

Patient Database, Segment Server and PACS
Communication Manual



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Software platform v2.0 R5666

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1 Conventions and Trademarks

1.1 Typographic conventions

A	Key A at the keyboard.
Ctrl-A	Control key. Hold down Ctrl key and A simultaneously.
	Icon in toolbar.
*.mat	Filename extension.
C:/Program	Folder.
File	Menu, e.g. File menu.
File→Save As	Sub menu, e.g. under the File menu the item Save As is found.
<input type="button" value="Close"/>	Push/Toggle button in the graphical user interface.
<input type="radio"/> Endocardium	Radiobutton in the graphical user interface.
<input checked="" type="checkbox"/> Single frame	Checkbox in the graphical user interface.

2 Background

The Patient Database functionality and the Segment Server module is an addition to the software Segment, Segment CMR or Segment CT that allows to send and store images. In this manual the software Segment, Segment CMR or Segment CT are used interchangeably since they work similarly with the Sectra PACS Plugin. At all places this manual specifies Segment this can also be read as Segment CMR or Segment CT. Please note that the availability of the functionality described in this manual is subject to your system configuration.

Patient Database allows you to keep track of studies that are stored on a workstation.

Segment Server allows you to send images from a PACS or directly from a scanner to Segment for storage in the Patient Database. This is a server software that listens for incoming images from PACS or DICOM compliant workstations and store them into the patient database. This is the preferred method to get images into Segment solutions.

PACS connection allows you to query and retrieve images from a PACS. It also allows you to send images back to the PACS system for storage.

To install the tools and modules described in this manual you need to have administrator privileges on the computer. If you need assistance with installation, please do not hesitate to contact support@medviso.com.


2.1 Conditions for use

Caution: Federal law restricts this device to sale by or on the order of professionals trained in medical image analysis.

3 Conventions and Abbreviations

The following typographic conventions are used in this manual.

3.1 Typographic conventions

A	Key A at the keyboard.
Ctrl-A	Control key. Hold down Ctrl key and A simultaneously.
	Icon in toolbar.
*.mat	Filename extension.
C:/Program	Folder.
File	Menu, e.g. File menu.
File→Save As	Sub menu, e.g. under the File menu the item Save As is found.
<input type="button" value="Close"/>	Push/Toggle button in the graphical user interface.
<input type="radio"/> Endocardium	Radiobutton in the graphical user interface.
<input type="checkbox"/> Single frame	Checkbox in the graphical user interface.

4 Patient Database


The Patient Database allows you to easily keep track of your patients and efficient and simple loading of image data into Segment.

The aim of the patient database is give the user an overview of available patient studies that are stored on the workstation and to facilitate loading of data. It is not designed to replace a hospital PACS for long time image storage. If so desired you should complement Segment by purchasing a commercially available PACS or freely available such as Conquest PACS.

For further help with designing an appropriate system for managing large patient image archives, please contact Medviso AB.

4.1 Installation and technical details

The patient database resides on a simple directory structure and an index file to keep track of the files. In the folder `DICOM`, raw unprocessed DICOM images are stored. In the folder `Analyzed` processed files with contours, measurements and annotations are stored. The location where the patient database is stored can be adjusted in Segment preferences.

If importing database from version prior R5123, then you need to rebuild the patient database to fit the new format. If the index has become corrupted or you have manually modified the folder structure, then index file can be regenerated by using maintenance functionality  and the option **Rebuild database**, see Figure 1. This option will scan the patient database folder for studies and rebuild the database from scratch. Do not attempt to manually insert DICOM files into this file structure. Instead use the importing tools provided under the **Tool** menu.

4.1.1 Maintenance of the patient database

Currently there is no automation to delete old studies, this has to be scheduled manually. The graphical user interface for database maintenance is

shown in Figure 1.

