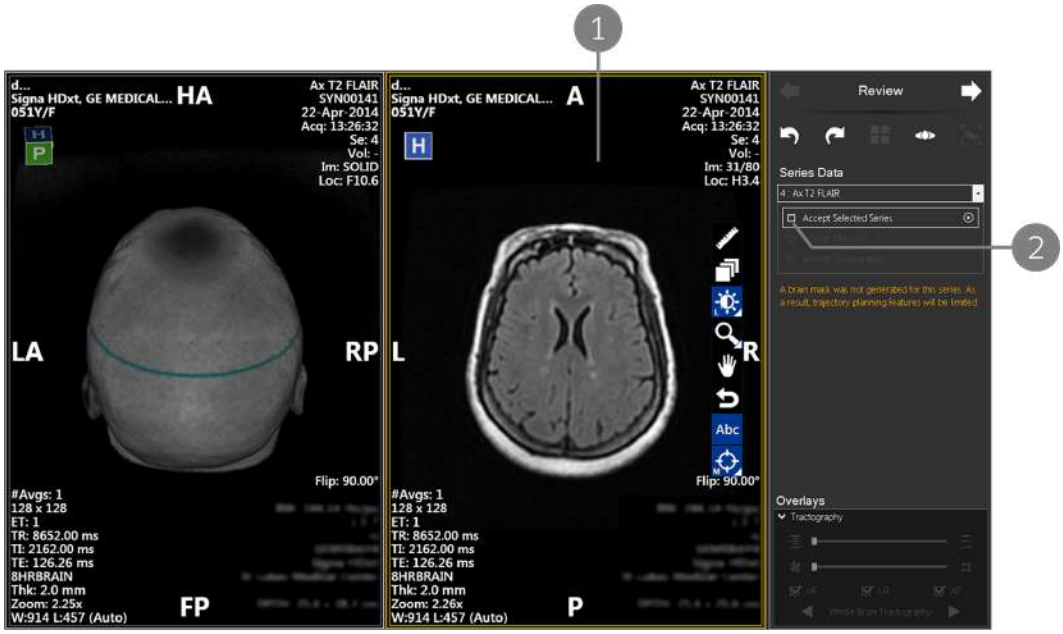



Figure 34 Workspace for reviewing a series with no brain mask

1 Review the images in the viewports to verify that the series contains sufficient information to create a plan.

2 If the series is acceptable, click the **Accept selected series** checkbox.

If the series has a brain mask associated with it, but the brain mask is not adequate for planning purposes, clear the **Mask** checkbox before clicking the **Accept selected series** checkbox (see items 6 and 7 in Figure 32).

**NOTE: If you accept a series without a brain mask, some features will be limited in the subsequent workflow phases, diffusion tracts may appear beyond the surface of the brain, and the skull may be visible in some viewports, obscuring the surface of the brain.**

### 4.1.1.3 Using an Alternate Series for Planning

The Modus Plan workflow is based on a 'primary series'. This is the series that Modus Plan performs image processing on (to generate visualizations such as the brain mask and tractography) and is the series that becomes the basis for your exported plan. By default, Modus Plan assumes that the T1 series with the highest spatial resolution is your primary series. If a study contains multiple series with the same spatial resolution, Modus Plan uses the most recent series as the primary series. If image processing on that series fails, Modus Plan attempts to use another T1 series or a T2 series if no other T1 series exist (or if image processing failed on all T1 series). Modus Plan continues this process until all T1 and T2 series have been exhausted.

**NOTE: Your system may have been configured at installation to use a T2 series as the primary series instead of a T1 series.**

To specify a particular series as the primary series for planning:

1. Exit Plan mode if it is open and return to the My Studies pane.
2. Right-click the study containing the series you want to use and select **View Series Details**.

3. In the Series Details dialog, select the primary series and the diffusion series you want to use for creating the plan.

   **NOTE: If it is not easy to identify the correct diffusion series from the series names, you can select all the series (CTRL+A) then de-select the T1 or T2 series that you do not want to use for planning (hold down the CTRL key while you click on the series names). Modus Plan automatically uses the appropriate diffusion series for processing.**

4. Click **Process Series** in the dialog toolbar.

When processing is complete, you can select the series from the **Series Data** list in the Review phase panel. Series that have processed data associated with them appear in bold text in the **Series Data** list.

**NOTE: Processing may take up to 30 minutes to complete.**

### 4.1.2 Diffusion

During processing, Modus Plan creates three diffusion series: Apparent Diffusion Coefficient (ADC), Fractional Anisotropy (FA) and an RGB color map. (For diffusion tensors with high anisotropy, the major eigenvector direction is generally assumed to be parallel to the direction of white matter tract. This is often represented using an RGB (red-green-blue) color map to indicate the eigenvector orientations.)

When you have accepted the primary series, the workspace updates with four viewports to help you evaluate the diffusion data. The top-left viewport displays the primary series, the top-right and two bottom viewports display different visualizations of the diffusion data.

Stack through the slices to verify the quality of the diffusion data. You can also click the Play icon in the phase panel to animate stacking through the slices in the series. If the diffusion data is not perfectly registered to the anatomy, you can still accept it and adjust it when you review the tractography data. For more information, see 4.1.3 Tractography on page 47.


Figure 35 Workspace for reviewing diffusion data

1 Use the Spatial Locator to follow anatomical structures in the viewports.
2 Optionally, click the Play icon to animate stacking through the slices.
3 If the diffusion data is adequate, click the **Accept Diffusion** checkbox.

IMPORTANT: Accepting series with poor registration will lead to inaccuracy in plans and surgery.

NOTE: By their nature, diffusion scans represent anatomy differently than T1 scans. In some cases, this may cause the diffusion data to appear to be incorrectly registered to the anatomy. In the ADC image on the right below, the margin of the tumor appears to extend beyond the margin indicated in the T1 scan on the left, however this is a characteristic of ADC visualizations.

Figure 36 Comparing the lesion margin in the T1 and ADC series

Use careful clinical judgment and look for very clear anatomical structures when evaluating the diffusion data.

NOTE: It is not necessary to accept the diffusion data to continue with the planning process, however if you do not accept the diffusion data in this phase, you will not be able to see it in other planning phases.

### 4.1.3 Tractography

When you have accepted the diffusion data for the series, the workspace updates with four viewports to help you evaluate the tractography data generated for this series.

**NOTE: If during processing Modus Plan detects that the image data in the primary series is of poor quality or is incomplete (for example if part of the head is missing), tractography data will not be generated for the series.**

IMPORTANT:

- **Tract information displayed in Modus Plan is based on diffusion data; it does not necessarily correspond to nerve bundles.**
- **The diffusion tract colors are based on the axes of the scanner. If the patient's head is not aligned with the scanner, the colors will not map to the patient axes. If necessary, you can change the tract RGB coloring to match the patient's orientation instead of the scanner's orientation. For more information, see Adjusting the Tractography Registration on page 48.**

If the tractography does not appear to be correctly registered to the anatomy, you can move it or scale it to correct the issue. For more information, see Adjusting the Tractography Registration below.

When you are satisfied that the tractography data registration is adequate, click the **Accept Tractography** item in the phase panel.

**NOTE: If the automatic tractography segmentation feature is enabled on your Modus Plan system, see Working with Automatically Segmented Bundles in the Review Phase on page 78.**

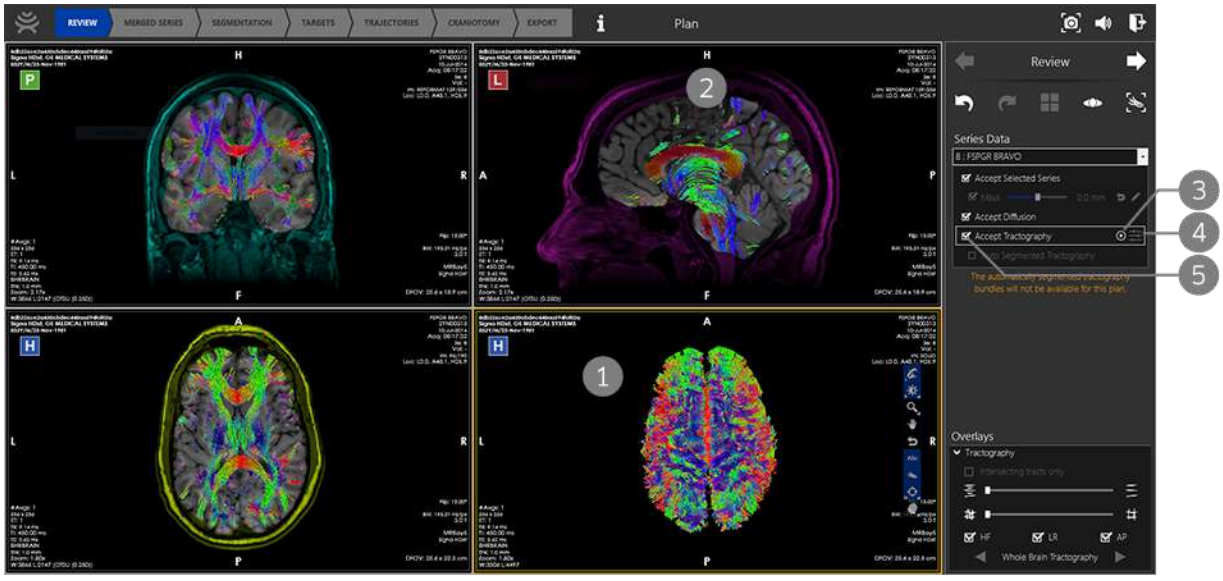



**Figure 37 Workspace for reviewing tractography**

1 Use the Window/Level tool to reduce the brightness in this view (right-click and drag down). This will hide the brain tissue and reveal the tractography. Rotate the view to review the tracts from all angles.

2 It can be easier to view the tracts in 2D slice mode. Stack through the slices in this viewport to view the tracts overlaid on the anatomy.

3 Optionally, click the Play icon to animate the images in the viewports. The solid image in the left viewport rotates and the 2D image in the right viewport stacks through the slices.

4 Click to show or hide the tractography adjustment controls.

5 When you are satisfied that the tractography data is adequate, click the **Accept Tractography** checkbox.

**IMPORTANT: Accepting series with poor registration will lead to inaccuracy in plans and surgery.**

**NOTE: Accepting the tractography data is not required to continue with the planning process, however if you do not accept the tractography data in this phase, you will not be able to see it in other planning phases.**

## Adjusting the Tractography Registration

To adjust the tractography registration:

1. In the phase panel, click the Tractography Adjustment Controls icon. The tractography adjustment controls appear in the phase panel.


1 Select this option to change the tract RGB coloring to match the patient's orientation instead of the scanner's orientation (for example if the scan was oblique or if the patient's head was not aligned with the scanner). For more information, see Important Information about Diffusion Tensor Calculations below.

2 Click the + and – icons to scale the tracts horizontally or vertically relative to the active viewport.

3 Click the arrows to move the tractography up, down, left or right relative to the active viewport.

4 Click and hold to "snap" to the original tractography position. Release the mouse button to jump back to your adjusted tractography.

5 Click to discard all your adjustments and reset the tractography.

**Figure 38 Tractography adjustment controls**

2. When you are satisfied that the tractography is correctly registered to the anatomy, click the the **Accept Tractography** checkbox.

**NOTE: When you adjust the tractography, the diffusion data on which the tractography is based is also adjusted to match your changes. When you accept adjusted tractography, a confirmation dialog appears requiring you to accept these changes.**

**TIP: Zoom in on the image in the viewport to see the effect of your tractography adjustments more clearly.**

**NOTE: Noise in the diffusion scan images may cause tractography to appear outside of the brain. Do not attempt to correct this using the tractography adjustment controls. Use the sliders on the Tractography**

**overlay options in the phase panel to remove stray tracts caused by noise. For more information, see Tractography Overlays Options on page 29.**

### Important Information about Diffusion Tensor Calculations

Diffusion tensor calculations involve vendor-specific private DICOM tag encodings of gradient direction vectors, which can be affected by a large number of user configurable scanner settings (for example, direction of scan, in-plane phase encoding direction, scan orientation, etc.). For best results, follow the Synaptive MR scan recommendations (listed in document MKT-0008). Contact Synaptive customer service if you experience any issues or have any concerns. For contact information, see 1.7 Synaptive Customer Service Information on page 13.

To correct cases where the patient's orientation does not match the scanner's orientation, select the **Use patient orientation** option in the tractography adjustment tools to have Modus Plan recalculate the RGB values based on the orientation of the patient's head. Figure 39 below shows an example of before and after recalculation.

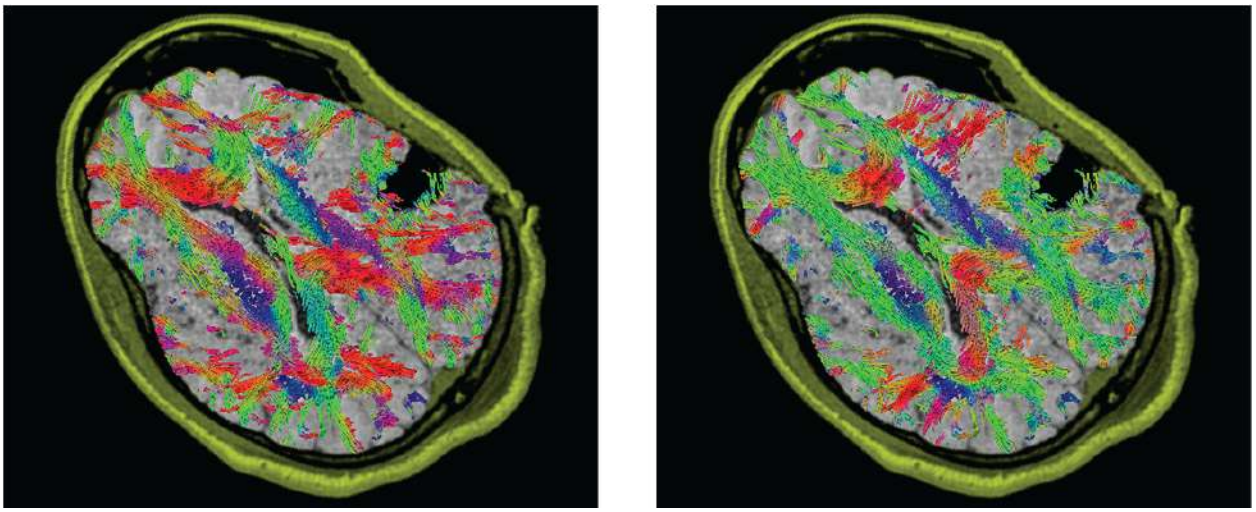


**Figure 39 RGB coloring based on scanner axes (left) and based on patient orientation (right)**

## 4.2 Merged Series Phase

If there are other series pertinent to the procedure you are planning for, or series in other modalities that you want to use when planning, you can merge them with the primary series for the plan. For example, to view vasculature, which may be blocking a potential engagement point, merge a contrast series with your primary series.

The Merged Series workspace consists of four viewports. Three viewports display a 2D slice view of the anatomy in coronal, sagittal, and axial orientations. The fourth viewport displays a solid view (except in the spyglass comparison mode).

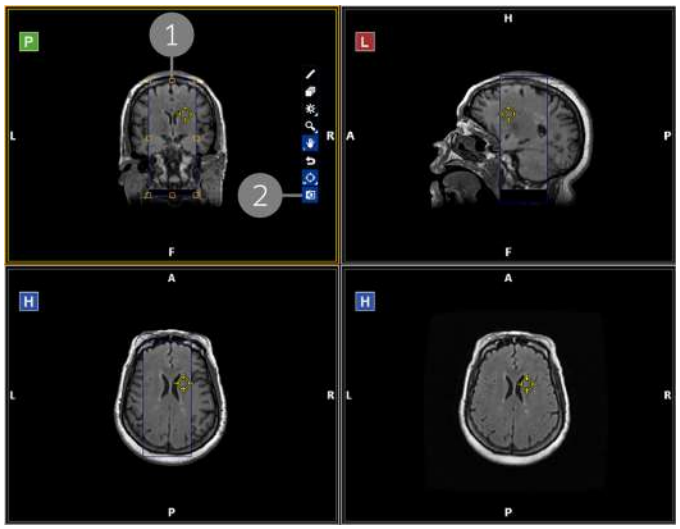
There are two ways to see the merged series overlaid on the primary series:

- Use the spyglass comparison mode

  -or-

- Use the color blend comparison mode

In the spyglass comparison mode, the merged series is displayed in a window overlaid on the primary series. You can adjust the size or shape of the overlay window by clicking and dragging the "handles" on the sides and corners of the window. To adjust the window/level values of the merged series, change the window/level values in the 2D view displayed in the bottom right viewport.

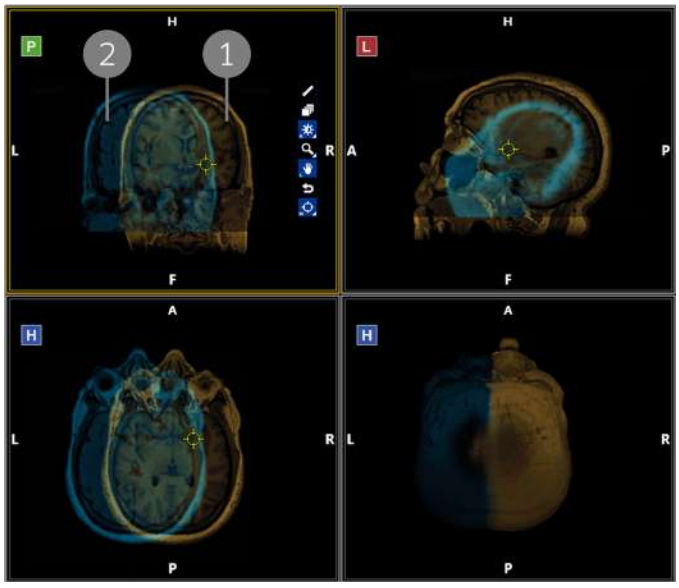



1 Merged series overlay window

2 Show/Hide Series Comparison Graphic. This tool shows or hides the overlay window.

**Figure 40 Spyglass comparison mode**

In the color blend comparison mode, the merged series has a different color from the primary series. The following example shows a manually adjusted merged series.




1 Primary series (amber)
2 Merged series (blue)

Figure 41 Color blend comparison mode

## 4.2.1 The Merged Series Phase Panel

The Merged Series phase panel displays the list of series that you have merged with the primary series.


1 Add a merge series.
2 Delete the selected series.
3 Toggle between spyglass and color blend comparison modes. Click to show the merged series overlay window.
4 List of merged series according to the study date and time, arranged in ascending order. Select a series to see it overlaid on the primary series in the viewports.

**TIP: Right-click a series from the list to view the details of the original series where it is merged from.**

5 Link window/level. Click this icon to link the adjustments made to the window and level values to the primary or merged series. This item only applies to color blend mode.
6 Drag the slider to adjust the intensity of images. The default opacity is 50% for the primary series and 50% for the merged series. This item only applies to color blend mode.
7 Click to reset the merged series color blending. This item only applies to color blend mode.

Figure 42 Merged Series phase panel

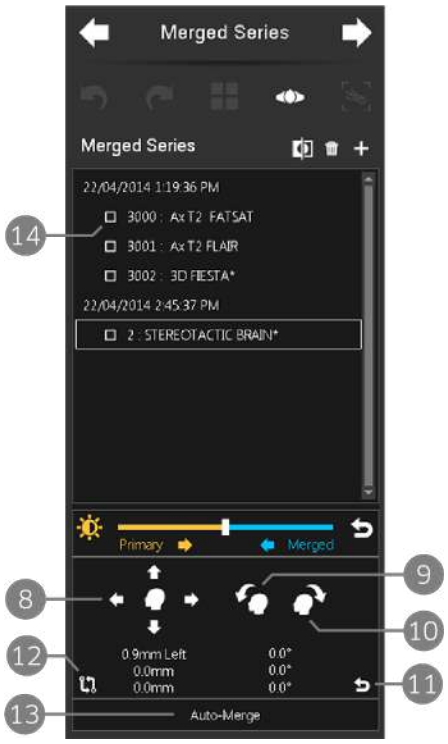



Figure 43 Merged Series phase panel, continued

8 Click the arrows to move the overlaid merged series up, down, left, or right relative to the active viewport.

9 Click the icon to rotate the overlaid merged series counter-clockwise.

10 Click the icon to rotate the overlaid merged series clockwise.

11 Click to discard all your adjustments and reset the merged series position.

12 Click and hold on this icon to temporarily restore the original merged series overlay position. Release the mouse button to reapply your adjustments.

13 Auto-Merge. Click this icon to automatically align the merged series to the primary series. This icon is enabled after you have made manual adjustments, or if the merge was done using the same frame of reference.

14 Select the checkbox to accept the series and make it available in subsequent phases.

## 4.2.2 Merging Series

To merge one or more series with the primary series:

1. In the phase panel, click the **Add a series** icon to open a list of available studies.
2. In the Merge Prior Series dialog, select the study that contains the series you want to merge.

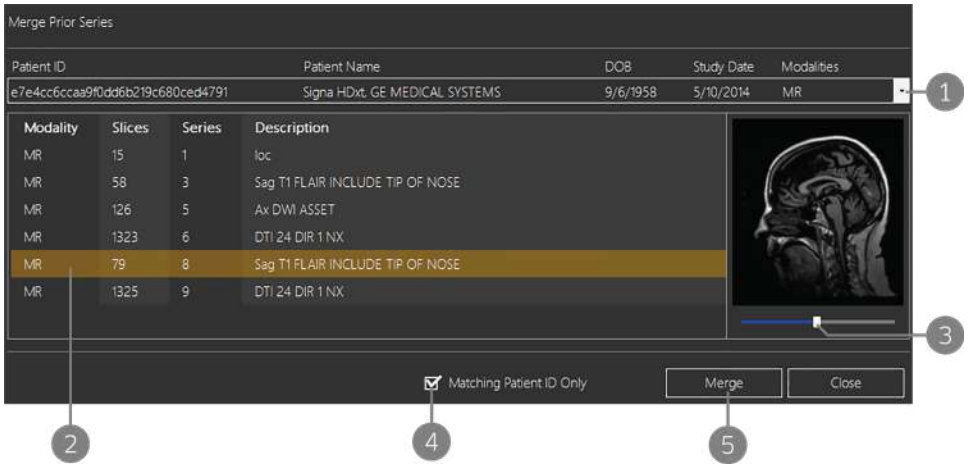



**Figure 44 Merge Prior Series dialog**

1 Study list. Select the study that contains the series you want to merge.

2 Series list. Click on one or more series to select them for merging.

3 The preview window displays thumbnails of the images in the series. Move the slider to stack through the images in the series.

4 By default, the study list contains only studies that match the Patient ID of the primary series. Deselect this option to view all the studies in the local database.

5 Merge button. Click to merge the selected series into the plan series.

**IMPORTANT**

If you deselect the **Matching Patient ID Only** checkbox, the list of available studies contains all studies in the local database, including studies from other patients. Modus Plan does not perform any verification to ensure that the study you select is for the same patient as the plan study. Merging a series from the wrong study may negatively impact clinical decisions.

If you select a study that does not match the Patient ID of the plan study, Modus Plan displays a notification message when you merge the study. Review the patient information in the merge study carefully to ensure that you have selected the correct study.

3. Click on one or more series to select them for merging, and then click **Merge**.

   **TIP: Hold down the CTRL key to select multiple studies.**

   The merged series appear in the phase panel.

4. Click the name of a merged series to view it overlaid on the primary series in the viewports. The viewports show the primary series (amber) blended with the merged series (blue).

   Carefully review the accuracy of the merge. If the merged series is not correctly aligned with the primary series, you can do the following:

   - Manually adjust the alignment. Use the alignment controls (items 8, 9, and 10 in Figure 43 on page 52) to move or rotate the merged series.

- Automatically adjust the alignment. Click the **Auto-Merge** button (item 13 in Figure 43 on page 52) to automatically adjust the alignment of the merged series to the primary series.
  - If the primary series and the series to be merged have the same frame of reference, the two series will be immediately overlaid in the viewports.
  - If the primary series and the series to be merged have a different frame of reference (for example, merging series of the same patient from two different studies), the system will do the registration first before merging, which may take longer. Registration only happens once for this type of merging.

NOTES:

- **Merging color series to the primary series is only possible if a series with the same frame of reference has already been merged. You cannot use the Auto-Merge feature for the color series.**
- **The system does not support merging of gantry-tilted series.**
- **Series merged into the primary series in Modus Plan are displayed in BrightMatter Guide. These series are read-only and cannot be adjusted.**

5. Select the checkbox (item 14 in Figure 43 on page 52) to accept the series and make it available in subsequent phases.

## 4.3 Segmentation Phase

Use the Segmentation phase to:

- Define the regions that will be important during the procedure. These may be regions that you want to reach during the procedure or regions you want to avoid.
- Create and edit tract bundles that contain a group of segmented tracts. This will help you plan and work on select tracts that will be important during the procedure.

**NOTE: The Segmentation phase is optional, but highlighting important regions and tracts can make it easier to visualize relevant anatomy.**

The Segmentation phase workspace consists of four viewports. Three viewports display a 2D slice view of the anatomy in coronal, sagittal, and axial orientations. The fourth viewport displays a solid view. When you rotate the solid view, the quadrant (defined by the slices currently displayed in the coronal, sagittal, and axial views) that is facing you is removed (or "clipped") so you can see inside the solid view.

You can manually adjust the quadrant clipping by moving each frame in the 3D solid view. The three frames (indicated by colors respective to the orientations) represent the 2D slice views and any adjustment to each frame will apply to each slice in the other three viewports. To hide the frames, right-click in the 3D solid viewport, and then select **Toggle Frames**.

Modus Plan can display up to eight regions at once. To add additional regions when eight regions are visible, hide a visible region by clicking the **Show/Hide Region** icon in the phase panel.

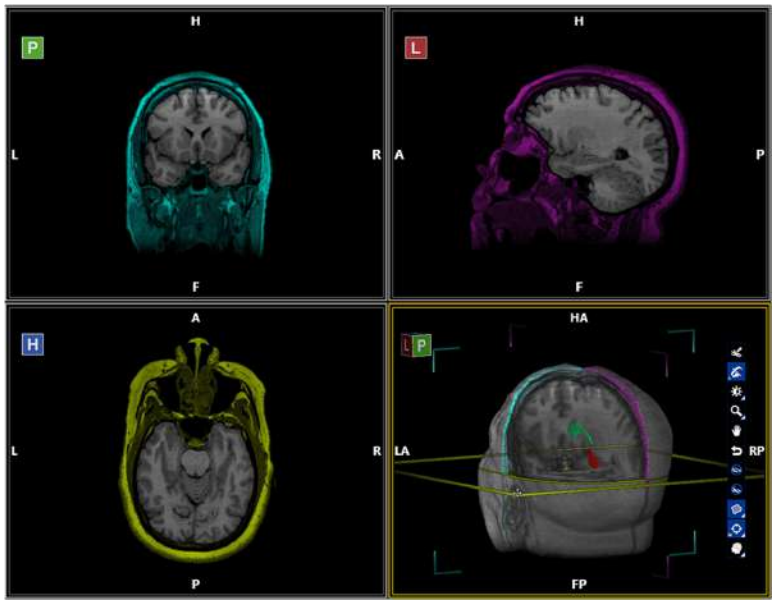



Figure 45 Viewport layout in the Segmentation phase

## 4.3.1 The Segmentation Phase Panel

The Segmentation phase panel displays the regions and tract bundles that you have created, including any merged series in the study.

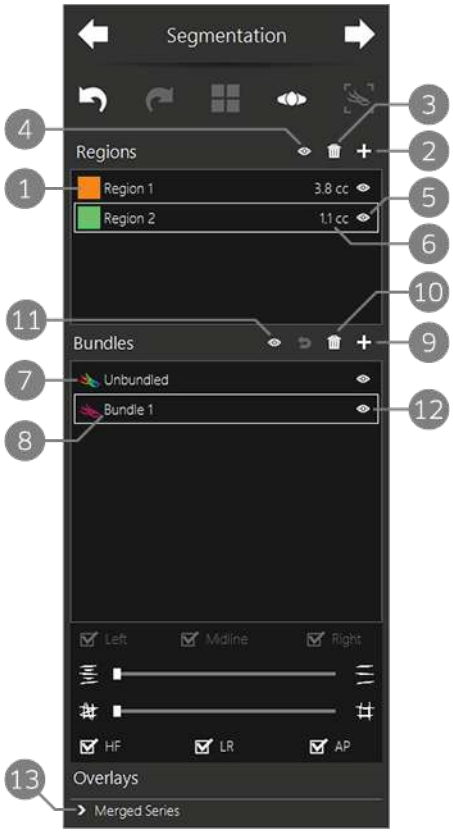



Figure 46 Segmentation phase panel

1 Region color and name. Click the colored square to assign a color to the region. The paint brush tool will also appear in this color in the viewport when editing this region.

Double-click the region name to rename it.

2 Add Region. Click to add a new region in the active viewport.

3 Delete Region. Click this icon to delete the selected region.

4 Toggle Region Visibility. Click this icon to show or hide all regions.

5 Show/Hide Region. Click this icon to show or hide this region.

6 Displays the region volume in cubic centimeters.

7 Unbundled tracts. This bundle contains all tracts that have not been segmented into any other bundle. You cannot delete this bundle.

TIP: It may be necessary to hide the unbundled tracts to get a clear view of any bundles that have been added.

8 Tract bundles are listed here.

NOTE: If the automatic tractography segmentation feature is enabled on your Modus Plan system, the automatically segmented tract bundles appear in the bundles list. For more information, see Working with Automatically Segmented Bundles in the Segmentation Phase on page 79.

9 Add new bundle. Click this icon to add a new tract bundle in the active viewport.

10 Delete selected bundle. Click this icon to delete a bundle. You can delete all bundles that have been added except for unbundled tracts.

11 Toggle Tract Visibilities. Click this icon to show or hide all tract bundles.

12 Show/Hide Bundle. Click this icon to show or hide this bundle.

13 Merged Series overlay. You can add or edit regions and tract bundles on any series that has been merged with the primary series.

## 4.3.2 Adding Regions

Use the **Region Editing** tools in the Segmentation phase to create a region by using the paint brush, 2D paint can, or 3D paint can tools. To access these tools, click the Region Editing Mode icon in the viewport that contains the series you want to create the region on.

**NOTE: If the Region Editing Mode icon is not visible in the viewports, verify that a region is selected in the phase panel.**

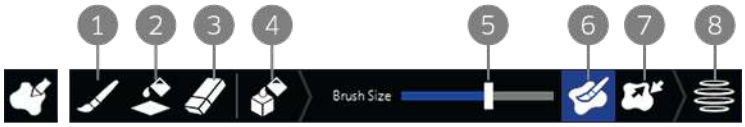



Figure 47 Region Editing Mode viewport tool (left) and Region editing toolbar (right)

1 Paint Brush. Use this tool to draw an area on the current slice by clicking and dragging in the viewport.

2 2D Paint Can. Use this tool to quickly fill an area on the current slice based on the surrounding area's brightness. For more information, see Creating a Region Using the 2D Paint Can below.

3 Eraser. Use this tool to remove parts of a region on the current slice by clicking and dragging in the viewport.

4 3D Paint Can. Use this tool to quickly fill an area on all slices based on the surrounding area's brightness. For more information, see Creating a Region Using the 3D Paint Can below.

5 Tool size slider. Move the slider to adjust the size of the active tool (paint brush or eraser). The cursor in the viewports shows the tool size.

6 Auto-fill mode. For more information about using auto-fill mode, see Creating a Region Using the Paint Brush Tool below.

7 Push/pull mode. Click this tool to set the tool mode based on the way you move the mouse.

When this tool is activated, when you click anywhere inside the region and drag outside the region, the tool acts like the paint brush and extends the region. When you click anywhere outside the region and drag inside the region, the tool acts like the eraser and removes that part of the region.

8 Interpolate. Click this icon to build a 3D region from the 2D regions you traced in the viewport.

An empty region is already available in the phase panel by default. If you do not edit this region, it will be removed automatically. You can use the default empty region or click the **Add Region** icon in the phase panel to create a new empty region.

NOTES:

- **When using the paint brush or 2D paint can, build only one region at a time.**
- **To get the best results when using the 2D or 3D paint can tools, when filling a dark region surrounded with lighter areas, you should select the darkest area in the region. When filling a light region surrounded with darker areas, you should select the lightest area in the region. Selecting a point near the edge of an area may result in the fill spilling outside of the desired area.**
- **The 3D paint can feature will not work on gantry-tilted series.**

**TIP: When using the 2D or 3D paint can tools, adjust the window/level value to accentuate the difference between light and dark areas in the image.**

## Creating a Region Using the Paint Brush Tool

To create a region using the paint brush tool:

1. Click the **Region Edit Mode** icon in the viewport where you want to create the region.
2. Click the **Paint Brush** tool in the region editing toolbar. You can also click the **Toggle auto-fill mode** tool to automatically fill in the area.

   For example, when auto-fill is on, if you draw a 'C' stroke using the brush, Modus Plan will connect the end point to the start point and automatically fill in the area. If auto-fill is off, a non-filled region is created.

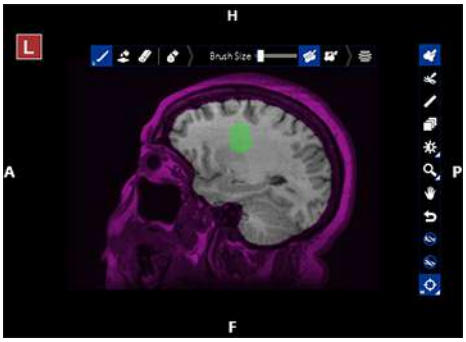



Figure 48 Auto-fill ON

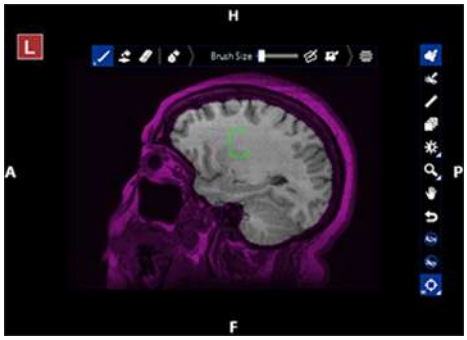



Figure 49 Auto-fill OFF

3. Click and drag in the viewport to trace around the region on the current slice.
4. Stack to another slice in the same viewport and repeat the process of tracing the region.
5. With the same viewport active, click the **Interpolate** icon in the region editing toolbar to build a 3D region from the 2D regions that you have drawn.

## Creating a Region Using the 2D Paint Can

Use the **2D Paint Can** tool to quickly fill an area on the current slice based on the brightness of the area around the point where you clicked. When you click in the image, all the surrounding voxels of a similar brightness are added to the region on this slice. You can control how similar the voxel brightness must be in order to be included in the region by adjusting the Threshold slider in the toolbar.

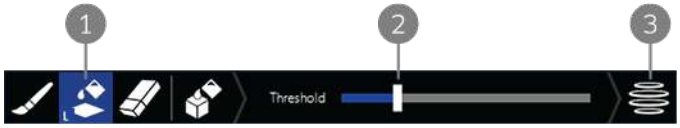



Figure 50 2D paint can tools

1 2D Paint Can tool.
2 Threshold slider. Move the slider to adjust the sensitivity of the tool.
3 Interpolate. Click this icon to build a 3D region from the 2D regions you traced in the viewport.

To create a region using the 2D paint can tool:

1. Click **2D Paint Can** in the toolbar.
2. Click an area to start creating a region on the current slice. You can move the Threshold slider to the expand or reduce the fill of adjacent areas.

   In the following example, a light area is initially selected with the threshold adjusted to a higher value to fill in adjacent areas with similar brightness.

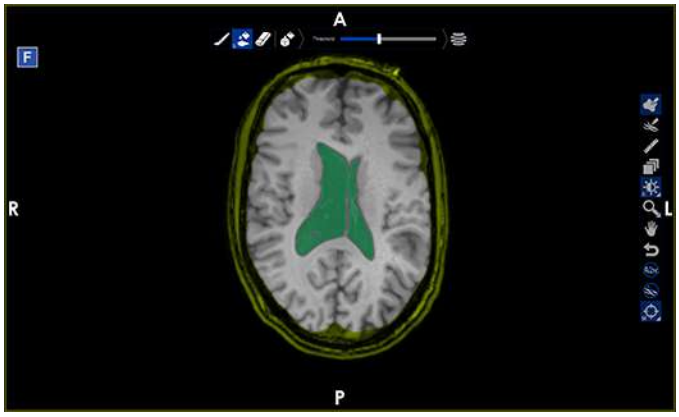



Figure 51 2D Paint Can

3. Stack to another slice in the same viewport and repeat the process of filling in the desired area on that slice.
4. Click the **Interpolate** icon in the region editing toolbar to build a 3D region from the 2D regions that you have drawn.

## Creating a Region Using the 3D Paint Can

Use the **3D Paint Can** tool quickly fill an area on all slices in the image based on the brightness of the area around the point where you clicked. When you click in the image, all the surrounding voxels of a similar brightness are added to the region. You can control how similar the voxel brightness must be in order to be included in the region by adjusting the Threshold slider in the toolbar.

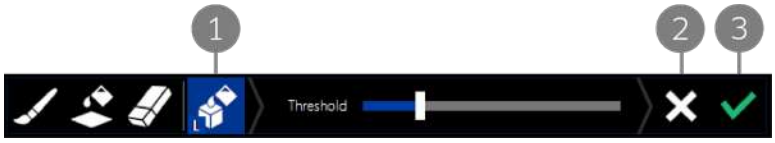



Figure 52 3D paint can tools

1 3D Paint Can tool.
2 Cancel paint can edit. Click to remove the 3D region fill.
3 Finish paint can edit. Click to create the region.

To create a region using the 3D paint can tool:

1. Click the **3D Paint Can** tool in the toolbar.
2. Click an area in the image to start creating a 3D region. You can move the Threshold slider to expand or reduce the fill of adjacent areas.

   In the following example, a dark area is initially selected with the threshold adjusted to a higher value to fill in adjacent areas with similar intensity.

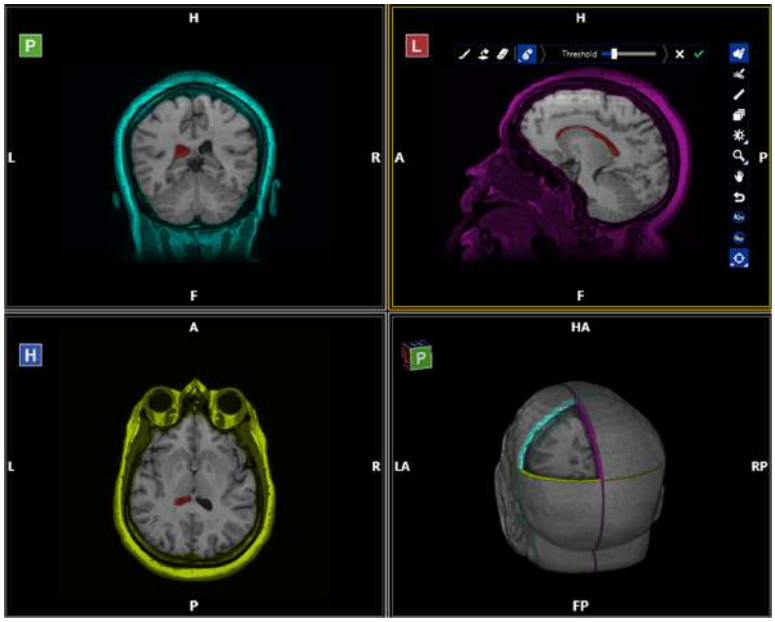



Figure 53 3D Paint Can

3. Click the **Finish paint can edit** tool.

When Modus Plan generates a 3D region, it immediately generates a coarse surface, then it generates a refined surface with a higher resolution. Generating the refined surface can be slow for a series with very large region volumes, but you can continue working while this is in process. If the surface is clinically relevant for the procedure, wait for the surface refinement to complete, and then review the surface before exporting. You can check the status in the phase panel. When the system completes the surface refinement, the "Refining surfaces" status disappears.

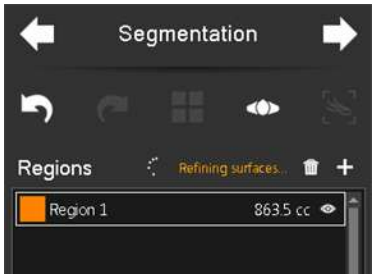



Figure 54 Regions - Refining surfaces message

## 4.3.3 Working With Tract Bundles

Use the **Bundle Editing Mode** tools to segment tracts into bundles. To access the these tools, click the **Bundle Editing Mode** tool in a viewport.

**NOTE: The Bundle Editing Mode tool is only available if you have accepted the tractography data in the Review phase. To enable the tools, a bundle must be selected in the phase panel (not the unbundled tracts).**

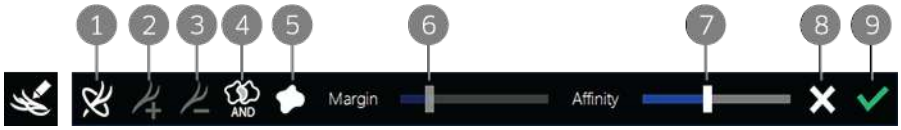
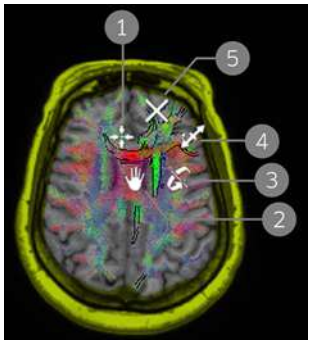



Figure 55 Bundle Editing Mode viewport tool (left) and Bundle Editing Mode toolbar (right)

1 Tract Selection. When this tool is selected, click and drag in the viewport to manually select tracts by drawing a ring around them. Hover over the ring to display additional features for working with the ring (see below).
2 Add Selected Tracts. Click to add the currently selected tracts to the bundle.
3 Remove Selected Tracts. Click to remove the currently selected tracts from the bundle.