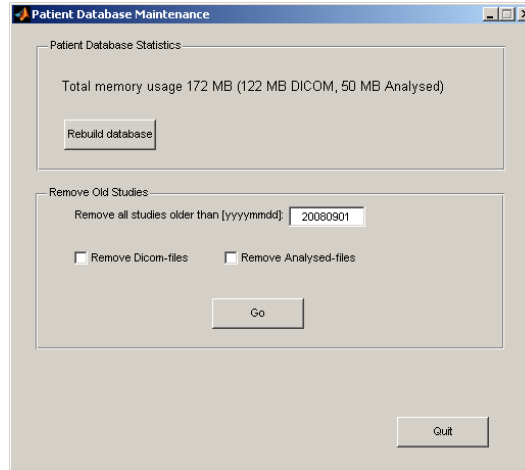


Figure 1: Maintenance graphical user interface.

It is possible to select to remove old studies (either only DICOMs, or only Analysed files, or both) from a specific date. For analysed files, the date used is the date when the analysis is performed, not when the study is acquired.

4.1.2 Sharing patient database with other users

For a multi users system it is possible to share the patient database with other users. This makes it possible to start the analysis of one study one computer and then a few hours later continue with the analysis on another computer. This is done by sharing the folder (or place it on a network disc) where the patient database resides (the folder where the file `patientdatabase.mat` resides). On the other computers, select this shared folder. Please ensure that all users have read and write access to the common folder.

4.1.3 Backup of patient database

We strongly advice all users to have adequate backup strategy of the patient database as it is typically placed on a local computer. Typically an incremental backup strategy is enough as it is generally not necessary to go back to a certain date. We suggest the usage of the software Syncback.

4.2 Overview and usage

The graphical user interface of the patient database is shown in Figure 2.

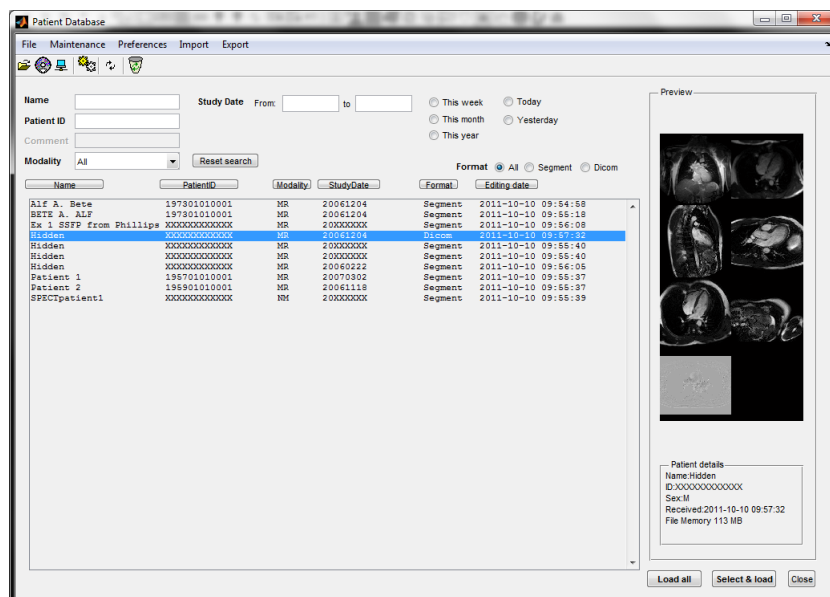


Figure 2: Graphical user interface of the patient database.

In the listbox all available studies which fulfills the searchcriteria are shown. In the listbox information on patient name and ID, imaging modality, study date and file format, either DICOM or Segment is given.

4.3 Search a study

Studies can be search for by using the different criteria, patient name, patient id, comment, imaging modality and study date. Search starts immediately when starting to type one of the criteria an the studies which fulfills all searchcriteria is shown in the listbox.

To search for a study by patient name start typing and the letters will automatically be placed in the edit box **Name** and the search will start. The letters typed in the edit box will be searched for at any place in the patient name, that is to say if you type in an 'a' it will match with both 'anne' and 'julia'. Wildcards such as '*' should never be inserted since the algorithm

automatically uses such an approach.

If a number is typed instead of letters it will automatically be inserted in the Patient ID edit box. The search for patient id works in the same way as the search for patient name.

The search for Comment is not yet available but will be a feature where you can search for a comment on the study after it has been saved in the internal Segment format.