NOTE: To prevent tracts from being removed accidentally, only tracts that are currently visible in the viewport can be removed from the bundle.

4 AND/OR Tract Selection. If you are using multiple rings to select tracts, click this icon to toggle between showing tracts that intersect each ring, and showing tracts that intersect all rings.
5 Region Intersection mode. Click to select any tracts that intersect a region.
6 Margin slider. Move the slider to adjust the region intersection margin. This slider is only available when Region Intersection mode is enabled.
7 Affinity slider. Move the slider to show or hide tracts based on their "affinity" to the bundle's definition. For more information, see About the Affinity Slider below.
8 Cancel Selected Tracts. Click to cancel the edits you made to the tract bundle.
9 Accept Selected Tracts. Click to save the edits you made to the tract bundle.




1 Click this icon to return to the slice where you placed the ring. Use this feature if you have stacked through the image and want to return to the original slice you were working on.
2 Click this icon and drag in any direction to move the ring in the current slice.
3 Click this icon and drag to rotate the ring along the selected tracts.
4 Click this icon and drag in any direction to adjust the ring size.
5 Click to close the ring tool.

**Figure 56 Tract Selection ring features**

To add or edit a tract bundle:

1. Select the bundle you want to edit, or click the **Add new bundle** icon in the Segmentation phase panel.
2. In a viewport, click the **Bundle Editing Mode** tool.
3. Use the bundle editing tools to select the tracts you want to add or remove from the bundle. Selected tracts are highlighted in the viewport.
4. When the tracts you want to add or remove are highlighted, click the **Add Selected Tracts** icon or the **Remove Selected Tracts** icon to add or remove the tracts from the bundle.
5. When you are done selecting tracts, click the **Accept Selected Tracts** tool.

**NOTE: Tracts that have been segmented cannot be culled using the culling sliders in the Tractography overlay options. If culling was applied before the tracts were segmented, that culling cannot be undone after the segmented tract bundle has been accepted.**

### About the Affinity Slider

Use the Affinity slider to show or hide tracts in a bundle based on their similarity (or "affinity") to the bundle as a whole. Move the slider to the left to show tracts with a lesser affinity to bundle (so you will see more tracts in the bundle). Move the slider to the right to show only those tracts that have a high affinity to the bundle.

**NOTE: When you increase the affinity, the tracts removed from the bundle are moved to the unbundled state. When you decrease the affinity, the tracts added to the bundle are taken only from the unbundled tracts, not from other bundles.**

## 4.3.4 Assigning a Color to Regions and Tract Bundles

To assign a color to each region and tract bundle, click the colored square beside the region or the colored tract icon beside the bundle and then select your desired color.

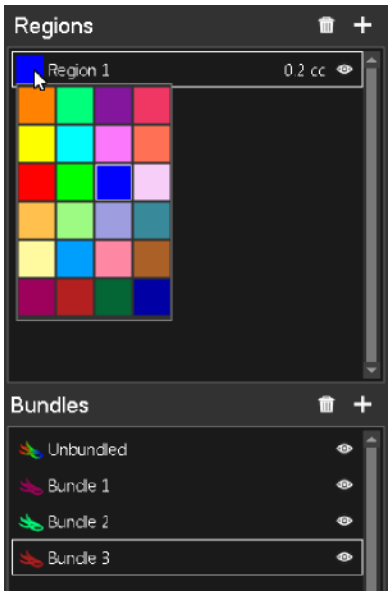



**Figure 57 Assigning a color to a region**

# 4.4 Targets Phase

In the Targets phase, define the target or targets you want to reach during the procedure. You must create at least one target before you can move to the next phase. You can return to this phase to add new targets if necessary. You can also adjust the location of a target in the Trajectories phase.

The Targets phase workspace contains four viewports. Three viewports display a 2D slice view of the anatomy in axial, sagittal, and coronal orientations. Move the spatial locator in these viewports to specify the location of the target. The fourth viewport displays a solid view.

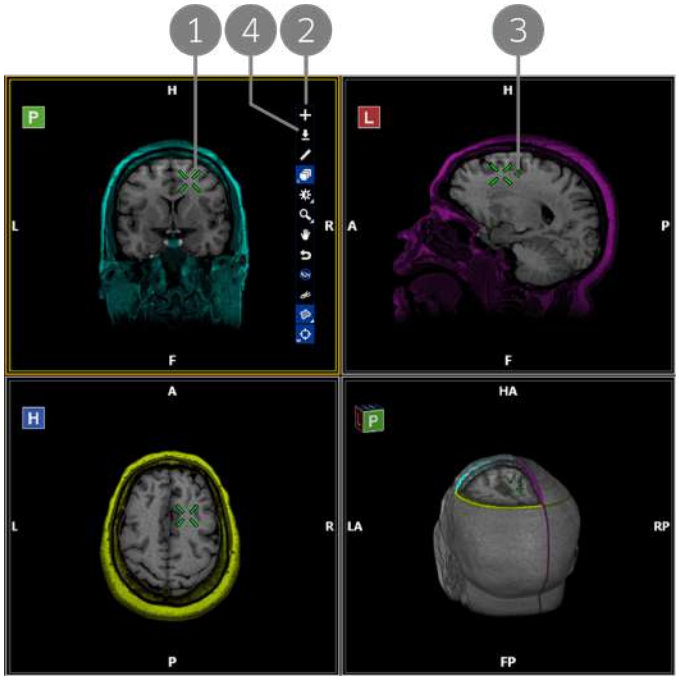



Figure 58 Viewport layout for placing targets

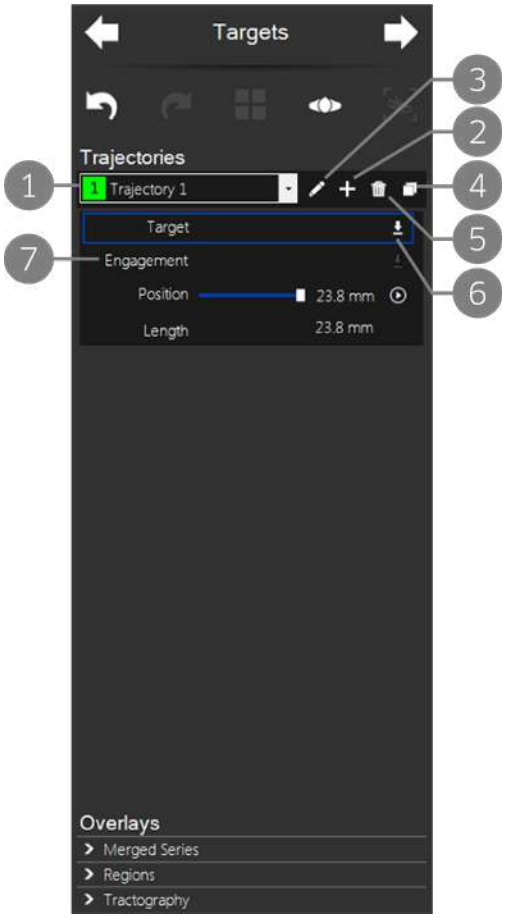
1 Position the spatial locator where you want to place a target and click the **Add** icon (item 2).

2 Click to add a target at the current spatial locator position.

3 Targets are represented by crosses on the image. Their color corresponds to the target item in the phase panel.

4 **Set Location** icon. Click this icon to move an existing target to the current spatial locator location.

### 4.4.1 Placing Targets




1. Modus Plan creates a trajectory for each target you add. Select a trajectory from the drop-down list to view or edit its properties.
2. Add a trajectory for this target point. Click to add a trajectory at the current spatial locator position. This option is also available as a tool in the active viewport.
3. Edit properties for the selected trajectory. Click to edit the trajectory name and color. You can also edit the properties of the selected trajectory in the Trajectories, Craniotomy, and Export phases.
4. Copy the selected trajectory. Add a new trajectory by copying the currently selected one. The new trajectory is added at the same location as the selected trajectory. Use this option if you want to evaluate two trajectories to the same target location.
5. Delete the selected trajectory.
6. Set target point. Click to move the target to the current spatial locator position. This option is also available as a tool in the active viewport.
7. You can add an engagement point for this target in the Targets phase, but it is recommended that you add engagement points in the Trajectories phase.

**Figure 59 Targets phase panel**

To place a target, in one of the 2D viewports drag the spatial locator to the location where you want to place the target and click the **Add a trajectory for this target point** tool in the viewport or in the phase panel. If you attempt to drag the spatial locator to an invalid location (such as a location outside of the brain), the spatial locator icon changes and the **Add a trajectory for this target point** tool is disabled.

**NOTE: If you are planning without a brain mask, Modus Plan cannot prevent you from placing a target outside of the brain. However, if you place a target outside of the brain, or on the surface of the brain, the resulting trajectory will not be usable in BrightMatter Guide. Always place targets within the brain volume.**

Once you have added a target, the Set target point tool becomes available. To move a target, drag the spatial locator to the new location and click the Set target point tool icon in the viewport or in the phase panel.

# 4.5 Trajectories Phase

In the Trajectories phase, define the engagement point where you will enter the brain to reach a target during the procedure. The target and the engagement point together comprise a trajectory. You can create one engagement point for each target you created in the Targets phase. If necessary, you can adjust the location of your targets in the Trajectories phase.

You must create at least one complete trajectory before you can move to the next phase. You can return to this phase to adjust your trajectories if necessary.

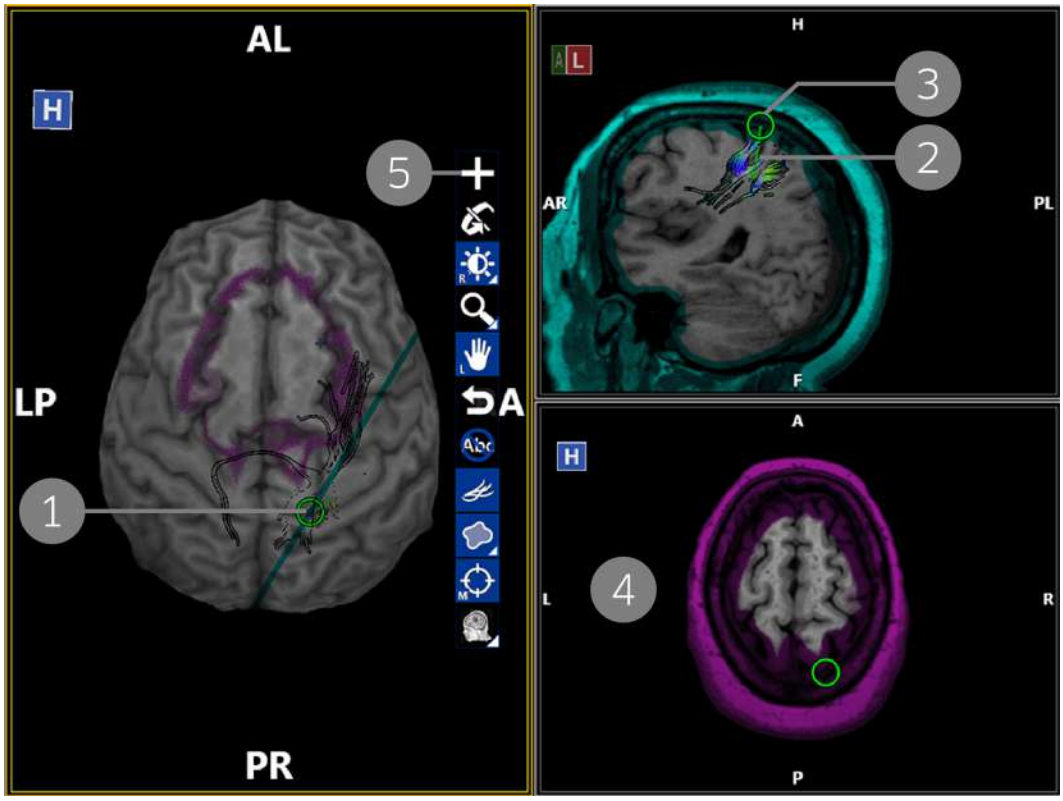



**Figure 60 Default viewport layout for placing engagement points**

1 Drag the spatial locator and observe the tractography to locate a suitable engagement point.
2 The projected trajectory between the target and the current position of the spatial locator is displayed as a colored line. The color corresponds to the color of this trajectory in the phase panel.
3 Adjust the **Mask** slider in the phase panel until the brain mask corresponds directly to the surface of the brain.
4 This viewport displays a trajectory-centric 2D view. Stack in this viewport to view the image slices as they intersect the proposed trajectory.
5 When you have located a suitable position for the engagement point, click the **Add** icon. This tool is also available in the phase panel.

**TIP: To toggle between showing all trajectories in the viewports or only the currently selected trajectory, right-click in a viewport and select Show all Trajectories or Show Only Active Trajectory. This feature is available in the Targets, Trajectories, and Craniotomy phases.**

## 4.5.1 The Trajectories Phase Panel

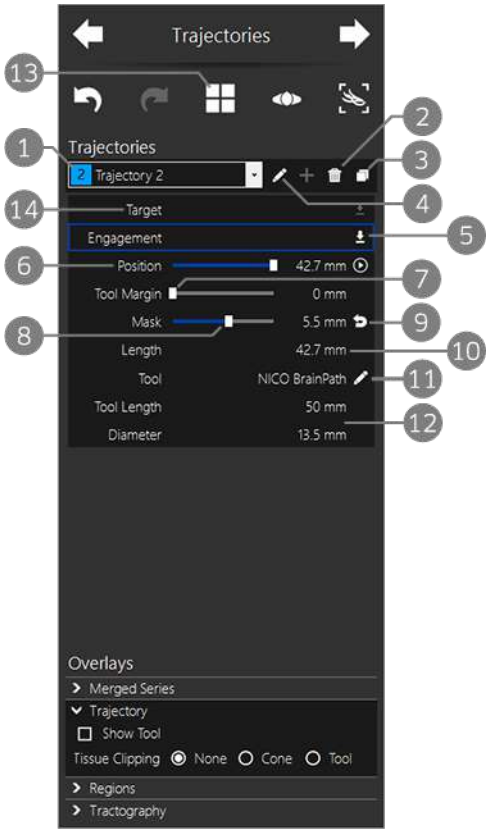



**Figure 61 Trajectories phase panel (after an engagement point has been created)**

1. Select the trajectory you want to create an engagement point for from the **Trajectories** list.
2. Delete this trajectory.
3. Create a new trajectory by copying the selected one.
4. Edit properties for the selected trajectory. Click to edit the trajectory name and color.
5. Set the engagement point location. Click to move the engagement point to the current spatial locator position. This option is also available as a tool in the active viewport.

   If an engagement point has yet not been created for this trajectory, the **Add** icon appears here.
6. Adjust the **Position** slider to simulate moving along the trajectory. For more information, see 4.5.4 About the Position Slider on page 69.
7. Add a margin to the tool graphic in the viewports. Use the slider to view the potential tract intersections over a larger area of the anatomy. The margin is an extension of the tool's radius.

   Use this feature to evaluate the impact of navigation error during the procedure and the risk of tool deflection for very fine tools.
8. Adjust the **Mask** slider until the brain mask corresponds directly to the surface of the brain in the viewports.
9. Reset the brain mask.
10. The length of the trajectory is displayed here.
11. Click this icon to open the tool selection dialog.
12. The length and diameter of your selected tool are displayed here.
13. Click this icon to view an alternate hanging protocol with four viewports; three display 2D orthogonal views and the fourth displays a trajectory-centric 2D view.
14. Click **Target** to adjust the target location for this trajectory. For more information, see 4.5.5 Adjusting a Target in the Trajectories Phase on page 69.

## 4.5.2 Placing an Engagement Point

To place an engagement point:

1. In the phase panel, select the trajectory you want to create an engagement point for.
2. In the left viewport, drag the spatial locator around the brain surface to locate a sulcus that provides good access to the target. If necessary, hide the tracts in this viewport to make the sulci more visible.

   Observe the tracts in the right viewports to assess the impact of the proposed trajectory.

When a brain mask exists for the study, the spatial locator in the left viewport is fixed to the surface of the brain (the only logical place to create an engagement point). You can move the spatial locator in the right viewport, but the nature of the 2D view may misrepresent the actual location of the engagement point that will be created.

In the 2D view, if you move the spatial locator off the brain mask, Modus Plan will correct for this by extending the proposed trajectory to the brain mask and creating the engagement point there. If you move the spatial locator too far from the surface of the brain, the spatial locator icon changes and the Add icon is disabled in the viewport and the phase panel.

**NOTE: If a brain mask does not exist for the study, the default engagement point created by Modus Plan will be on the skin surface not the brain. Always move the default engagement point to an appropriate location on the surface of the brain in the right viewports to ensure that the resulting trajectory length is accurate for the procedure. If the engagement point is placed too close to the skin surface, or outside of the skin surface, Modus Plan will not be able to create a craniotomy for the trajectory.**

3. In the right viewports, verify that the brain mask is accurate. If necessary, adjust the Mask slider in the phase panel to dilate or erode the mask to correspond to the brain surface.

   As a result of changing the brain mask, you may need to repeat the previous step to locate the best location for the engagement point.

4. When you are satisfied with the position of the spatial locator, click the **Add** icon in the viewport or in the phase panel to add an engagement point at the spatial locator position.

5. Click the pencil icon beside the Tool item in the phase panel to open the Tool Selection dialog.

   Select a tool type from the list on the left, then select or enter the tool specifications in the options on the right.

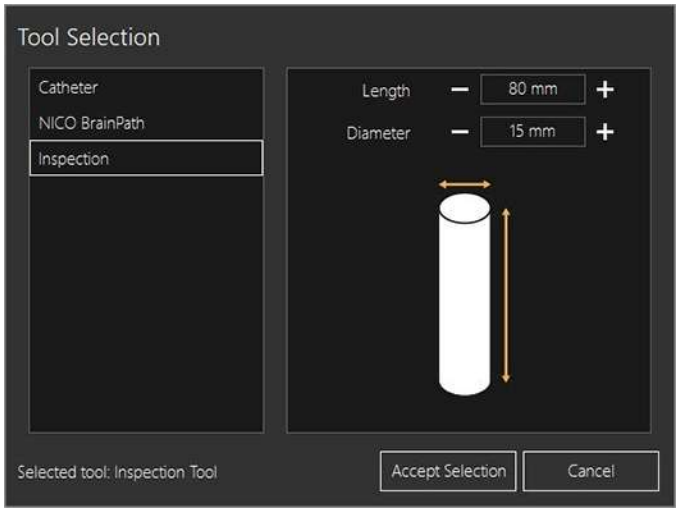



**Figure 62 Tool Selection dialog**

**NOTES:**

- **If you select a NICO tool and the tool you select is shorter than the trajectory, Modus Plan displays a notification recommending that you select a longer tool.**

- If you select a very small tool, such as a custom tool with a 1 mm diameter, for the best accuracy it is recommended that you apply a tool margin when reviewing the trajectory for intersecting tracts.
- The following tools are **not** available for use with BrightMatter Guide. You can select these tools to visualize their effect during a procedure, but they will not be exported with the plan. When you open the plan in BrightMatter Guide, the trajectory will contain an adjustable tool and will use the default craniotomy for an adjustable tool.
  - NICO BrainPath ports 11 mm in diameter
  - NICO BrainPath ports 95 mm in length
  - Inspection tools

## 4.5.3 Adjusting an Engagement Point

Once you have added an engagement point, the Set Engagement Location tool becomes available. To move an engagement point, drag the spatial locator to the new location and click the **Set Engagement Location** tool icon in the viewport or in the phase panel.

Optionally, in the Trajectories overlay options, select **Show Tool** to display the interventional device in the viewports. The trajectory runs down the center of the device graphic with the target fixed at the tip. Drag the grip ring and observe the tractography to evaluate possible trajectories. When you find a suitable trajectory, click the **Set Engagement Location** tool icon in the viewport or in the phase panel.

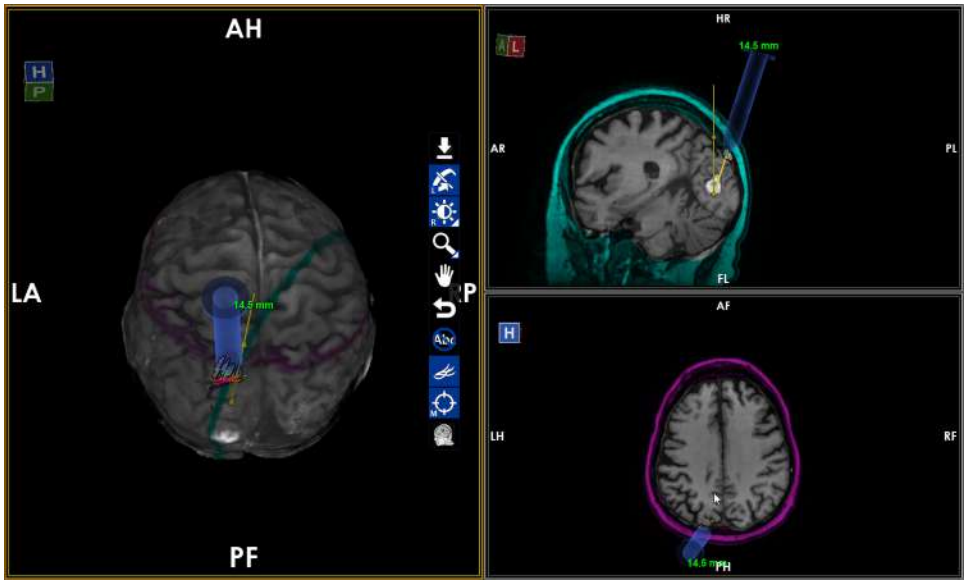



Figure 63 Viewports in the Trajectories phase showing the NICO tool overlay graphic

NOTE: Modus Plan uses the brain mask to determine the location of the surface of the brain for distance to target calculations. Once you have created an engagement point for a trajectory, if you subsequently change the brain mask setting for the trajectory, Modus Plan moves the engagement point to correspond to the new brain surface location. You must confirm this new location by clicking the Set Engagement Location tool icon in the viewport or in the phase panel.

### 4.5.4 About the Position Slider

Use the Position slider to simulate the movement of the tool along the selected trajectory. When the slider is at its leftmost point (0 mm), the tool is at the engagement point; at its rightmost point, the tool is at the target point. The tool's distance from the engagement point is displayed beside the slider (in mm).

Click the play icon beside the Position slider to animate flying through the trajectory. The animation begins at the skin surface and continues until the tool is 10 mm past the target.

When the Position slider is selected, the Stack viewport tool in 2D views changes to the Trajectory Stack tool. Use this tool to stack through images perpendicular to the trajectory.

### 4.5.5 Adjusting a Target in the Trajectories Phase

As you search for a good engagement point, you may find that it is necessary to move the location of a target. You can do this directly in the Trajectories phase:

1. In the phase panel, select the trajectory whose target you want to edit, and then click **Target**.
2. In one of the viewports, move the spatial locator to the location where you want to move the target.
3. Click the **Set Target Location** tool icon in the viewport or in the phase panel.

### 4.5.6 Copying a Trajectory

You can create a new trajectory by copying an existing one. To copy a trajectory, select it in the phase panel, and then click the **Copy** icon (item 3 in Figure 61). The new trajectory's target and engagement points, mask, and tool settings, are all identical to the trajectory you copied.

## 4.6 Craniotomy Phase

In the Craniotomy phase, plan the craniotomy for the surgical procedure and verify that you will be able to reach the full extent of the target with the interventional device. Modus Plan automatically draws a proposed craniotomy for each trajectory in your plan based on the location of the target and the size of the tool selected for the trajectory. You can adjust the size of the craniotomy, but not its location.

**IMPORTANT: Specifying a craniotomy that is too small may prevent sufficient movement of the interventional device.**

When you are satisfied that the craniotomy is the correct size for the procedure, proceed to the Export phase to export a plan.

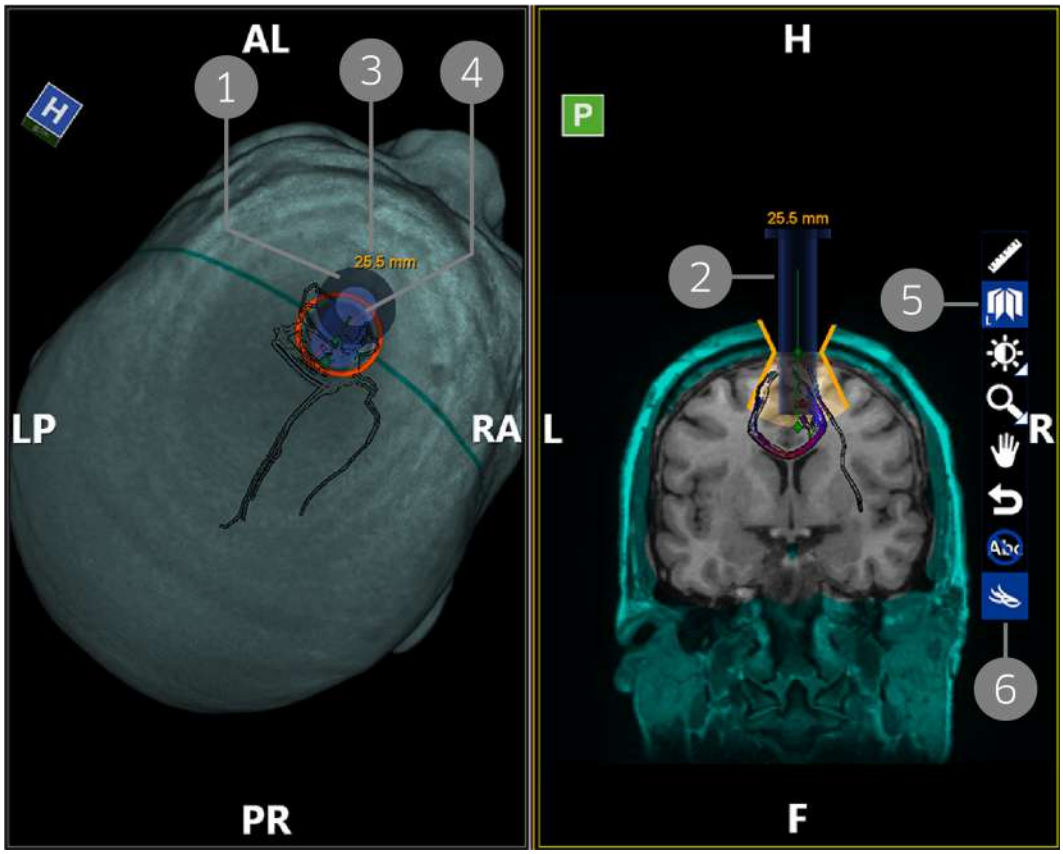
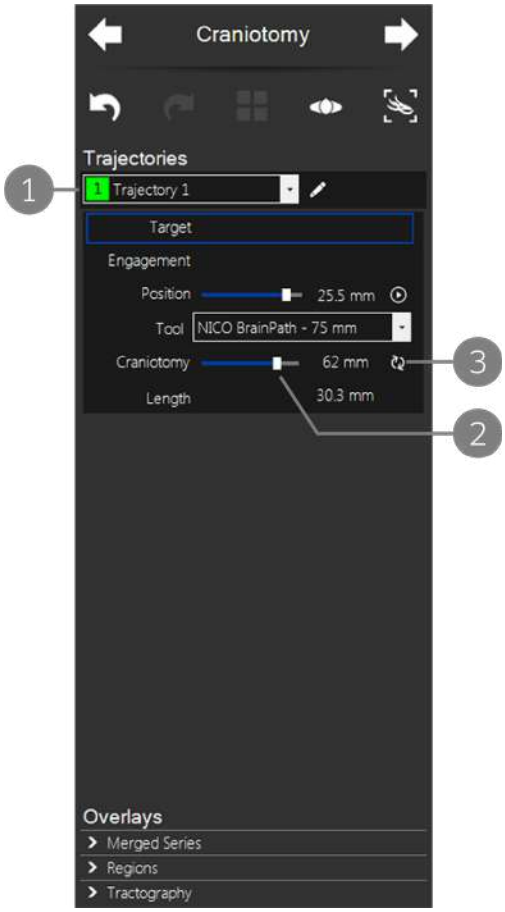



Figure 64 Viewport layout for planning a craniotomy

1 Drag the grip ring on the tool graphic to simulate the reach of the tool. Observe the results in the right viewport.
2 Drag the body of the tool graphic up and down to simulate cannulation.
3 The depth to the target is displayed in the viewport overlay.
4 The craniotomy size is reported as the major axis of an ellipse.
5 Use the radial stack tool in the right viewport to verify that the tool can reach all parts of the region.
6 Show the tractography to see which tracts intersect the path of the interventional device.

### 4.6.1 Craniotomy Phase Panel

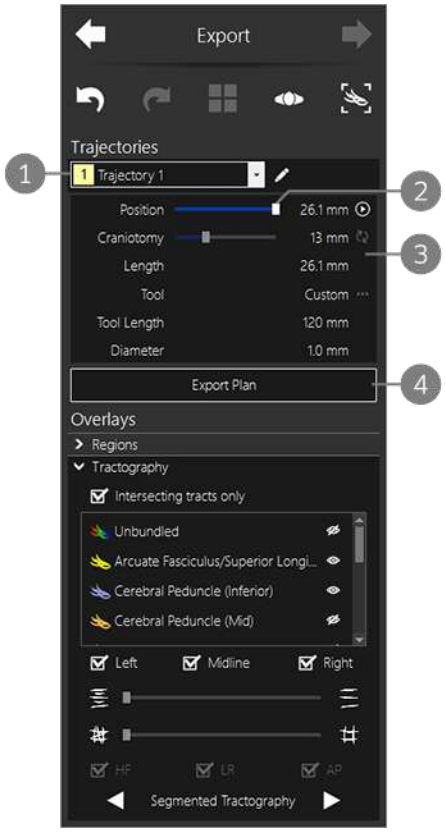



1 Select the trajectory you want to plan a craniotomy for.
2 Adjust the **Size** slider to change the size of the craniotomy.
3 Click to recalculate the craniotomy size Modus Plan estimated for this trajectory.

Figure 65 Craniotomy phase panel

## 4.7 Export Phase

In the Export phase, you can do a final review of your trajectories and, if you are satisfied, you can export a navigation plan for each trajectory.




1 Select the trajectory you want to export a plan for.

2 Adjust the Position slider to move the tool along the trajectory. For more information, see 4.5.4 About the Position Slider on page 69.

3 Information about the trajectory appears here. You cannot edit the tool or craniotomy size in this phase. If you want to change these values, go back to the Craniotomy phase.

4 Click **Export Plan** to export a plan for this trajectory.

Figure 66 Export phase panel

## 4.7.1 Exporting a Plan for a Trajectory

**NOTE: Once a trajectory has been exported, it can no longer be edited. This is a safety measure to ensure that an incorrect version of a plan is not mistakenly used. However, you can use the Copy feature in the Trajectories phase to make a copy of the exported trajectory and edit that.**

To export a plan:

1. From the Trajectories list in the phase panel, select the trajectory you want to export a plan for then click **Export Plan**.

   **NOTE: If you selected a NICO BrainPath tool for this trajectory, and the trajectory is longer than the tool, a dialog appears asking you to confirm that you want to export the trajectory. Click Yes to continue with the export.**

2. In the Name Plan and Select Destinations dialog, enter a name for the plan, select your export options, and then click **Next**.

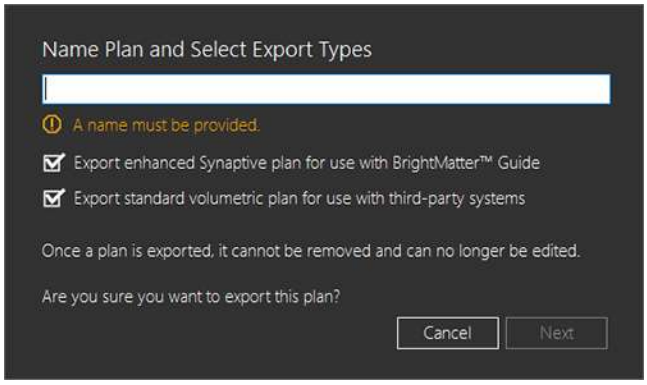



**Figure 67 Name Plan and Select Destinations dialog**

You can export a plan for use with Guide or export a standard volumetric plan for use with third-party systems, or both.

**NOTE: In the volumetric plan, the target and engagement point are indicated by a bright white spot with a black background. The volumetric plan has the same name as the default exported plan with the word "VOLUME" added into it.**

3. Specify the location (or locations) where you want to export the plan.

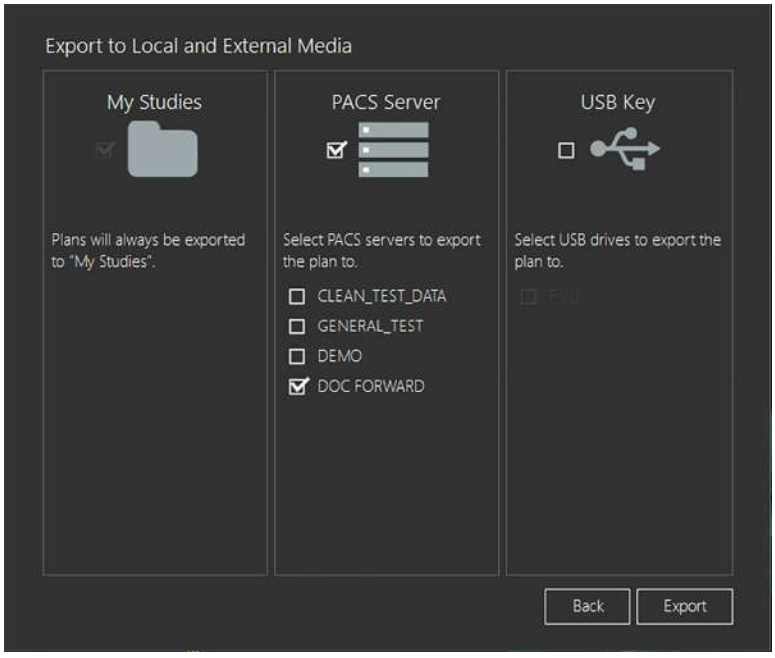



**Figure 68 Plan export options**

**My Studies**: This option is always selected.

**PACS Server**: Select this option if you want to export the plan to one or more PACS servers then select the server (or servers) you want to export to.

**NOTE: If you have configured one or more servers as your default servers, they will automatically be selected. For information about configuring default servers, see 8.2 System Configuration on page 94.**

**USB Key**: This option becomes available when one or more USB flash drives are connected to the Plan computer. Select this option if you want to export to a USB flash drive, then select the drive (or drives) you want to export to.

**NOTE: Do not remove the flash drive from the Modus Plan computer before the export is complete. Due to the limitations inherent in the FAT32 file system, it is not recommended that you use a USB flash drive formatted with that file system.**

4. Click **Export**.

When you export a plan, Modus Plan creates a new series in the study with the following images:

- Target references – axial, sagittal, and coronal renderings centered on the target with the trajectory projected on the slice
- Trajectory references – axial, sagittal, and coronal renderings centered on the engagement point with the trajectory projected on the slice
- A craniotomy reference – a 3D rendering of the skull, engagement point, and planned extent of the craniotomy
- A list of any series that were merged with the primary series
- An image of each region and tract bundle that were created as part of the plan

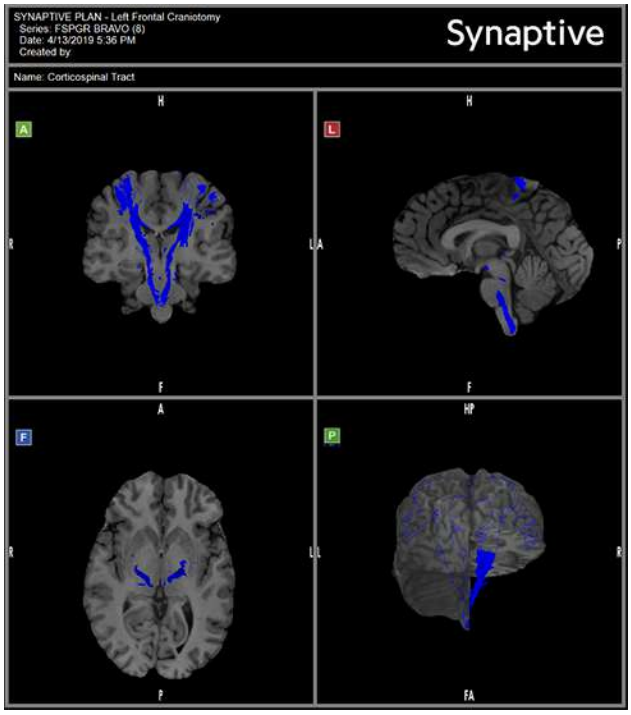



**Figure 69 Bundle image example**

You can open a plan in Investigate mode to review its details and/or forward the plan to ImageDrive Clinical or another PACS for review or reference.

**NOTE: When you import the plan into a navigation system, always review the series in the plan before starting the procedure to ensure the imported data matches the clinical intent of the plan.**

## 4.8 Exporting Tractography

Use the Export Tractography feature to generate a DICOM series of the tractography data. The generated series includes the tractography as it is currently displayed in the viewports (tract culling values and bundle visibility are preserved). The data is always generated in the acquisition plane of the target series, not in the plane of the selected viewport. For example, if the target series was captured from left to right, then the generated series will be L-R.

The generated series can contain the whole brain tractography or tract bundles.

NOTES:

- **This feature is only available if you have accepted the tractography in the Review phase.**
- **This feature is available in all phases except the Merged Series phase.**
- **Tractography export is designed for use with third-party systems that can display volumetric DICOM data; it is not the same as exporting a plan.**

To export tractography:

1. Use the tools in the Tractography overlays options to set up the tractography in the viewport as you want to export it.
   - If you select **Whole Brain Tractography**, all tracts will be included.
   - If you select **Segmented Tractography**, only bundled tracts will be included. If you do not want to exclude a tract bundle from the export, hide the bundle in the phase panel.
2. Click the Export Tractography icon in the phase panel.

   **Figure 70 Export Tractography icon**
3. In the **Export Tractography** dialog:
   - If you are exporting the segmented tractography, from the **Mode** drop-down list, select whether to export all the bundles in a single series, or each bundle in its own series.

     If you are exporting the whole brain tractography, there are no options available in the **Mode** list.
   - Select the **Color Setting** for the series: color or grayscale.
   - If you are exporting the whole brain tractography, or the segmented tractography in a single series, enter a name for the generated series.

     If you are exporting the segmented tractography with each bundle in its own series, the series are automatically named with the bundle names.

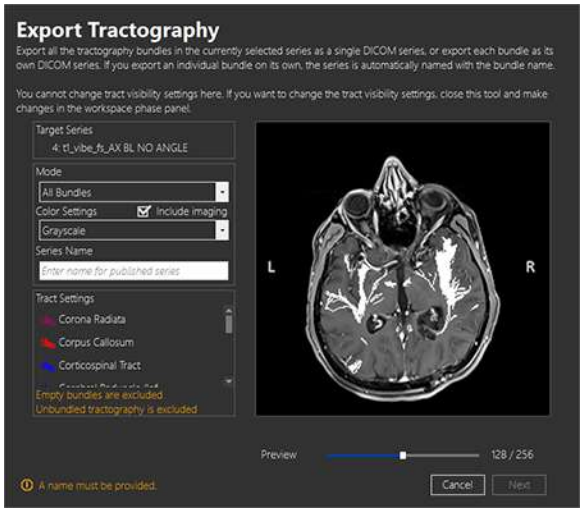
   
   

   **Figure 71 Export Tractography dialog**
   - Drag the **Preview** slider to view the image slices. The preview area displays the total number of image slices in the series and automatically updates when you change the color.
   - Use the Tract Settings information to verify that the correct tracts will be included in the export. Note that you cannot make changes to the tract settings in the Export Tractography dialog. If you want to make changes to the tract settings, click **Cancel** to close the dialog, and then make the necessary tract adjustments in the phase panel.
4. Click **Next**.

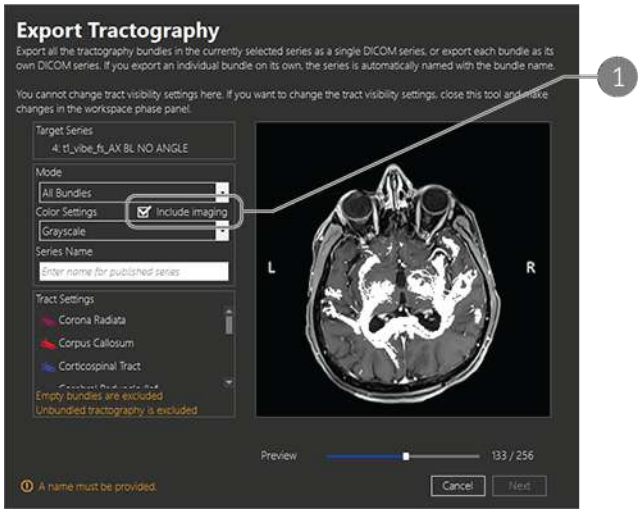
5. In the Publish to Local and External Media dialog, specify the location (or locations) where you want to send the generated DICOM series and then click **Publish**.

# 5.0 Optional Surgical Planning Features

This section describes separately-licenseable features in Modus Plan. For information about enabling these features, contact Synaptive customer support.

## 5.1 Tract-Only Tractography Export

Use the tract-only tractography export feature to export the selected tractography and not the background image data. For complete information about exporting tractography, see 4.8 Exporting Tractography on page 74.




1 This option becomes available when the tract-only tractography export feature is licensed in Modus Plan.

To export tractography that includes only tracts and not the background image data, make sure this option is **not** selected.