To only find studies of a certain imaging modality change in the pop up menu Modality from All to the imaging modality of your choice.

Searching for a study by the date can be done in two ways, by searching for studies within a week, month or year by using the radiobuttons This week, This month or This year or by editing Study date in the edit boxes From: and to. To start typing in either of the edit boxes first click in the box. When starting to type the search will immediately start. When typing '2' in the from box all studies after '20000101' which fullfils the other searchcriteria such as name and patient id will be shown in the listbox. When the whole date has been typed in both the from and to boxes the search will result in only those studies performed between those two dates. To be able to change in the patient id or name edit boxes again a mouse click in the edit box must be performed first.

The studies can also be searched for by matching the Format of the file, either Dicom or Segment. This is done by changing the format radiobutton from All to either Segment or Dicom.

When deleting in a search criteria a thorough search will be done to show all studies that match the searchcriteria still present. All search criteria can also be deleted by using the button

4.3.1 Sort studies

The studies in the list box can be sorted by the different criterias by pushing the buttons , , , or .

4.3.2 Load a study

To load a study select it in the list box and push either the button `Load all` or `Select & Load`. The button `Select & Load` is only available if the format of the study is Dicom and it allows you to choose which series to load in the graphical Dicom selector, described in 4.3.3.

4.3.3 Graphical image series selection

The graphical series selector tool is shown in Figure 3. While moving the mouse pointer over the image series more information on each image series is shown in the top of the graphical interface. Select which image series to load with left mouse button. Image series outlined in yellow are selected. It is also possible to group image series to one image stack. Image series that are to be grouped are selected by holding down the **Shift** key while mouse clicking, or by using the middle mouse button. Thereafter, press the push-button `Group Selected`. Grouped image series are shown with a green outline. Multiple image stacks can be selected for loading or grouping by clicking and dragging over the selection. When finished selecting image series, press `Load`. To speed up the process this operation the generation of the thumbnails is cached.

Note that when using this tool to load the image, then there is no cropping of the images done, and that is highly recommended to crop the images during the image analysis process. Also note that if multiple directions is detected in the dicom folder all the different directions are loaded as separate image stacks.

4.4 Import studies

Studies can be imported to the patientdatabase in three different ways, from CD, from PACS and from network/disc. The import function can be found under the menu **Import**. When choosing to import from CD it is possible to restrict the import to be only dicom format otherwise both dicom and segment format files will be imported. When importing from PACS the PACS connection will be started and how to search for and retrieve files from the PACS is further described in Chapter 6. Importing from network or disc is done by choosing from which location to import files and then choosing which format to import.

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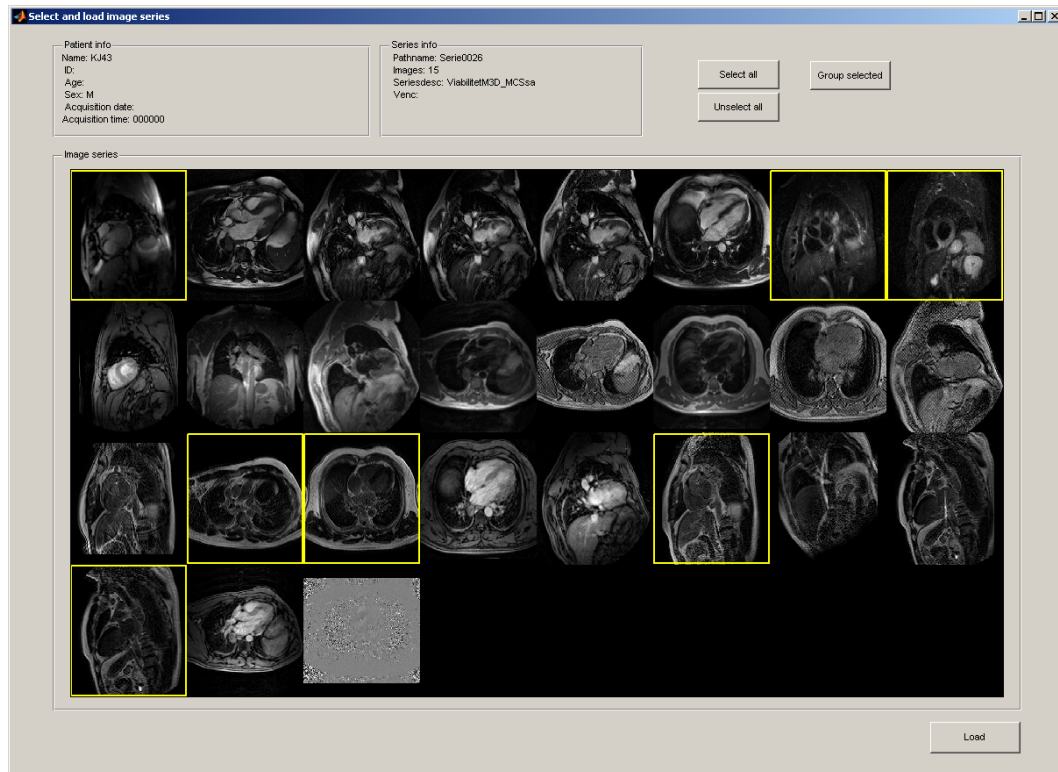