**Figure 72 Export Tractography dialog**

## 5.2 Automatic Tractography Segmentation

When the automatic tractography segmentation feature is enabled, Modus Plan automatically generates the following tract bundles when processing the series for planning:

- Arcuate Fasciculus/Superior Longitudinal Fasciculus
- Cerebellar Peduncle (Inferior)
- Cerebellar Peduncle (Middle)
- Cerebellar Peduncle (Superior)
- Cingulum
- Corona Radiata
- Corpus Callosum

- Corticospinal Tract
- Fornix
- Inferior Fronto-Occipital Fasciculus
- Inferior Longitudinal Fasciculus
- Optic Radiations
- Uncinate Fasciculus

## Working with Automatically Segmented Bundles in the Review Phase

You must review and accept the automatically segmented bundles in the Review phase in order to see them in subsequent phases.


**Figure 73 Reviewing and accepting automatic tractography segmentation**

1 The automatically segmented tract bundles appear in the Tractography overlays options.

2 Click this icon to toggle the visibility of the tract bundles and unbundled tractography.

3 If you are satisfied with the automatically segmented tract bundles, select this option and proceed with reviewing and accepting the other tractography.

NOTE: If you want to make changes to the automatically segmented tract bundles you can edit them in the Segmentation phase, but you must first accept them in the Review phase.

IMPORTANT:

- **The quality of the tract bundles created by the automatic tractography segmentation feature depends on a number of factors including the patient's anatomy and the scan quality. Always review the tract bundles carefully and adjust if necessary. For more information, see 4.3.3 Working With Tract Bundles on page 60.**
- **For additional important information about reviewing tractography, see 4.1.3 Tractography on page 47.**

## Working with Automatically Segmented Bundles in the Segmentation Phase

The automatic tractography segmentation feature changes some features in the Segmentation phase. For complete information about working with bundles in the Segmentation phase, see 4.3.3 Working With Tract Bundles on page 60.

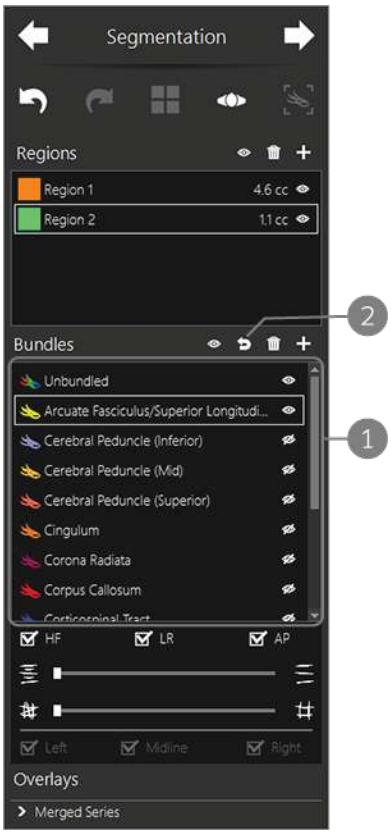



**Figure 74 Segmentation phase panel showing automatic tractography segmentation features**

1 Automatically segmented bundles, and all other unbundled tracts, appear in the phase panel.

2 When editing an automatically segmented bundle, you can undo your edits and restore the bundle to its automatically-generated state by clicking the reset icon.

NOTE: Resetting a bundle might affect other bundles. If tracts were moved from this bundle to another bundle, they will be removed from that bundle and restored to this one.

### Affinity Slider Behavior for Automatically Segmented Tract Bundles

Bundles that were automatically segmented by Modus Plan when the series was processed for planning (and have not been edited) are defined by the processing algorithm. The slider's original position is set at the middle of its range to account for a margin of error during processing. You can move it left or right to show more or fewer tracts to more accurately represent that bundle.

When you modify an automatically segmented bundle using the tract selection rings or region intersection tool, Modus Plan resets the Affinity slider to the far left of its range and you can only move it to the right to hide tracts with a lesser affinity to the current group of tracts in the bundle.

# 6.0 Working in Investigate Mode

Use Modus Plan Investigate mode to review images before creating a surgical plan or to view a surgical plan created in Plan mode.

## 6.1 Opening Studies in Investigate Mode

To open a study in Investigate mode, double-click on the study in Explorer and select **Investigate**. The study and any prior studies associated with it open in the Investigate workspace.

How the study appears in the workspace (for example, the number of viewports visible and what they display) depends on several Modus Plan options, such as hanging protocol configuration and layout configuration options.

## 6.2 About the Investigate Workspace

The Modus Plan Investigate workspace consists of the toolbar, one or more viewports, and panels for working with various Modus Plan features.

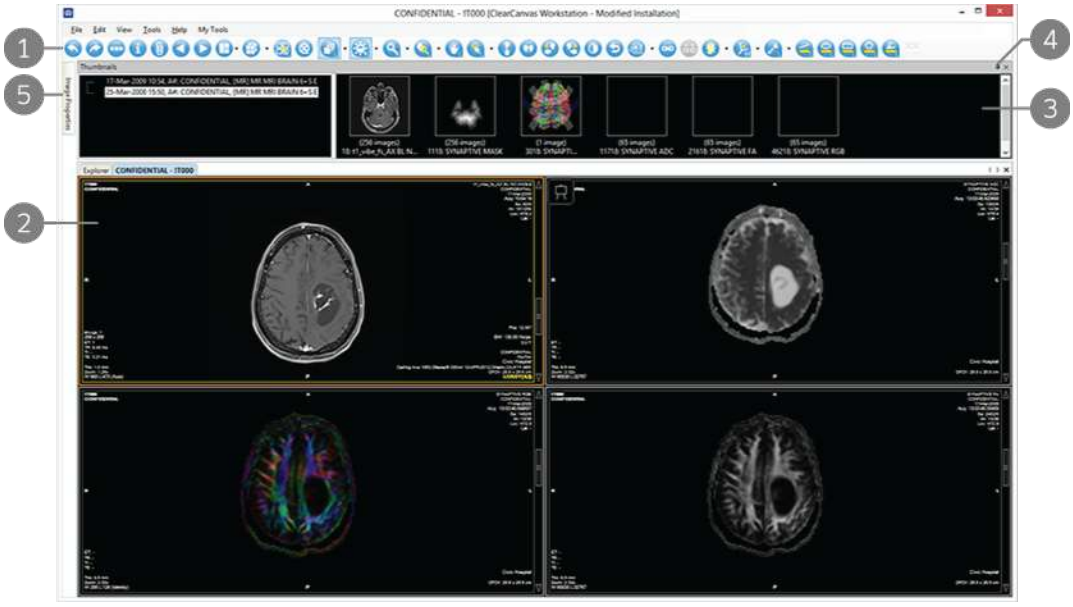



**Figure 75 The Investigate workspace**

1 Investigate toolbar.

2 Viewports. The active viewport is highlighted with an orange border. If the series contains multi-frame images, the viewport may display the images in “tiles”. The active tile is highlighted in yellow.

3 An open "pinned" panel.

4 Click the pin icon to hide a panel. You can also double-click the panel title bar to undock the panel and display it in a separate, moveable, window. Double-click the title bar again to dock the panel in the workspace again.

5 An "unpinned" panel. Unpinned panels appear as tabs in the workspace. Mouse over the tab to open the panel.

The panel remains open while you are working in it. When you click away from the panel, for example in a viewport, the panel slides away to the edge of the workspace.

To keep a panel displayed at all times, click the pin icon to "pin" it to the workspace.

## 6.3 Using the Thumbnails Panel to Open a Series in a Viewport

The Thumbnails panel displays the open studies and thumbnails of the series they contain. Click **Show Thumbnails** in the toolbar to open the Thumbnails panel.

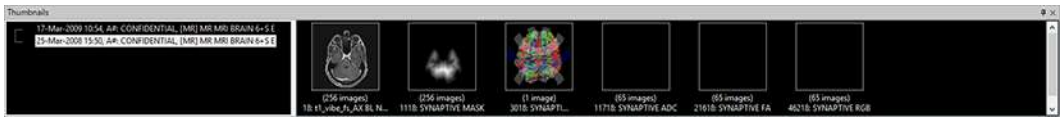



**Figure 76 Thumbnails panel**

The open studies, and any prior studies associated with them, appear in the left pane, grouped by patient ID. Expand the patient ID node to view the open studies. Select a study to view its series thumbnails in the right pane.

Drag a thumbnail into a viewport to open the series.

## 6.4 Viewport Layouts

You can specify the default number of viewports and their configuration in the workspace on the Layout Preferences page (for more information, see 8.4.4 Layout on page 105).

To change the number and arrangement of viewports in the workspace, click **Change Layout** in the toolbar. Click and drag over the boxes to select the desired viewport arrangement.

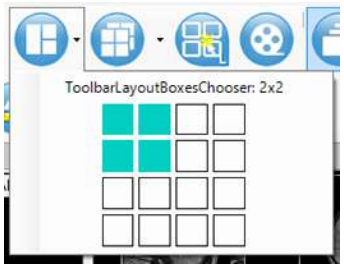



**Figure 77 Selecting a viewport arrangement**

# 6.5 Viewport Overlays

Modus Plan displays supporting information over-top of the image in a viewport. This can include text from the DICOM headers in the study, a scale ruler, and other image data.


**Figure 78 Viewport overlays**

The Text overlay displays information from the DICOM data for the series. This includes information about the patient, the study, the scanner, and the image series.

To show or hide the viewport overlay text, click the arrow beside the Image Overlays icon in the toolbar and select or deselect the **Text** option.

# 7.0 Investigate Mode Tools

## 7.1 Working with Tools

You can access Investigate mode tools in the following ways:

- Clicking the tool in the toolbar
- Selecting the tool from one of the sub-menus in the Tools menu
- Right-clicking in the viewport and selecting the desired tool from the context menu
- Using the keyboard shortcut (not available for all tools)

### 7.1.1 Assigning a Tool to a Mouse Button

By default, certain tools are mapped to the left and right mouse buttons in each workflow phase, but many tools can be temporarily assigned to a mouse button.

To assign a tool to a mouse button, click the tool in the toolbar with the mouse button you want to use. Clicking in the image with that mouse button now performs the function associated with the tool.


**Figure 79 Tools assigned to mouse buttons**

When a tool has been assigned to a mouse button, the toolbar icon for the tool is highlighted and displays the letter corresponding to the mouse button it has been assigned to (left, right, middle, and others). For mouse devices with five buttons, the buttons on the left and right edges of the mouse are indicted by the numbers 4 and 5.

### 7.1.2 Using Keyboard Shortcuts

Many tools have keyboard shortcuts assigned to them. Mouse over the tool in the toolbar to see the keyboard shortcut for that tool. The tool icon indicates which mouse button the tool will be assigned to when you press the associated key. For example, the Zoom tool will be assigned to the left mouse button when you press the Z key.

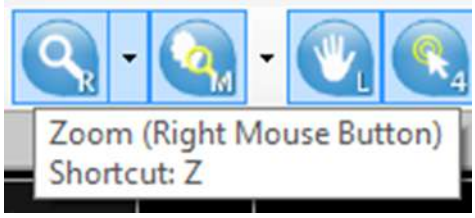



**Figure 80 Keyboard shortcut information for the Zoom tool**

For a list of the default keyboard shortcuts, see 10.0 on page 114.

### 7.1.3 Accessing Tool Options

A drop-down arrow appears beside tools that have options associated with them. Click the arrow to select an option to use with the tool.

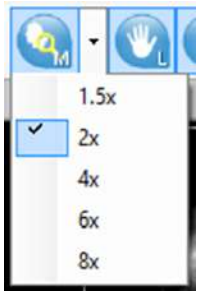



**Figure 81 Magnification tool options**

## 7.2 Standard Image Tools

Use the following tools to adjust the image in the active viewport.

**Table 5 Standard Image Tools**

| | Tool | Description |
|---|---|---|
|  | Survey/Explode | Displays the active viewport in the full screen. Select the tool again to restore the original viewport configuration.<br>You can also double-click in a viewport to open it in the full screen. Double-click in the viewport again to restore the original viewport configuration. |
|  | Cine | Opens a player that animates stacking through the slices in the series. For more information, see 7.2.1 Using the Cine Player on page 86. |
|  | Stack | Click and drag the mouse up or down to stack through the slices in the series.<br>• Click and drag the mouse up or down to decrease or increase the slice index.<br>• Click and drag the mouse left or right to stack through volumes.<br>**NOTE: You can also use the mouse scroll wheel to stack.** |

Table 5 Standard Image Tools (continued)

| | Tool | Description |
|---|---|---|
|  | Window/Level | Click and drag the mouse in the image to adjust the window contrast and brightness.<br>• Drag the mouse left or right to adjust the window (contrast) value.<br>• Drag the mouse up or down to adjust the level (brightness) value.<br>If window/level presets have been configured, click and hold on tool to select a preset.<br>**NOTE: The window/level settings may cause sulci to appear wider and deeper than they are.** |
|  | Pan | Click and drag the mouse to move the image in any direction in the viewport. |
|  | Zoom | Zoom in or out of the image.<br>• Drag the mouse up to zoom in.<br>• Drag the mouse down to zoom out.<br>**NOTE: Modus Plan may be configured to reverse these directions. For more information about specifying preferences for tools, see 8.4.7 Tools on page 108.**<br>Click and hold on this tool to select a discreet magnification factor. |
|  | Magnification | Magnifies the area of the image immediately under the mouse. |
|  | Probe | Displays the characteristics of a specific voxel. |
|  | Flip Vertical | Flips the image vertically. |
|  | Flip Horizontal | Flips the image horizontally. |
|  | Rotate Counter-clockwise | Rotates the image counter-clockwise. |
|  | Rotate Clockwise | Rotates the image clockwise. |
|  | Invert | Inverts the colors in the image. |

Table 5 Standard Image Tools (continued)

| | Tool | Description |
|---|---|---|
| | Reset | Resets the image to its original parameters (zoom, pan, flip, rotation). |
| | Hide Overlays / Show Overlays | Click to hide the viewport overlays. When this tool is active, it changes to the Show Overlays tool. Click it to show the viewport overlays.<br>Click and hold on this tool to select specific overlay elements to show or hide. |
| | Add Text | Adds a text box to the image. For more information, see 7.2.2 Adding Annotations on page 87. |
| | Add Text Callout | Adds an arrow with a text box to the image. For more information, see 7.2.2 Adding Annotations on page 87. |
| | Previous Display Set | Opens the previous series in the study in the viewport. |
| | Next Display Set | Opens the next series in the study in the viewport. |

## 7.2.1 Using the Cine Player

Use the Cine player to view an animation of stacking though the images in the series.

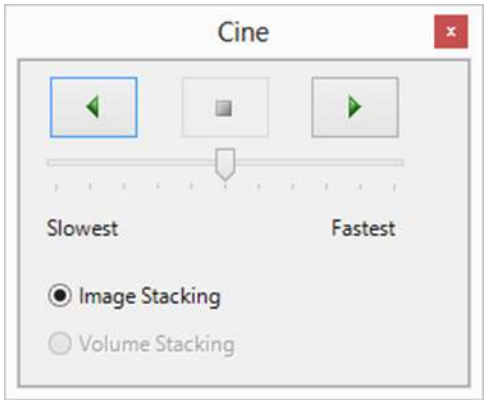



Figure 82 Cine player

- Click the forward or reverse icons to start stacking through the images.
- Click the stop icon to stop.
- Move the slider left or right to slow down or speed up the animation.

## 7.2.2 Adding Annotations

Use the text annotation tools to add comments to an image.

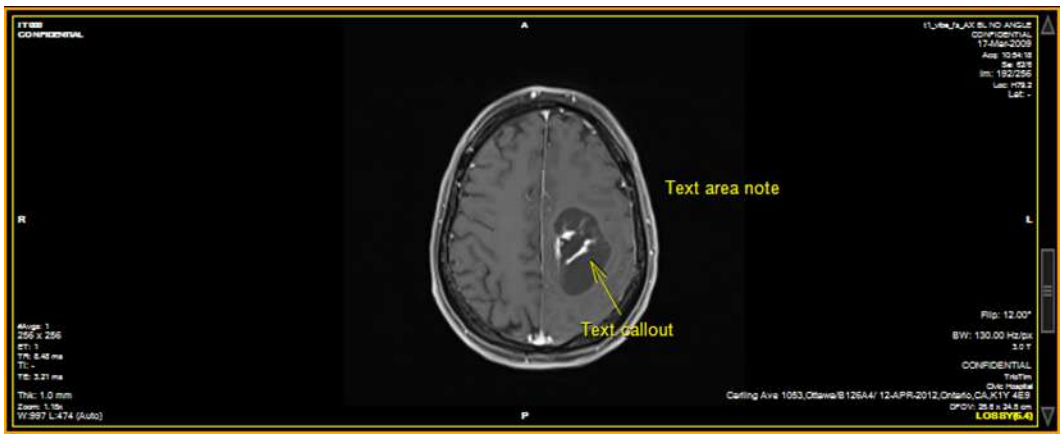



**Figure 83 Image with text and a text callout**

### 7.2.2.1 Add Text to an Image

To add text to an image:

1. Click the **Add Text** tool in the toolbar (if necessary, click the drop-down arrow beside the Add Text Callout tool and select the **Add Text** tool).
2. Click in the viewport.
3. Type your text then press Enter.
4. If necessary, click and drag the text to move it to the appropriate location on the image.

To edit the text, double-click on the text, or right-click on the text and select **Edit**.

### 7.2.2.2 Add a Text Callout to an Image

A text callout is a text box with an arrow connected to it.

To add a text callout to an image:

1. Click the Add Text Callout tool in the toolbar (if necessary, click the drop-down arrow beside the Add Text tool and select the Add Text Callout tool).
2. Click in the viewport at the location where the arrow will point.
3. Click again in another location (there arrow will end here).
4. Type your text then press Enter.
5. If necessary, you can click and drag the arrow point and/or the text to move it to a more appropriate location on the image.

To edit the text, double-click on the text, or right-click on the text and select **Edit**.

# 7.3 Measurement Tools

Use the measurement tools to measure features or to view information about a particular region of interest (ROI) in an image. The measurement tools create annotations on the image with the relevant information.

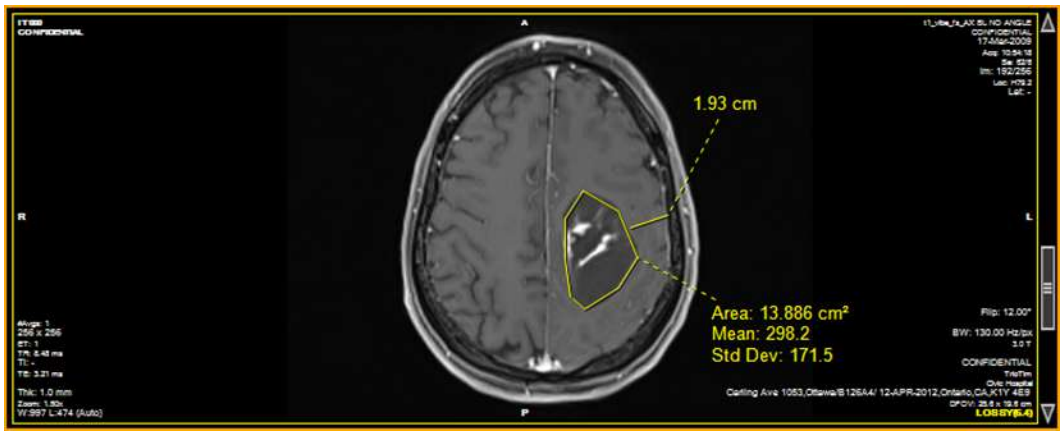



**Figure 84 Image with measurement annotations**

To use a measurement tool, assign the tool to a mouse button and click in the image using that mouse button. For more information, see 7.1.1 Assigning a Tool to a Mouse Button on page 83.

To stop creating measurement annotations, assign another tool to the mouse button.

**Table 6 Measurement Tools**

| | Tool | Description |
|---|---|---|
|  | Ruler | Draws a line on the image and displays its length. For more information, see 7.3.1 Using the Ruler and Protractor Tools on page 89 below. |
|  | Protractor | Draws an angle and displays its size. For more information, see 7.3.1 Using the Ruler and Protractor Tools on page 89. |
|  | Elliptical ROI | Draws an ellipse on the image and displays information about the area it contains. For more information, see 7.3.3 Creating Elliptical and Rectangular ROIs on page 89. |
|  | Rectangular ROI | Draws a rectangle on the image and displays information about the area it contains. For more information, see 7.3.3 Creating Elliptical and Rectangular ROIs on page 89. |
|  | Polygonal ROI | Draws a freehand polygon on the image and displays information about the area it contains. For more information, see 7.3.4 Creating Polygonal ROIs on page 89. |

### 7.3.1 Using the Ruler and Protractor Tools

To use the Ruler tool:

1. Assign the tool to a mouse button.
2. Click in the image where you want to start the measurement.
3. Move the mouse to where you want to end the measurement and click again to complete the line. The length of the line (in centimeters) appears in the annotation.

To use the Protractor tool:

1. Assign the tool to a mouse button.
2. Click in the image where you want to start the first line
3. Move the mouse to where you want to place the angle vertex and click again to complete the line.
4. Move the mouse to where you want the second line to end and click again to complete the line. The size of the angle between the two lines (in degrees) appears in the annotation.

### 7.3.2 About Regions of Interest (ROIs)

Use the ROI tools to view information about a specific region of an image. When you create an ROI, the area and the voxel intensity statistics (mean and standard deviation) of the ROI are displayed in the ROI text label. To hide the text label, right-click on the text and deselect the **Show Analysis** option. To show the text again, right-click on the ROI name and select the **Show Analysis** option.

### 7.3.3 Creating Elliptical and Rectangular ROIs

To create an elliptical or rectangular ROI:

1. Assign the Elliptical ROI or the Rectangular ROI tool to a mouse button.
2. Click in the image where you want to start the ROI.
3. Move the mouse until the ROI surrounds the area of interest.
4. Click again to complete the ROI.

### 7.3.4 Creating Polygonal ROIs

The Polygonal ROI tool creates a polygonal region of interest with any number of sides.

To draw a polygonal ROI:

1. Assign the Polygonal ROI tool to a mouse button.
2. Click on the image to start the first line, then move the mouse to where you want the line to end and click again.
3. Move the mouse to where you want the next line to end and click again. Repeat this process to create the sides of the polygon (each line starts where the last line ended).
4. To complete the polygon, join the end of the last line to the start of the first line, or double-click.

# 7.4 Working with Annotations

## 7.4.1 Resizing ROIs and Lines

ROIs and lines are displayed with square "handles" at their edges or endpoints. These are visible when you mouse over the annotation. To resize an ROI or line, click on a handle and drag it to a new location.

## 7.4.2 Moving an Annotation

To move an ROI, line, or text annotation, click on the annotation you want to move and drag it to a new location.

**NOTE: Text labels can be moved independently of the ROI or line they are connected to. Move text labels as necessary to avoid obscuring details in the image.**

## 7.4.3 Deleting Annotations

To delete a single ROI or annotation, right-click the object and select **Delete** from the context menu.

To delete all the ROIs and annotations, right-click anywhere in the viewport and select **Delete all Annotations** from the context menu.

**NOTE: All annotations on all images in the series will be deleted, not just the annotations currently visible. No confirmation dialog is displayed before the annotations are deleted.**

# 7.5 Synchronization Tools

The synchronization tools link two or more viewports together to assist in cross-referencing images.

**Table 7 Synchronization Tools**

| | Tool | Description |
|---|---|---|
|  | Synchronize Stacking | Links viewports for synchronized stacking. For more information, see 7.5.1 Synchronizing Viewports on page 91. |
|  | Unlink Studies / Link Studies | Unlinks or links viewports that contain series from different studies. For more information, see 7.5.1 Synchronizing Viewports on page 91. |
|  | Reference Lines | Adds reference lines to non-active viewports. For more information, see 7.5.3 Working with Reference Lines on page 91. |
|  | Spatial Locator | Adds persistent crosshairs to all viewports. For more information, see 7.5.4 Working with the Spatial Locator on page 92. |

### 7.5.1 Synchronizing Viewports

When synchronized stacking is enabled, viewports are linked so that they stack in tandem. Other image manipulations, such as panning, zooming, and rotations, are also applied simultaneously to all linked viewports.

When you click the Synchronized Stacking tool in the toolbar, all viewports containing series in the same orientation (axial, coronal or sagittal) are linked based on the image DICOM coordinates.

### 7.5.2 Synchronization When Viewports Contain Series from Different Studies

You can use the Synchronize Stacking tool to link viewports that contain series from different studies. If the studies were created at different times, however, it is likely that they will have different frames of reference and the default synchronization will not be adequate. To account for the offset between the frames of reference, use the Unlink Studies and Link Studies tools to manually adjust the synchronization.

To adjust synchronization between studies:

1. Open a series from each study in a viewport and ensure they are all in the same orientation.
2. Click the Synchronized Stacking tool in the toolbar.
3. Click the Unlink Studies tool in the toolbar.
4. Manually stack through the images in each viewport until they all display the same point of reference.
5. Click the Link Studies tool in the toolbar to re-link the studies.

### 7.5.3 Working with Reference Lines

The Reference Lines tool displays yellow lines on any non-active viewports that are in a different orientation than the active viewport. These lines correspond to the image in the active viewport. There are three reference lines: one for each of the first and last images in the active viewport, and one for the current image in the active viewport.

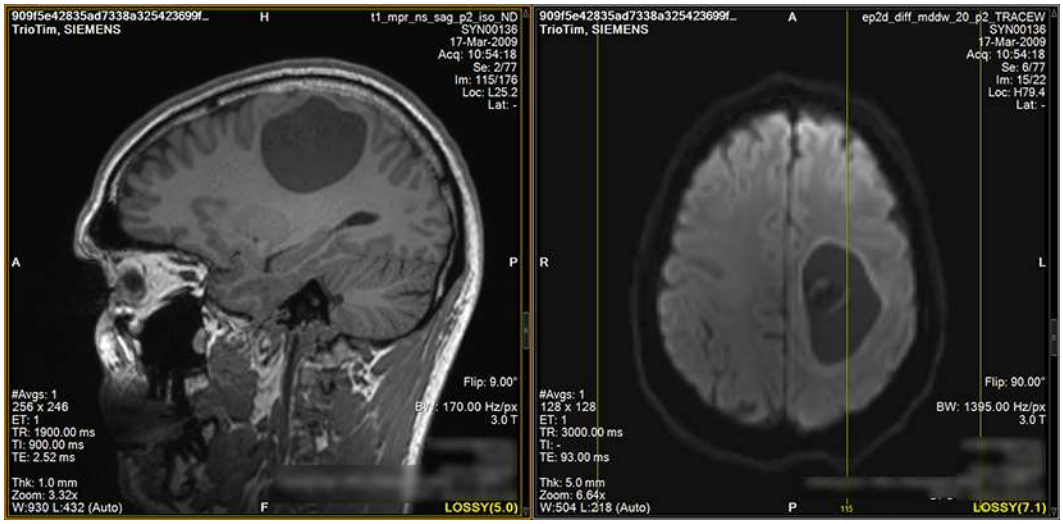



Figure 85 Reference lines (displayed in right viewport)

When you stack through the images in the active viewport, the reference line corresponding to the current location moves in tandem in the non-active viewports.

**NOTE: To hide the reference lines corresponding to the first and last images in the active viewport, click the drop-down arrow beside the Reference Lines tool in the toolbar and deselect the Show First and Last Reference Lines option.**

## 7.5.4 Working with the Spatial Locator

Use the Spatial Locator tool to locate the same point in space in all viewports. When you click the Spatial Locator tool, a crosshairs icon appears in the viewports. Moving the crosshairs in one viewport updates the other viewports so that the slice they display intersects the crosshairs coordinate. Location and image information are also updated in the top right corner of the viewports.

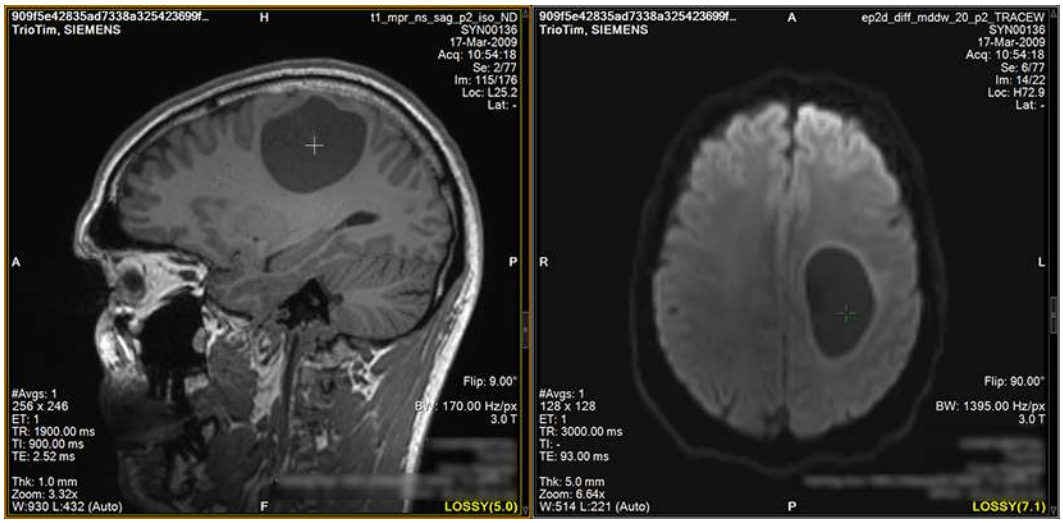



Figure 86 Viewports showing Spatial Locator crosshairs

# 8.0 Modus Plan Administration

Modus Plan administration involves tasks such as managing scheduled activities, setting up the workstation to communicate with other DICOM servers, and configuring default behaviors.

**NOTE: Modus Plan is designed to use the default Windows theme. Do not change the Windows theme on any computer running Modus Plan.**

## 8.1 Working in the Activity Monitor

The Activity Monitor displays information about activities that Modus Plan is performing, or is scheduled to perform. These activities include:

- Retrieving studies from a remote DICOM server
- Sending studies to a remote DICOM server
- Deleting series or studies from the local database
- Re-indexing the local file store

You can also use the Activity Monitor to start, stop, or change the priority of activities.

To open the Activity Monitor, from the menu bar choose **Tools** > **Activity Monitor**.

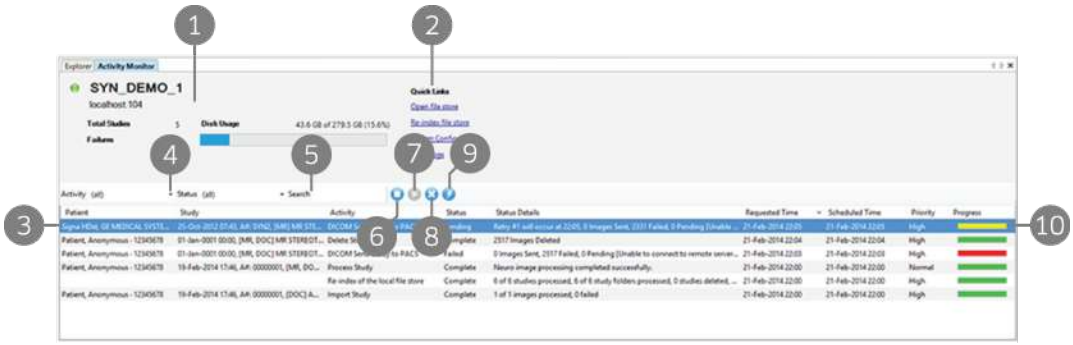



**Figure 87 Activity Monitor tab**

1 Workstation information.
2 Links to common administration tasks.
3 Activity list.
4 Use the Activity and Status fields to filter the list of activities by the activity type or status.
5 To search for an activity, enter your search term here. Only those activities that contain the search term (in any column) are displayed in the activity list. Clear the search field to view all activities.
6 Stop the selected activity.

7 Restart the selected activity. You can restart activities that were manually stopped or that failed to complete normally. Restarted activities start at the beginning of the task, they do not resume where they left off when they were stopped or failed.

8 Delete the selected activities. Activities that are in progress cannot be deleted. Activities that completed normally are automatically deleted after two hours.

9 Increase the priority of the selected activity to “Stat”. Activities with this priority are processed ahead of activities with a priority of “High” or “Normal”.

10 The color of the progress bar indicates that status of the activity:
- No color: Pending
- Green: In progress, idle, or complete
- Yellow: Stopped
- Red: Failed

## 8.2 System Configuration

Use the System Configuration dialog to configure the Modus Plan workstation. To open the System Configuration dialog, from the menu bar choose **Tools** > **System Configuration**.

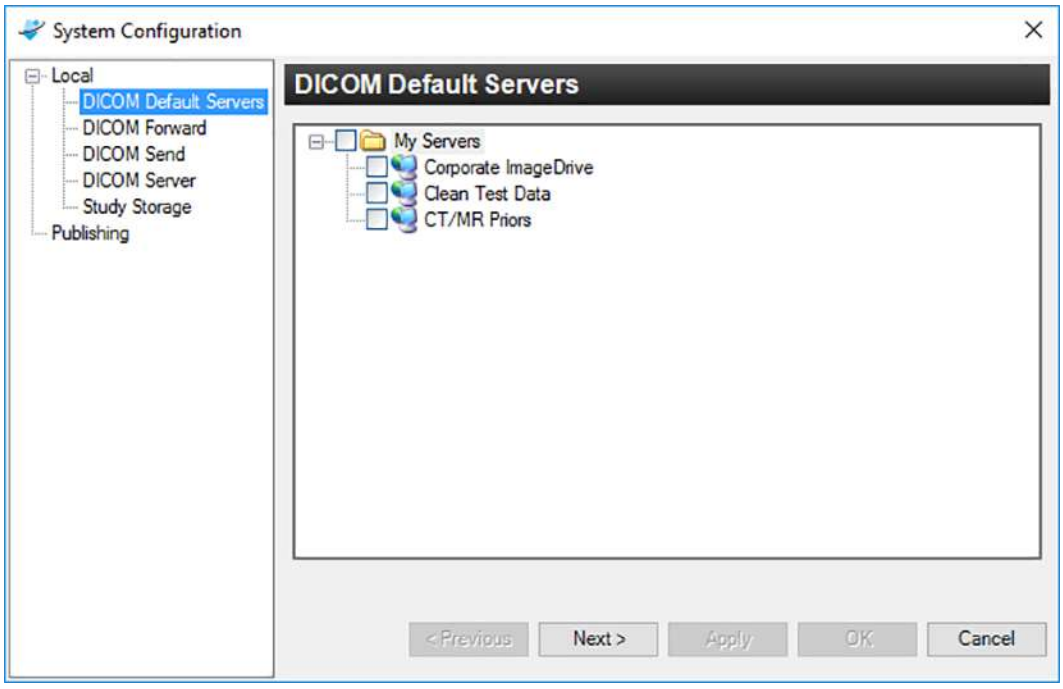



**Figure 88 System Configuration dialog**

### 8.2.1 Local > DICOM Default Servers

Default servers are servers that are selected by default in the plan export options dialog when you export a plan. Although these servers are selected by default, you can always select additional servers or de-select a selected server in the plan export options dialog.

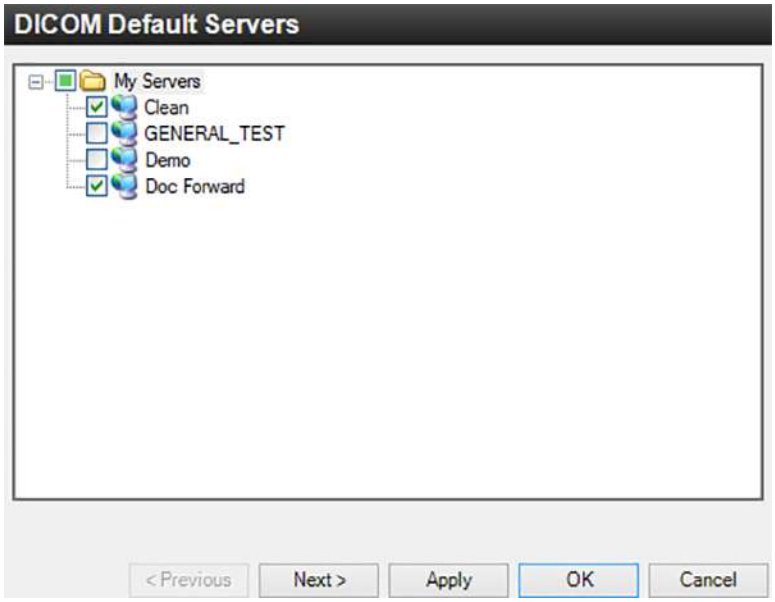



Figure 89 DICOM Default Servers list

In the DICOM Default Servers dialog, select the servers to export a plan to by default.

## 8.2.2 Local > DICOM Forward

Use the DICOM Forward option to specify the servers where you want to forward DICOM data. Modus Plan automatically forwards processed data to the servers you specify whenever a study is pushed to the workstation.

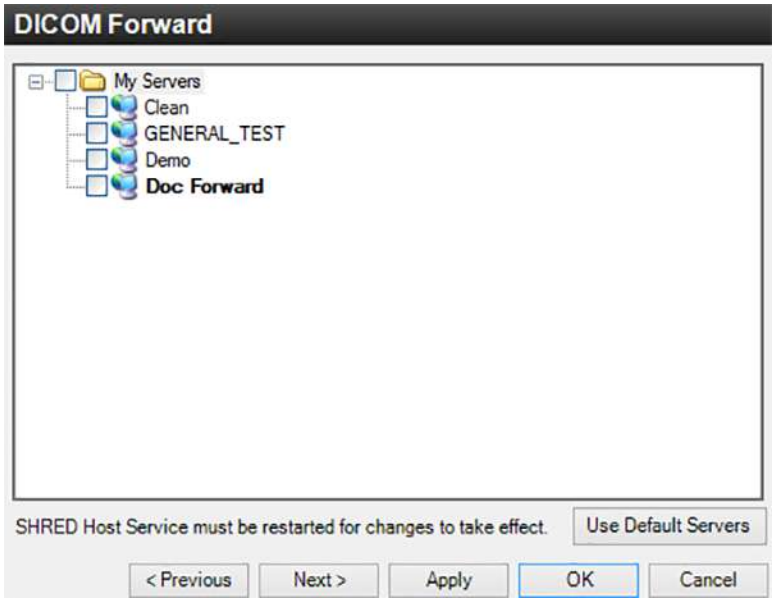



Figure 90 DICOM Forward options

Click the **Use Default Servers** button to automatically select the servers you defined as your default servers in the DICOM Default Servers settings.

## 8.2.3 Local > DICOM Send

The DICOM Send options control how Modus Plan behaves when an attempt to send a study to a remote DICOM server fails.


**Figure 91 DICOM Send options**

## 8.2.4 Local > DICOM Server

To communicate with a remote DICOM server, such as a PACS, the Modus Plan workstation must be configured as a DICOM server itself.


Figure 92 DICOM Server options

**AE Title** A unique name to identify this workstation as a DICOM server. It is customary to enter the AE (Application Entity) Title in uppercase characters.

**NOTE: If you change the AE Title for a workstation, you must update the name on each DICOM server that is configured to communicate with the workstation.**

**Port** The network port through which this workstation will communicate with other DICOM servers.

### 8.2.5 Local > Study Storage

Use the Study Storage options to manage the workstation hard drive space.

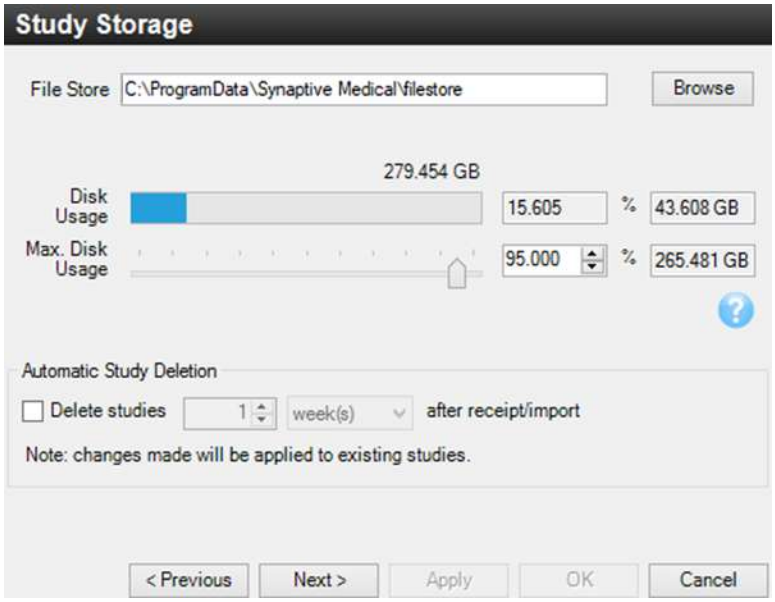



Figure 93 Study Storage options

**File Store** The location on the hard drive where study images and files are saved when they are imported into the local database. For information about changing the file store location, see 8.2.5.1 Changing the File Store Location on page 98.

**Disk Usage** The amount of disk space currently being used; displayed as percent of the total disk space available.

**Max. Disk Usage** Adjust the slider to specify the maximum amount of disk space Modus Plan may use. When this amount is reached, Modus Plan will stop importing or receiving studies.

**Automatic Study Deletion** Select the **Delete studies** option to allow Modus Plan to automatically delete studies from the local database and specify when studies should be deleted. Selecting this option can help to keep the local database size to within the maximum allowed disk space.

**NOTE: The local service must be running to apply changes to the automatic study deletion schedule. If you stopped the local service to change the file store location, start it again before changing the automatic study deletion schedule.**

### 8.2.5.1 Changing the File Store Location

To change the file store location:

1. Stop the local service (**Tools** > **Service** > **Stop**).
2. In the Study Storage system configuration option, browse to and select the new file store location.
3. If there were studies in the old file store location, copy them to the new file store location.
4. Click **Apply** then start the local service again (**Tools** > **Service** > **Start**).