Figure 3: Graphical image series selector.

4.5 Export studies

It is also possible to export files in dicom format from the patientdatabase. This can be done by either selecting multiple files, exporting the one file selected in the listbox or by exporting all dicom files. If you want to select multiple files to export you add files to an exportlist by selecting the file in the listbox and then going to the menu **Export** and selecting **Add DICOM files to exportlist**. This procedure can be repeated until you have added all the files that you want to export. The files selected can be shown by selecting **Show exportlist** in the **Export** menu. When satisfied with the export list select **Export DICOM files to PACS** in the **Export** menu. This pops up an GUI in which you choose either to export selected files. To export the files the correct PACS system must be selected from the drop down menu.

5 Segment Server Module

The Segment Server is a separate program and by having this running on a computer it is possible to send DICOM files directly from a Scanner or DICOM compliant workstation to Segment Patient Database.

In a typical clinical workflow situation both the PACS connection and the Segment Server are used to import images into Patient Database for analysis and storage. The Segment Server allows to receive images that are pushed onto from an imaging device such an MRI Scanner, or DICOM workstation. The PACS Connection Module allows to query and retrieve images from a PACS system, or a DICOM workstation. Segment Server is the recommended main source of input data to a Segment installation.

5.1 Configuring Segment Server

In order to make it possible to retrieve images from imaging devices and other DICOM workstations a two server processes are required to run on the computer. Both these processes are run as services. Please not that the Segment Server solution was radically changed from version R5123, and when upgrading the software you need to manually install it again.

If you require help with setting up Segment DICOM Server, please contact Medviso AB support, support@medviso.com.

Start with setting up the Patient Database manual, see Chapter 4 for details. Configuration of the Segment Server is done in preferences and under Segment Advanced System and DICOM Settings. The relevant part of this user interface is shown in Figure 4.

- Database folder sets the location of the Patient Database folder, this is the patient database where all images are stored. See details in Chapter 4.
- Temporary folder is a temporary folder where images from the Segment Server temporary are stored. This is also used by the PACS