**NOTE: If there were studies in the old file store location, or if the new file store location contained studies before you designated it as the new file store, you must re-index the file store. For more information, see 8.2.7 Re-indexing the File Store on page 99.**

## 8.2.6 Publishing

The Publishing options configure publishing behavior when adding new content to studies such as study attachments.

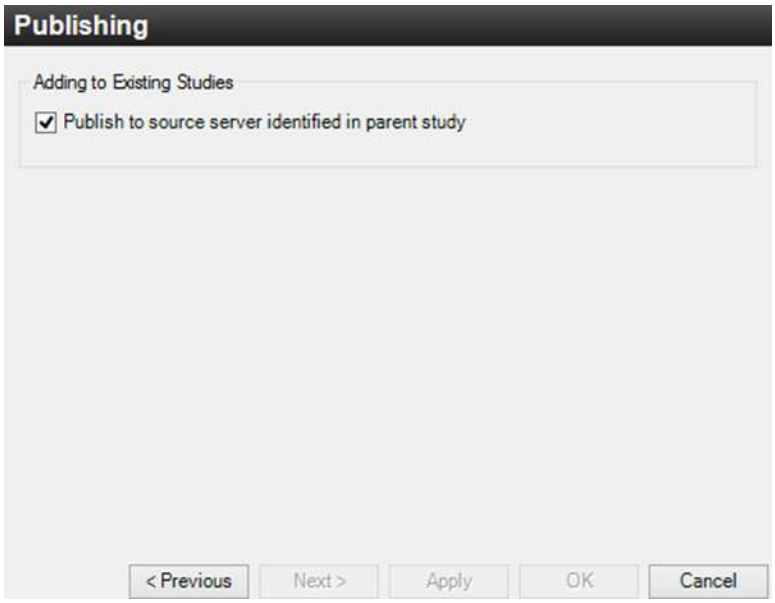



**Figure 94 Publishing options**

Select the **Publish to source server identified in parent study** option to publish the new content to the same server the study was retrieved from. The server must be configured in your Servers list. For more information see 8.3 Server Configuration on page 100.

## 8.2.7 Re-indexing the File Store

Under normal circumstances, Modus Plan automatically maintains the index between the file store where study files are saved and the local database. However in certain circumstances you may need to manually re-index the file store. For example:

- You have moved the file store location
- You have upgraded to a new version of Modus Plan
- The study data has become corrupted and it is necessary to rebuild the local database

To re-index the file store, from the menu bar choose **Tools** > **Re-index File Store**. The My Studies list is re-populated as studies are indexed.

Depending on the size of the file store, re-indexing may take a considerable amount of time and you cannot work in Modus Plan while re-indexing is in progress. If necessary, you can stop the re-index operation in the Activity Monitor and restart it at a later time. Studies that were not re-indexed are restored in the My Studies list in their original state.

**NOTE: When you restart the re-index activity, it re-indexes the entire file store; it does not pick up where it left off when it was stopped.**

## 8.3 Server Configuration

You must configure the Modus Plan workstation with information about any other DICOM servers you want it to communicate with. This includes servers that you want to receive studies from as well as servers you want to publish studies to.

Use the tools in the Servers pane on the Explorer tab to manage your DICOM servers.


**Figure 95 Servers pane**

1 Servers are listed by name in the Servers pane.
2 You can organize your servers into groups. To add a server to a group, drag it into the group folder.
3 Add a new server. For more information, see 8.3.1 Adding a Server on page 100 below.
4 Create a folder for organizing servers.
5 Edit the selected server or server group.
6 Delete the selected server or server group.

**NOTE: You can only delete empty server groups. If the server group contains servers, move the servers to another group or delete them before deleting the server group.**

7 Verify the connectivity of the selected server or server group.

### 8.3.1 Adding a Server

To add a new DICOM server:

1. In the Servers pane on the Explorer tab, click the **Add Server** icon.
2. In the Add New Server dialog, enter the server properties (described below).
3. Click **OK**.

NOTE: Before a remote DICOM server can communicate with the Modus Plan workstation, it must be configured with the workstation's DICOM properties.

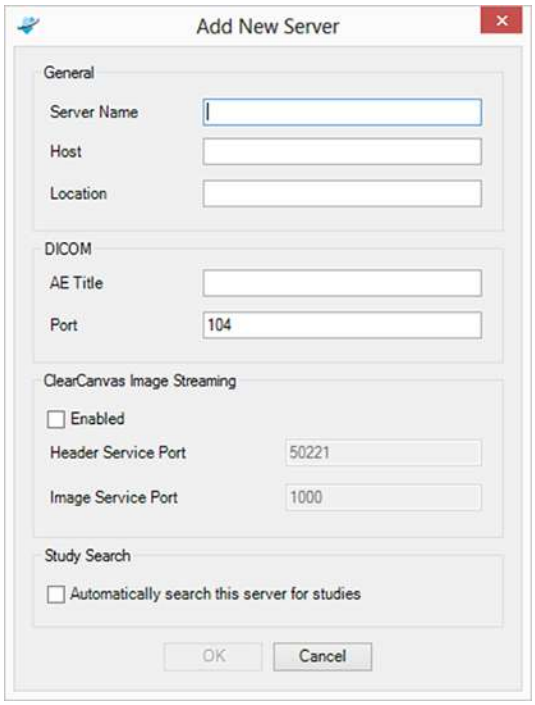



Figure 96 Add New Server dialog

| | |
|---|---|
| **Server Name** | Enter a name to identify this server. |
| **Host*** | Enter the server IP address. You may also use the server's DNS name if the network is DNS enabled, however, using the DNS name will be slower because the computer must resolve the name. It is recommended that you use the IP address, particularly in an environment where security is an issue. |
| **Location** | Enter a description of the server location. |
| **AE Title*** | The AE Title of the server computer.<br>**NOTE: It is customary to enter the AE Title in capital letters.** |
| **Port*** | Enter the network port to communicate with the server through. The default is 104. |
| **ClearCanvas Image Streaming** | Select the **Enabled** option if you are using a ClearCanvas PACS and want to use the ClearCanvas image streaming functionality. Enter the **Header Service** port number and the **Image Service** port number configured on the PACS. |
| **Study Search** | Select this option to search the server for related studies such as priors. |

* These fields are required to connect to the server.

# 8.4 Modus Plan Preferences

Use the Preferences dialog to determine Modus Plan behavior and specify default values for certain features. To access the Preferences dialog, from the menu bar choose **Tools** > **Preferences**.

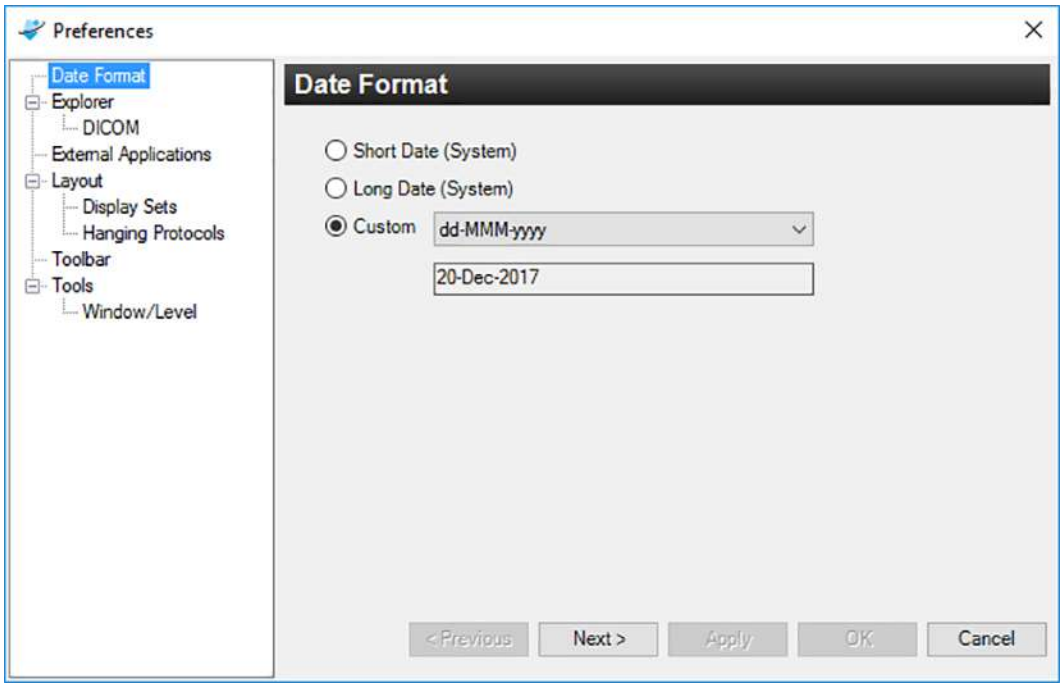



**Figure 97 Preferences dialog (all nodes expanded)**

Some preferences pages are grouped under a category in the tree view on the left. Click the plus icon beside a node to view the pages in that category.

## 8.4.1 Date Format

The Date Format options determine how Modus Plan displays dates. Choose either the system short or long date, or select a custom date from the drop-down list.

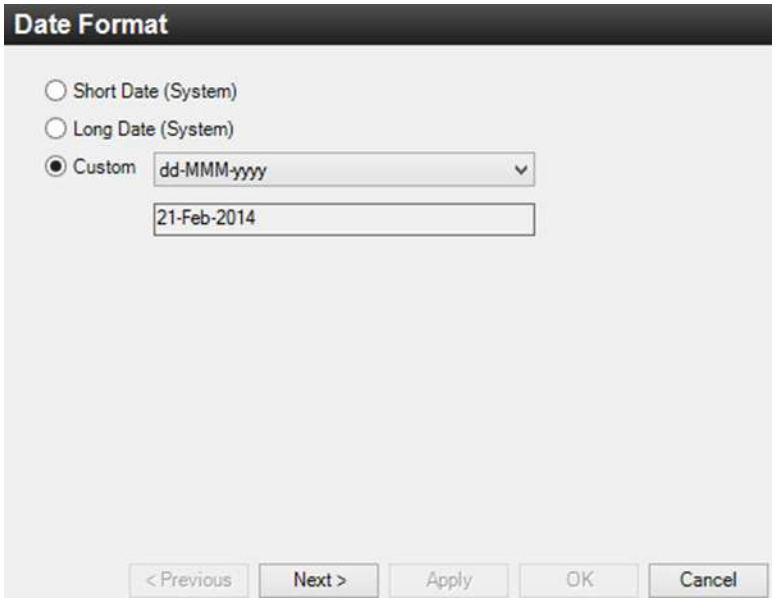



Figure 98 Date Format options

## 8.4.2 Explorer > DICOM

The Explorer > DICOM options determine how the study explorer behaves.

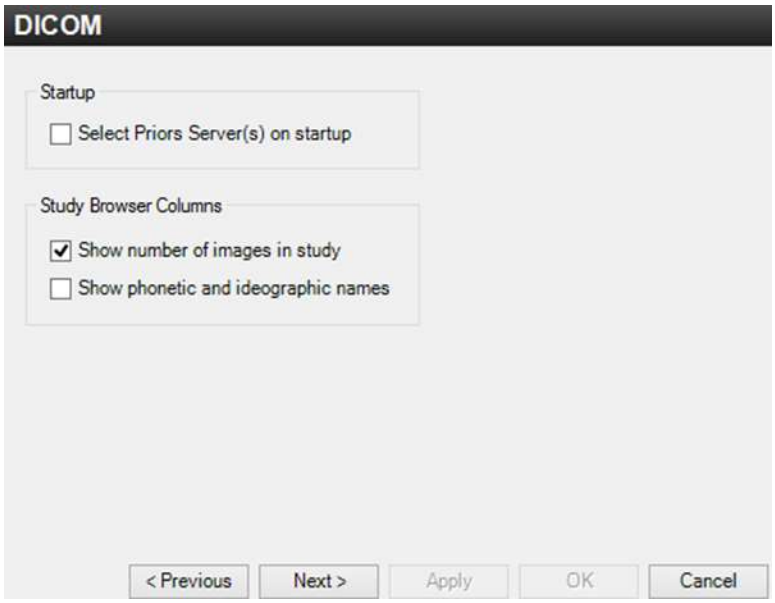



Figure 99 Explorer > DICOM options

| | |
|---|---|
| **Select Priors Server(s) on startup** | When this option is selected, Modus Plan will open with the server (or servers) configured as your priors servers selected in the study explorer. For more information about configuring priors servers, see 8.3.1 Adding a Server on page 100.<br>If the option is not selected, Modus Plan will open with My Studies selected. |
| **Show numbers of images in study** | When this option is selected, Modus Plan will display the number of study images (or instances) in the studies explorer. Deselect this option if your PACS does not return this information when queried. |
| **Show phonetic and ideographic names** | When this option is selected, Modus Plan displays multibyte characters (such as Japanese characters) in the study explorer when they are present in the DICOM data for a study. |

## 8.4.3 External Applications

Use the External Applications dialog to define other applications you want to use in conjunction with Modus Plan, such as other DICOM viewers or report generators. When external applications have been defined, users can send a study to the external application by right-clicking in the Investigate workspace and selecting the application to send to.

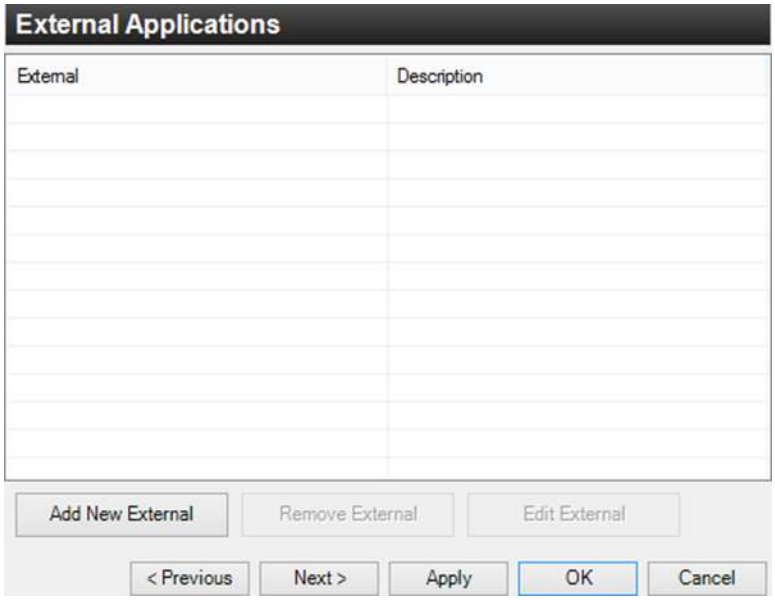



**Figure 100 External Applications options**

To add a new external application:

1. Click **Add New External** and select **Launch via Command Line** (currently, only command line applications are supported).

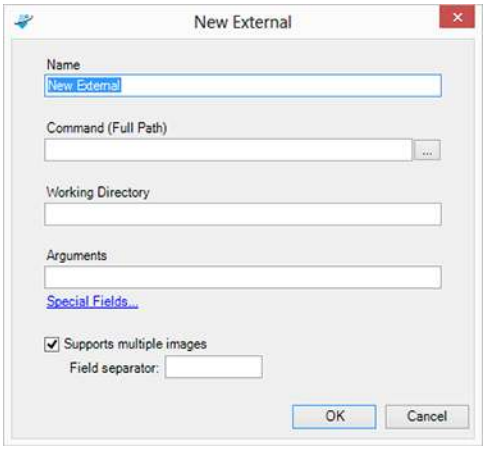



Figure 101 New External dialog

| | |
|---|---|
| **Name** | Enter a name for the application. This name will appear in the context menu when a user right-clicks in a study and selects Externals. |
| **Command (Full Path)** | Enter or browse to the executable file for the application. |
| **Working Directory** | If necessary, enter the path to the working directory for the application. |
| **Arguments** | Enter any arguments to pass to the external application. Click the **Special Fields** link to see a list of variables you can use with arguments. |
| **Supports multiple images** | Select this option if the external application supports multiple images. In the **Field separator** field, enter the character to use as the field separator. |

2. Click **OK**.

To edit the properties of an existing external application, select the application and click **Edit External**.

To remove an external application, select the application and click **Remove External**.

### 8.4.4 Layout

Use the Layout options to define the number and configuration of viewports (or image boxes) in the Investigate workspace. You can configure a different workspace layout for each study modality.

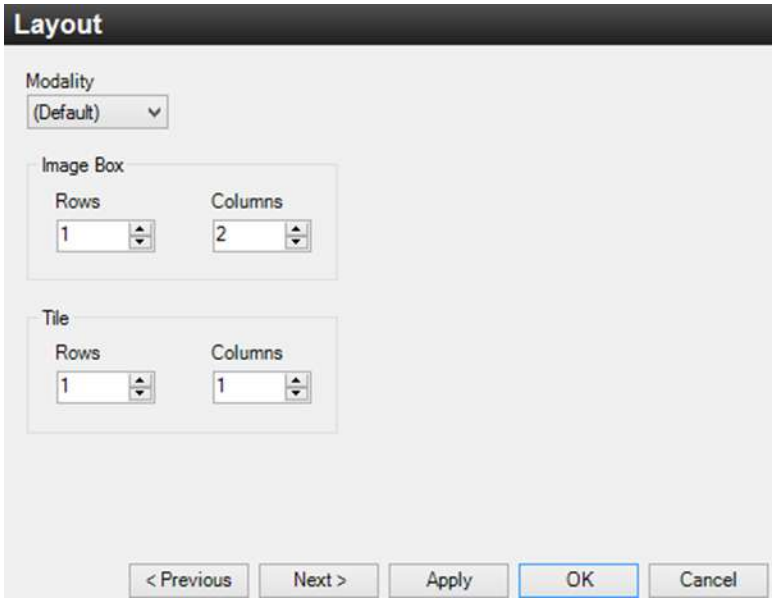



Figure 102 Layout options

To configure a layout for a modality, select the modality from the list and adjust the number of viewport (or image box) rows and columns and the number of tile rows and columns to appear in each viewport.

**NOTE: The number of tiles you specify here will be applied to all viewports in the layout.**

## 8.4.5 Layout > Hanging Protocols

The Hanging Protocols options control how hanging protocols behave in Modus Plan.

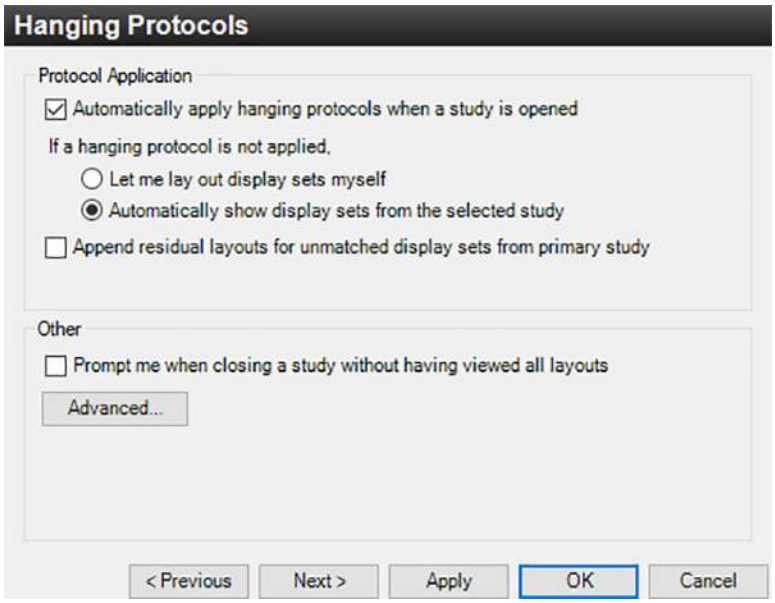



Figure 103 Hanging Protocols options

**Protocol Application**

Select the **Automatically apply hanging protocols when a study is opened in the viewer** option to automatically apply a hanging protocol to a study if an applicable protocol exists.

Specify what should happen if a hanging protocol is not automatically applied:

- **Let me lay out display sets myself**: Select this option to leave the viewports empty and allow users to choose the series they want to view.
- **Automatically show display sets from the selected study**: Select this option to fill the viewports with the first few series from the study.

If you do not want to make residual layouts available, deselect the **Append residual layouts for unmatched display sets from primary study** option.

Residual layouts are hanging protocol layouts created by Modus Plan that contain any series not included in any other hanging protocol. This is a safety feature to ensure that users do not miss seeing a series because it wasn't included in any hanging protocol.

**Other**

Select the **Prompt me when closing a study without having viewed all layouts** option if you want Plan to prompt the user if they close a study without having viewed all the hanging protocol layouts associated with the study.

**Advanced**

Click **Advanced** to select whether you want hanging protocols to include the institution tag when determining applicability.