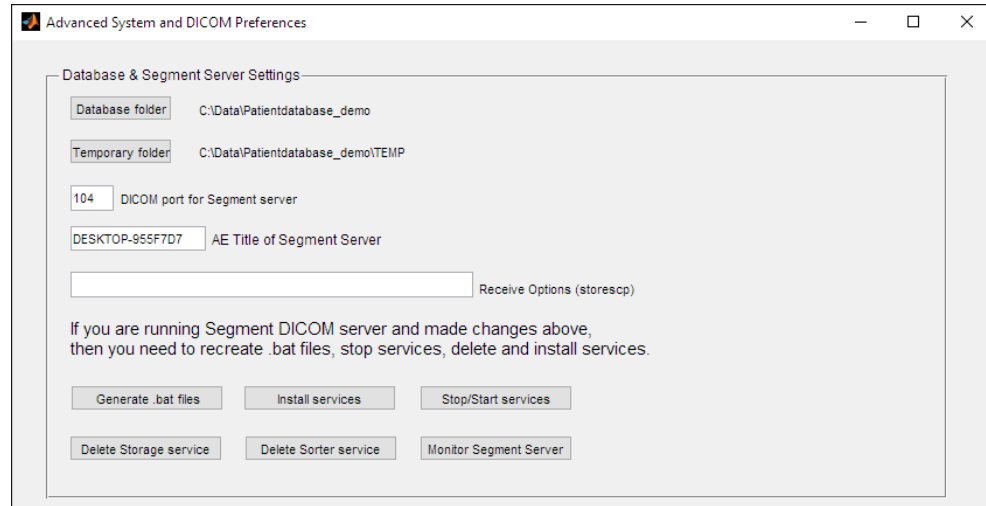


Figure 4: User interface for adjusting Segment DICOM Server settings.

connection module. Normally this is subfolder called **TEMP** under the patientdatabase but can if so desired be moved to a separate location. It could for performance reasons make sense to have this temporary folder located on a SSD disk in case the patient database is not located on a SSD disk.

- **DICOM Port for Segment Server** sets the port used for incoming associations.
- **AE Title of Segment Server** it is the AE title for the Segment DICOM Server, and is set to the hostname of the computer by default.
- **Receive Options** sets options used for negotiating used network transfer syntax. Options can be combined (some but not all). Recommended is to not fill this and thus use default settings. For particular systems, useful options are:
 1. `--prefer-uncompr` prefer explicit VR local byte order (default)
 2. `--prefer-little` prefer explicit VR little endian TS
 3. `--prefer-deflated` prefer deflated expl. VR little endian TS
 4. `--implicit` accept implicit VR little endian TS only
 5. `--normal` allow implicit format conversions (default)

6. `--bit-preserving` write data exactly as read (less error checking...)

Output transfer syntax (not with `-bit-preserving` or compressed transmission):

1. `--write-xfer-same` write with same TS as input (default)
2. `--write-xfer-little` write with explicit VR little endian TS
3. `--write-xfer-implicit` write with implicit VR little endian TS
4. `--write-xfer-deflated` write with deflated expl. VR little endian TS

Please note that if you make any changes then the services running needs to be stopped, deleted, installed, and restarted, please see below for details.

5.2 Starting Segment Server

Please note that these operations may require that you run the software as Administrator (not only being logged in as Administrator). This is done by right clicking on the icon of the software and then select "Run as administrator".

There are two processes running that needs to run for Segment Server can work; 1) storage server that listens on the designated port and stores images to the temporary folder location, 2) sorter server that sorts the files on the folder and stores them into the patientdatabase.

5.2.1 Install services

1. Click `Generate .bat files`. This generates two .bat files stored in the Segment folder that are used to start the services.
2. Click `Install services`. This registers the services to automatically start when the computer starts. Note that no user needs to be logged in on the computer in order for the services starts.
3. Click `Stop/Start Services`. Although the services are set to start automatically on system start they are not yet started unless you log-out.

In order to start them now, use this option and scroll down to the services named `SegmentStorageServer` and `SegmentSorterService`. This is done in Windows standard service editor as illustrated in Figure 5. Click on the green "Play" icon (or the text Start the service) to start the service, and the status of the Service should turn to `Running`.

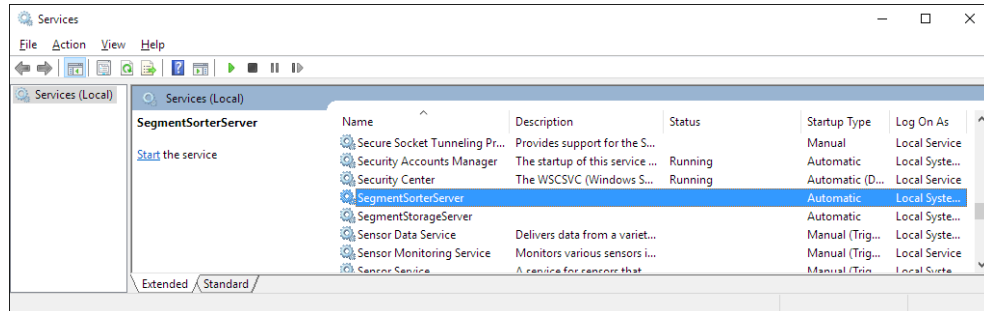


Figure 5: User interface Starting / Stopping services.

5.2.2 Starting/stopping services

In order to start or stop the services, click on `Stop/Start Services`. The user interface is shown in Figure 5.

5.2.3 Deleting services

When upgrading the software it is recommended to completely delete the services and reinstall them as otherwise the files that are used by the services are locked and prevents installation. When you want to delete the services, first make sure that they are stopped, please see the section above for details. Thereafter click on `Delete Storage Server`, and `Delete Sorter Server`, respectively to delete the two services. You may also need to manually delete the process `nssm.exe` that is used by Segment to install/delete the services. This is done by pressing `Ctrl-Alt-Delete` and select `Task manager` and find the process named `nssm.exe` and manually delete it.

5.3 Diagnosing the Segment Server

To start the Segment Server monitor click on `Monitor Segment Server`. This opens up a user interface illustrated in Figure 6.

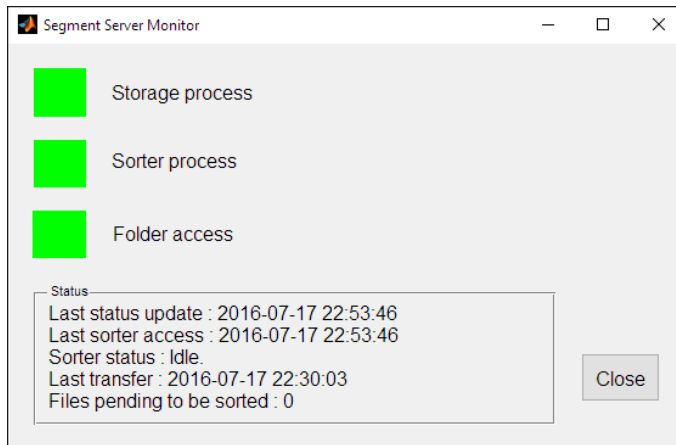


Figure 6: User interface to monitor the Segment Server.

The user interface has three "lamps" indicating the status. All of them should generally be green, then the two services (storage and sorting) are up and running and idle. The last lamp is green if the Segment Server can access the folder where the patient database is located. Note, it does only check if it is reachable, not if it is write enabled. The monitor also indicated the time of last check and the time of last status response from the sorter service. The status is updated every 1-2 seconds. Furthermore, time of last transfer is also indicated. If there are files that currently are being sorted or there is a queue of files waiting the the sorter service is indicated with yellow. If there are no signs of life from the sorter for 15 minutes, then the sorter is assumed to be non working and needs to be manually inspected.

The Segment Server monitor is also available under **Maintenance** menu in the Patient Database Module.

5.4 Troubleshooting

Segment DICOM Server uses routines from DCMTK to receive images, and also Medviso AB code to sort and store the received images in the Patient Database. The sorter service creates a log file that is stored in the **Temporary Folder** under a subfolder called **logfiles**. Inspect this log file carefully for debug information. When contacting support@medviso.com, please ensure


CHAPTER 5. SEGMENT SERVER MODULE

to include this logfile.

6 PACS Connection

The PACS connection allows to retrieve images directly from a hospital PACS system to the Patient Database.

6.1 Using the PACS connection

The PACS connection GUI is started by the clicking on  icon. The graphical user interface for the PACS connection functionality is shown in Figure 7. In the upper left corner of the GUI you can select what PACS to connect to.