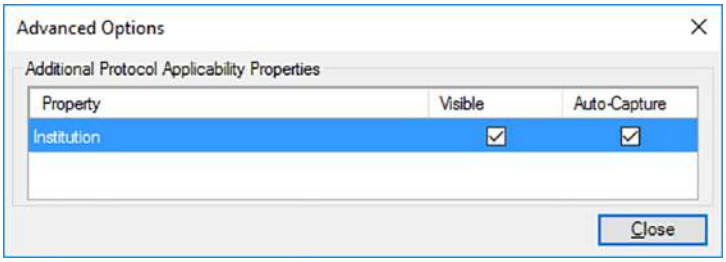



**Figure 104 Advanced Options dialog**

## 8.4.6 Toolbar

Use the Toolbar options to specify the size of the toolbar icons and whether the toolbar should wrap if it does not fit in the application window. If you do not allow the toolbar to wrap, a drop-down arrow appears at the end of the toolbar that you can click to access the hidden tools.

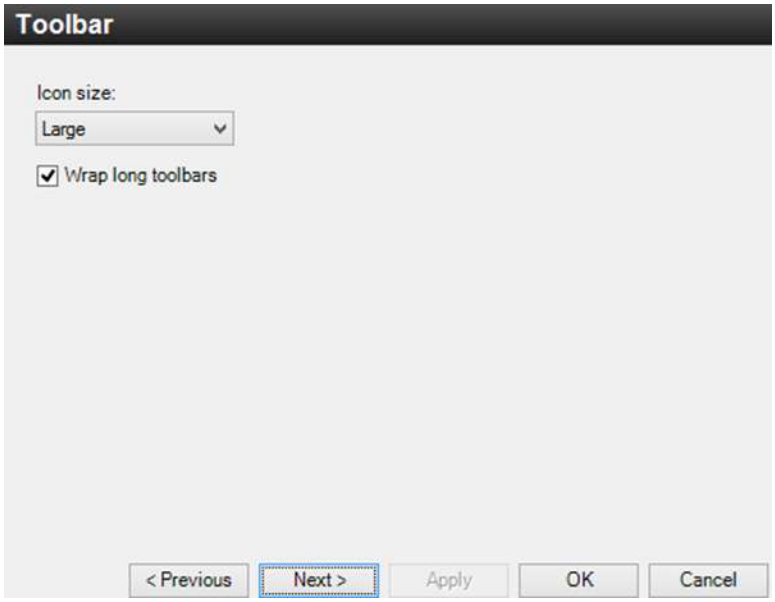



Figure 105 Toolbar options

## 8.4.7 Tools

The Tools options control the general behavior of basic viewing tools. You can specify different tool behaviors for different imaging modalities.

**NOTE: The Tools options apply to tool behavior in Investigate mode only.**

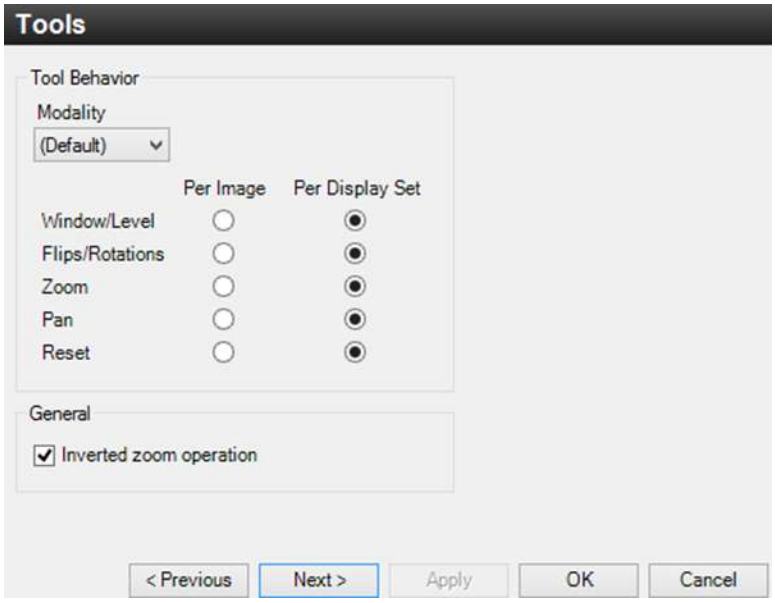



Figure 106 Tools options

| | |
|---|---|
| **Tool Behavior** | **Modality**: Select the modality to configure from the drop-down list.<br>For each tool select how the behavior should apply:<br>**Per Image**: The tool behavior applies to each image individually<br>**Per Display Set**: The tool behavior applies to all the images in the series |
| **General** | Select the **Inverted zoom operation** option to change the zoom tool behavior so that dragging up with the mouse zooms out and dragging down zooms in. |

## 8.4.8 Tools > Window/Level

Use the Window/Level options to manage window and level presets for each imaging modality.

**NOTE: The window and level presets you create here are available in both the Investigate and Plan modes.**

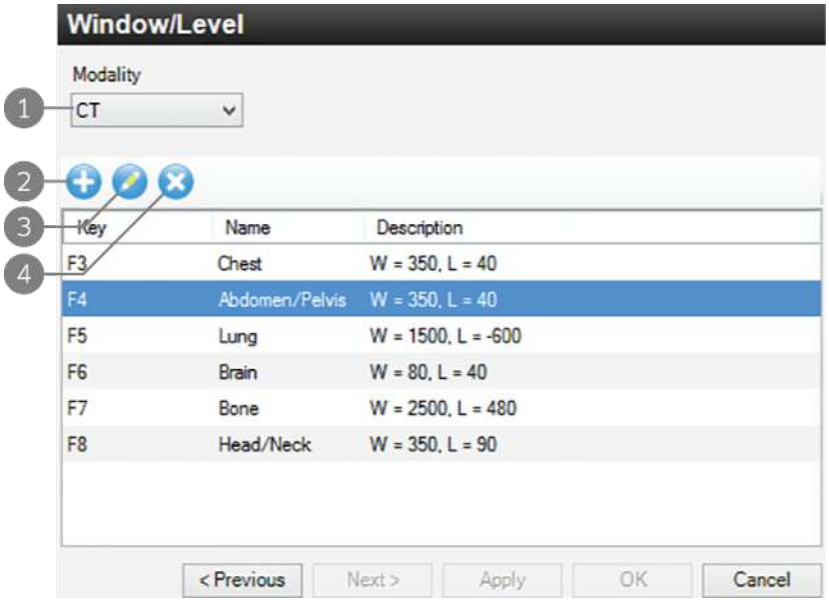



**Figure 107 Window/Level options**

1 Select a modality to view its window and level presets.
2 Add a new preset.
3 Edit the selected preset.
4 Delete the selected preset.

To create a window/level preset:

1. From the **Modality** drop-down list, select the modality you want to create the preset for.
2. Click the Add icon.

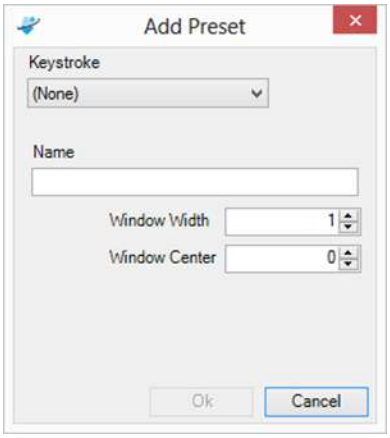



Figure 108 Add Preset dialog

| | |
|---|---|
| **Keystroke** | Select a keyboard to key to bind the preset to. When you press this key, Modus Plan will apply the preset to the workspace. |
| **Name** | Enter a name for the preset. |
| **Window Width** | Enter the window value or use the up and down arrow buttons to adjust the value by increments of 10. |
| **Window Center** | Enter the level value or use the up and down arrow buttons to adjust the value by increments of 10. |

3. Enter the values for the preset.
4. Click **OK**.

**NOTE: The window/level settings may cause sulci to appear wider and deeper than they are.**

To edit the properties of an existing preset, select the preset and click the **Edit** icon.

To delete a preset, select the preset and click the **Delete** icon.

# 9.0 Troubleshooting and FAQs

## 9.1 Troubleshooting

### 9.1.1 General Problems

| Problem | Possible Solutions |
|---|---|
| Part of the screen is missing or buttons are missing | Make sure that the default screen text size of the computer is set to 100%. Some computers will default to 125%. |
| Modus Plan, or one of its subcompoents, crashes | Restart the workstation.<br>See also 9.1.2 Laptop Problems below. |

### 9.1.2 Laptop Problems

| Problem | Possible Solutions |
|---|---|
| Poor resolution | Make sure that the resolution is set to 1920 x 1080. |
| Slow speed | Make sure that the computer is not working from the battery.<br>Make sure the power profile is set to “High Performance”. |
| Modus Plan crashes when you open a study | The laptop may not be configured properly. To adjust the configuration:<br>1. Open Nvidia Control Panel.<br>2. Click **Manage 3D Settings**.<br>3. Select the **Program Settings** tab.<br>4. Select **ClearCanvas** from the drop-down list (or add it if it's not in the list). If you have to browse to locate ClearCanvas, the file is "ClearCanvas.Desktop.Executable.exe" located in the install directory.<br>5. Select **High-performance NVIDIA** processor from the drop down list.<br>6. In the **Specify the settings for this program box**, scroll down to **Power Management mode** and select **Prefer maximum performance**. |

### 9.1.3 Study Import and Data Processing Problems

| Problem | Possible Solutions |
|---|---|
| Studies are not getting through to the database | Make sure that the “Shred Host” service is running in the background.<br>Make sure the system firewall has been configured to allow ClearCanvas and the ShredHostService. |
| Data processing fails with a negative error message | Make sure that the VC++ 2013 redistributable package is installed. If it is not, download it from:<br>http://www.microsoft.com/en-ca/download/details.aspx?id=40784<br>You must be logged in as a system administrator to install the package.<br>Once the package has been installed, follow the instruction in section 4.1.1.3 on page 44 to manually trigger data processing. |
| Series selection not as expected | Make sure that the series selection criteria match the current scanning protocols and naming conventions. |

### 9.1.4 Problems Specific to Planning Phases

| Problem | Possible Solutions |
|---|---|
| Cannot proceed to the next phase | Some phases have mandatory actions you must complete before you can proceed to the next phase.<br>• Follow any instructions in the dialog that appears when you attempt to leave the current phase.<br>• For more information, review the appropriate section in this reference guide. |
| In the Segmentation phase, Modus Plan fails to build a region | Make sure that the active viewport is the viewport you drew the region in when you click the Build Region icon in the phase panel.<br>Trace the region of interest in one viewport only.<br>Trace the region of interest in one of the 2D viewports. |
| A trajectory does not appear correct in the Targets phase. | You can edit trajectories in the Targets phase. Since this phase shows the standard orthogonal planes, trajectories must be projected onto them. Sometimes, this results in your engagement point appearing to be within the brain volume. Refer to the 3D view to confirm the actual placement. |

| Problem | Possible Solutions |
| --- | --- |
| Unable to use an exported plan for navigation | By default, Modus Plan exports a report-style plan, which provides DICOM coordinates that may be entered into your navigation station. However, it is possible to enable a volumetric export format if your navigation system requires it. This format produces a derived series, with the location of your intended target and engagement point burned directly into the images.<br>This export format results in greater demands for storage and network transfer and must be enabled by the Synaptive Medical Customer Service team. |

## 9.2 Frequently Asked Questions

**Where is Modus Plan installed by default?**

C:\Program Files\Synaptive Medical\Modus Plan.

**Where is the Modus Plan file store?**

C:\ProgramData\Synaptive Medical\filestore.

**What are these Synaptive.UsabilityTracking.log files?**

Modus Plan records some basic usage information whenever you create a plan. This data includes the amount of time spent in each phase as well as when you activated different tools. This information is never connected with a particular Study and is also never transmitted back to Synaptive. When a Customer Service representative asks for logs, you can choose to include this file, but it is not essential for resolving most problems.

**Where do I find log files?**

C:\Program Files\Synaptive Medical\Modus Plan\logs. (To quickly access this folder, in the toolbar click **Help** > **Show Logs**.)

**Where did my exported plan go?**

Exported plans are placed in the study they were planned from. A copy is stored on the system where you created the plan. During the export process, you identify a PACS server that you want the plan pushed to. This creates a copy of the full study, including the plan, on the target PACS system.

# 10.0 Keyboard Shortcuts

Table 8 Keyboard Shortcuts

| Keystroke | Function |
|---|---|
| CTRL + Left Mouse | Pan |
| CTRL + Right Mouse | Rotate (only applicable in solid views) |
| CTRL + Middle Mouse | Window/Level |
| CTRL + Scroll | Zoom |
| CTRL + Z | Undo |
| CTRL + Y | Redo |
| O | Toggle text overlays |
| X | Explode/Unexplode |
| S | Assign mouse button to Stack |
| R | Assign mouse button to Rotate (only applicable in solid views) |
| P | Assign mouse button to Pan |
| W | Assign mouse button to Window/Level |
| Z | Assign mouse button to Zoom |
| L | Toggle locator visibility |
| , | Zoom out |
| . | Zoom in |
| Page Up | Stack up |
| Page Down | Stack down |
| Arrow Keys (Up/Down/Left/Right) | Window/Level |
| CTRL + Arrow Keys (Up/Down/Left/Right) | Pan |
| F2 | Return to default window/level values |

# 11.0 Fiducial Placement Guidelines

If you are using fiducial registration, fiducial markers must be placed prior to image acquisition and remain affixed to the patient for the duration of image acquisition and during registration. Instruct the patient to not move during image acquisition and not to remove or alter the fiducial markers prior to, during, or after the image acquisition.

Use standard MR-compatible adhesive fiducial markers such as IZI Multi-Modality Fiducial Markers. If a fiducial marker falls off after the image acquisition, leave it off. Do not attempt to re-affix the fiducial marker.

**NOTE: A minimum of five fiducial markers are required to perform fiducial registration using Modus Plan. It is recommended that you place at least seven fiducial markers on the patient prior to image acquisition to ensure that at least five are available at the time of registration.**

Fiducial markers must be placed on firm skin around the head (for example, mastoid process, zygomatic arch).

For best results, follow these steps when placing fiducial markers:

1. Shave a small area of hair at the location where the fiducial marker will be placed.

   **NOTE: If the patient is diaphoretic, applying an adhesive is allowed.**
2. Remove the paper backing from the fiducial marker and place the marker on the prepared area.
3. Using an indelible marker, mark the center of each fiducial.
4. Place 7-10 fiducial markers around the head, spread out over as much of the surface of the head as possible. The minimum supported distance between fiducials is 20 mm.

   Distribute the fiducial markers in non-coplanar and asymmetrical locations.

   **NOTE: To help the surgeon confirm the patient orientation in the images, place two fiducial markers close to one another on one side of the head.**
5. When positioning the patient in a head holder, confirm that the fiducial markers have not shifted from their original locations.
6. Image the patient using a scan protocol that meets the Synaptive MR scan recommendations (listed in document MKT-0008).

# 12.0 Recommended Hardware and Software

The following hardware and operating system configuration is recommended for the Modus Plan software:

- NVIDIA video card with a minimum of 2 GB RAM and DirectX 11.1-compatible
- 2.7 GHz Quad Core CPU
- 32 GB of RAM
- 256 GB SSD with at least 20 GB of free storage space available at all times
- Minimum screen resolution of 1080p (a resolution greater than 1080p may affect performance)
- Keyboard
- Three-button mouse is recommended (minimum two-button mouse)
- Windows 10 with the latest update package
- Microsoft .NET Framework 4.7.1
- Microsoft PowerShell 4.0
- If Modus Plan will be running on a virtual machine, the VM software must provide AVX hardware support

# 13.0 Cybersecurity Considerations

## 13.1 Secure System Configuration

The features below apply to Modus Plan when it is running on a system supplied by Synaptive Medical. For assistance with configuring other systems that will run Modus Plan, contact Synaptive customer service.

### 13.1.1 Anti-Virus

A default anti-virus software application (Windows Defender) is deployed during initial configuration of your system. It is possible to replace this application with your Institution's approved anti-virus software.

For performance reasons, the following directories and their children should be added as an exception to any configured anti-virus application:

- C:\ProgramData\Synaptive Medical
- C:\Program Files\Synaptive Medical\Modus Plan

Consult your Synaptive Support representative for further details.

### 13.1.2 Firewall

The default Windows firewall is deployed and enabled during initial configuration of your system. It is recommended that you replace this application with your Institution's approved firewall software. The following firewall exceptions are required:

- ClearCanvas.Desktop.Executable.exe
- ClearCanvas.Server.ShredHostService.exe

To enable DICOM communication to the Modus Plan system, port 104 must be open for TCP send/receive.

## 13.2 User Profiles and Permissions

### 13.2.1 Domain Membership

It is recommended that this system be placed on your institution's Windows Domain, if one exists. This will enable centralized management of the system.

### 13.2.2 Default User Profiles

- Admin user

  The system is deployed with a local administrator account, named “Admin”. This account has sufficient permissions to enable software configuration, update, and management.

  It is recommended that access to this account be restricted to users who are responsible for maintaining the operation of the system.

- Operator user

  The system is deployed with a default local user account, named “Operator”. This account is configured for general use of the system, and is restricted from software install or update. Additional accounts may be configured for you during initial installation of the system.

### 13.2.3 Recommendations Regarding User Accounts and Permissions

- User accounts

  It is recommended that a minimum number of user accounts be enabled for the system. If individual user accounts must be configured, they should be Domain accounts so that account and authentication settings are consistent for each user.

- Administrator accounts

  General users should not be provided with administrator privilege on the Synaptive system.

- Password management

  Authentication policy should be adjusted to match your institution's guidelines.

## 13.3 Device Configuration and Restrictions

### 13.3.1 Removable Media

Removable media, such as USB and DVD, can be vectors for malicious software. By default, these devices are accessible to all users. Apply access restrictions to these devices consistent with your institution’s security policies.

### 13.3.2 Data Encryption

The Windows file system can be configured to encrypt data. This may be a useful precaution to protect patient data stored on the Modus Plan system. Note, however, that the use of encryption can have a significant adverse effect on the performance of the system. If you enable data encryption tools, it is recommended that you evaluate their impact on computer and software performance.

### 13.3.3 Audit Logging

It is recommended that Windows audit logging be configured to capture account “logon events” or audit “logon attempts”. See https://technet.microsoft.com/en-us/library/cc952128.aspx for details.

### 13.3.4 Use of a Trusted Network

Modus Plan uses the industry standard DICOM protocol for transferring image data. In typical configurations, this protocol does not provide a secure means of data transport. For this reason, Modus Plan should only be used on trusted networks.

## 13.4 Windows Update

### 13.4.1 Minimum Supported Patch Level

Modus Plan supports a minimum Windows patch level which will be provided to IT Operations at the time of installation or upgrade.

### 13.4.2 Maximum Supported Patch Level

Modus Plan is periodically validated for compatibility with new Windows updates. A maximum supported patch level is published on a quarterly basis. The current support level is available through your Synaptive Service representative.

### 13.4.3 Update to Supported Patch Level

Modus Plan should be updated to the most current supported patch level as soon as reasonably possible. These updates can be deployed manually, or through an automated process, such as WSUS.

## 13.5 System Storage

When not in use, Synaptive systems should be turned off and stored in a secure location.

# 14.0 Summary of Performance Test Results

## 14.1 DTI Derivative Volume Creation

| Data set[1] | Diffusion Parameter | Acceptance Criteria (dB) | Image PSNR Result (dB) | |
|---|---|---|---|---|
| | | | Win 7 | Win 10 |
| "Horn Image" | FA | ≥ 102 | 147.88 | 147.88 |
| | ADC | ≥ 102 | 153.319 | 153.319 |
| "Semicircles Image" | FA | ≥ 102 | 142.18 | 142.18 |
| | ADC | ≥ 102 | IDENTICAL* | IDENTICAL* |
| Simple Intersections | FA | ≥ 102 | 144.57 | 144.57 |
| | ADC | ≥ 102 | 156.329 | 156.329 |

* PSNR is termed IDENTICAL when there is no noise, hence by definition the PSNR value is undefined. This is the ideal result and represents no difference between the two images.

## 14.2 Tractography Generation

A third-party software was used to generate tracts for comparison to those generated by Modus Plan with the same input parameters. Two numbers are shown since the Tract Distance computation contains two asymmetric components. The first value results from using Modus Plan as the source for the distance calculation; the second value uses the third-party software as the source. Both directions are not represented elsewhere because synthetic data is used, and since the tracts are generated by the same algorithm, large differences should not occur between the two directions.

[1] Contact Synaptive Medical for detailed information about synthetic data that was used in this analysis.

| Image | Acceptance Criteria (mm) | Mean Tract Distance (mm) | |
|---|---|---|---|
| | | Win 7 | Win 10 |
| “Horn Image” | ≤ 0.5 | 0.14 | 0.14 |
| “Semicircles Image” | ≤ 0.5 | 0.14 | 0.14 |
| Simple Intersections | ≤ 0.5 | 0.25 | 0.25 |

| Source Data | Acceptance Criteria (mm) | Mean Tract Distance (mm) | |
|---|---|---|---|
| | | Win 7 | Win 10 |
| MRI Studio | ≤ 1.0 | 0.27 | 0.27 |
| “Semicircles Image” | ≤ 1.0 | 0.64 | 0.64 |

Synaptive