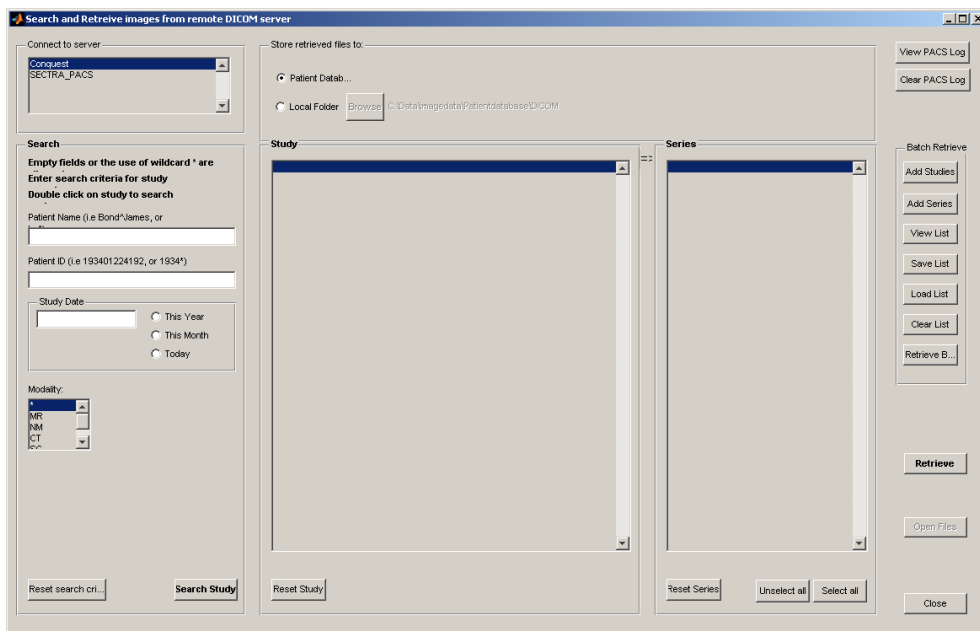


Figure 7: Screen-shot of the PACS search and retrieval GUI.

6.1.1 Searching for studies

The most common approach is to search for a desired patient. You can enter either patientname or patient ID. The wildcard * is allowed. The wildcard

* may represents zero, one or more letters. The patient first name is followed by a ^ and the surname. For instance the search string `bo*` will find `Bond^James`. Note that there is no difference made on versal or capital letters. The search string `*Ja` will also find `Bond^James` since once at least one wildcard is entered, then an implicit wildcard is added on the end.

For Swedish users the PatientID system allows to search on patients born a specific year. Entering `*Bert` as patientname and `1934*` as Patient ID will find patients who are born in 1934 and with names such as `Bert` or `Berta`. Note that it will also find `Bertilsson^Arne` since the wildcard `*` may represent no or more letters.

Studies can also be searched for by editing the criterias study date and imaging modality. Study date can be entered either as a particular date or by using the radiobuttons `This year`, `This month` or `Today`.

When you have found correct study, double click on the desired study and the available image series will be shown. Select the desired image series with the shift or control keys. There is also a pushbutton to select all image series.

6.1.2 Retrieving files

When you have selected your desired image series it is time to retrieve the data. This is done by the pushbutton . Before starting the retrieve operation ensure that the retrieved images are stored to the desired location. This can be adjusted in the GUI panel termed `Store retrieved files to:`.

The the images are stored in sorted subfolders. The first folder level is the patient name, i.e `Bond^ James`. The second folder level is the study data, i.e `20060821`. The next folder level is the the series and are named as `Seriexxxx` where `xxxx` are a serial series number.

After retriving the files you can directly start the file loader with the pushbutton .

6.1.3 Batch retrieval

It is possible to add studies and series to a batchdownload session. Start by searching for the desired patient. To add entire studies to the batch download list select the desired studie(s) and press . To add specified image series, select the image series and press . Note that you can select studies and series from several patients at the same time. To view what patients there are in the batch list press . It is possible to save the batchlist to a file for future use. To start the batch download retrieval press . When retrieving a batch a waitbar is displayed with the number of series done and total number of files. The batch download takes to one series at a time. Some other commercial systems attempts to take several image stacks at the same time. By using so it might be possible for one client to use more band robots if the data have been swapped out to tapes. However, in our experience this leads to more instable systems.

7 Sending DICOM data back to PACS

Segment can send DICOM information back to PACS systems in the following four contexts:

- Complete analysed studies for final storage in PACS. Essentially the stores a DICOM camouflaged `.mat` file back. On the PACS system this is indicated as a file with Medviso logo.
- Reports in form of DICOM screen captures from the Report Module.
- From the Patient database it is possible to send a study containing DICOM files.
- Send back derived image stacks such as T2*, and ECV maps. This is work in progress.

In order to send images back the PACS connection needs to be configured and the needs to be a defined `.con` file. Please note that the most common problem with sending images back is that the PACS system needs to be configured to receive images from the computer. Settings for sending back is done under the **Advanced Systems and DICOM Preferences** and illustrated in Figure 8.

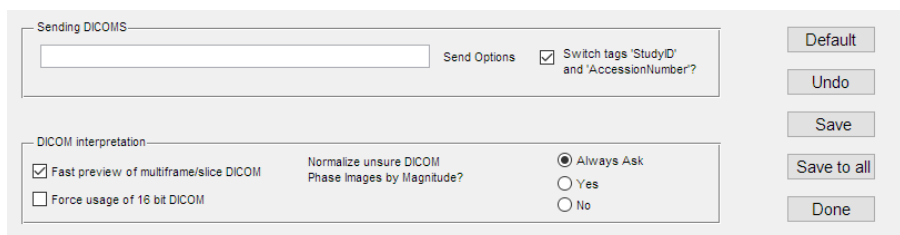


Figure 8: Settings to send images back to PACS.

The `Switch StudyID and AccessionNumber` is a fix for a Sectra PACS bug and should normally be enabled only when using Sectra PACS.

8 External PACS Module

The purpose of the External PACS Module is to be able to invoke Segment from an external PACS. This description is only intended for setting up and we strongly suggest to configure the external PACS coupling in close collaboration with personal from Medviso AB.

The External PACS Module consists of two parts. The first is contained in the separate file `SegmentAPI.exe`. This file is called by an external PACS system and upon this call starts Segment (if it is not already running) and outputs a text file `studies2load.txt` containing instructions on which file or patient is to be opened. It is therefore necessary that the file is placed in a catalog where the user has write permission.

The call to the API has the form
`SegmentAPI.exe /x "argument/s x" /y "argument/s y" ...`

It takes the following types of arguments:

- `/p "PatientID"` ID of patient.
- `/d "StudyDate"` Date of study.
- `/f "Filename"` Name of file.
- `/s STUID` Study UID.
- `/n "Windowname"` Beginning of window title in which to do the loading, if such window exists. Default is "Segment CMR v".
- `/c "Callfile"` Name of file to call for launching loading application, if no window with suitable title exists. Default is "SegmentCMR.exe".
- `/m "StudyPath"` Set data path of Segment.
- `/l "PathList"` Load DICOM files from folders separated by semicolon. Currently not in use.
- `/g "GraphicalSelector"` Including this opens the graphical series selector for the specified study. Takes no arguments.
- `/a "DynamicPACS"` Three input arguments for dynamically setting AE title, IP and port of a PACS.

The second part of the module is contained in Segment. It continuously looks for the file `studies2load.txt` and parses it for instructions. Once instructions are found, one of the following actions is taken depending on the instructions contained.

1. **Name of one or several mat-files.** The files are loaded.
2. **Name of folder of DICOM files.** The graphical Series Selector is opened for this path.
3. **Patient ID uniquely identified in the Patient Database.**
 - (a) **DICOM files associated with the patient.** The Series Selector is opened for this patient.
 - (b) **Mat-file associated with the patient.** The file is loaded.
 - (c) **Both DICOM and mat-file associated with the patient.** The user is asked whether to open the Series Selector for the DICOMs or to load the mat-file.
4. **Patient ID found in several database instances containing DICOMs or mat-files.** An error message appears.
5. **Patient ID not found in database.** An error message appears.

There is also an optional parameter that can be specified by the external PACS:

Dynamic PACS definition (optional). AE title, IP and port are specified for the PACS connection. Then instructions for loading files are parsed.