RemotEye Viewer, version 10

User Manual

CE
0051

Table of Contents

1 Abbreviations

Abbreviation	Description
DICOM	Digital Imaging and COmmunications in Medicine
DPI	Dots Per Inch
GUI	Graphical User Interface
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
JAI	Java Advanced Imaging
JRE	Java Runtime Environment
JWS	Java Web Start
LAN	Local Area Network
LUT	Look-Up Table
MPR	Multi-Planar Reconstruction
PACS	Picture Archiving and Communication System
PC	Personal Computer
RAM	Random Access Memory
SR	Structured Report
TCP	Transfer Control Protocol
URL	Uniform Resource Locator

2 Indications for use

The RemotEye Viewer software module is intended to be used as a fully functional, web-based medical image viewer to download, visualize, review, analyse, interpret, manipulate, reconstruct and print medical multi-modality image data in DICOM format, also stored in remote locations with respect to the viewing site. When interpreted by a trained physician, the medical images displayed by RemotEye Viewer can be used as an element for diagnosis.

When employed for diagnostic purposes, RemotEye Viewer should be used in conjunction with a diagnostic-quality PC monitor, which guarantees compliance with DICOM 3.0 – Part 14 (Grayscale Standard Display Function).

Typical users of RemotEye Viewer are trained healthcare professionals, including but not limited to radiologists, physicians, nurses and technicians.

3 Manual in printed paper form

According to European Regulation EU No 207/2012, upon request, you are entitled to receive a printed paper version of this manual for free. Physical delivery of this printed paper version shall happen within 7 days from the date of the request. Request shall be done via email, by writing to the email address support@neologica.it.

4 Before you begin

Before beginning usage of the RemotEye Viewer software module, please ensure that your installation of this software module has been done correctly and is working properly. This can be done by verifying that the "Installation checklist" described in the installation manual has been executed and all tests have been passed.

4.1 Minimum hardware requirements

RemotEye Viewer shall run on a machine based on the x86 or on the x64 (also known as x86-64, x86_64 or AMD64) CPU architectures. Here is the minimum configuration which is required in order to ensure RemotEye Viewer will work properly on the client side:

- CPU Intel Core i5, 2.5 GHz or faster
- 8 GB RAM or more
- Dedicated graphics adapter, 1 GB video memory or more, video driver compatible with OpenGL 2
- Screen with 1280x768 minimum resolution
- Hard Disk 7200 RPM or faster
- 50 GB minimum free hard disk space

4.2 Supported operating systems

RemotEye Viewer works on the following Operating Systems:

- Microsoft Windows operating systems of the following version:
  - Windows Server 2012 R2, 64-bit versions
  - Windows Server 2016, 64-bit versions
  - Windows 8, 32-bit and 64-bit versions (**WARNING: usage on touch screen devices is NOT supported**)
  - Windows 10, 32-bit and 64-bit versions (**WARNING: usage on touch screen devices is NOT supported**)
- Apple Mac OS X / macOS of the following versions:
  - Mac OS X 10.8.3, or higher
  - macOS, version 10.12 or higher
- Linux operating systems of the following versions:
  - Oracle Linux 5.5+, 6.x (32-bit), 6.x (64-bit), 7.x (64-bit)
  - Red Hat Enterprise Linux 5.5+, 6.x (32-bit), 6.x (64-bit), 7.x (64 bit)
  - Ubuntu Linux 13 and above
  - Suse Linux Enterprise Server 10 SP2 and above

4.3 Supported web browsers

RemotEye Viewer can be invoked by web applications running under any web browser.
The viewer application is executed in its own independent process, and the supported invocation mechanism relies on technologies which are available on any desktop web browser (starting from Internet Explorer 8). Hence there are no limitations on the type of web browser in use to invoke the viewer.

5 Introduction

The following chapters explain the user features available from RemotEye Viewer's Graphical User Interface (GUI) and how to exploit the capabilities of this system.

In order to load a sample RemotEye Viewer instance, point your web browser to the web address where the RemotEye Viewer test HTML page has been installed. It shall be something like:

http://<yourServer>:<yourPort>/RemotEye/testInstall.htm

This page will check for an existing installation of RemotEye Viewer on the client, and will eventually prompt to download and launch the installation package. Once the viewer application is launched, the viewer's GUI appears.
This GUI is composed of the following main panels and toolbars:

- *Main menu bar*: this top menu bar allows accessing the main functionalities of the viewer.

- *Top, left and right toolbars*: these toolbars contain buttons which correspond with actions available within the viewer. Example of such actions are: patients/studies search, association of tools with mouse buttons, image manipulation functions, display layout configuration functions, reporting functions, etc.
  These toolbars are completely configurable and customizable for each user through the viewer's settings. If no buttons are configured for a given toolbar, that toolbar will be completely hidden and won't appear on the GUI. For instance, in RemotEye Viewer's default configuration, there are no buttons configured for the left toolbar, so the GUI will appear with just a top toolbar and a right toolbar.

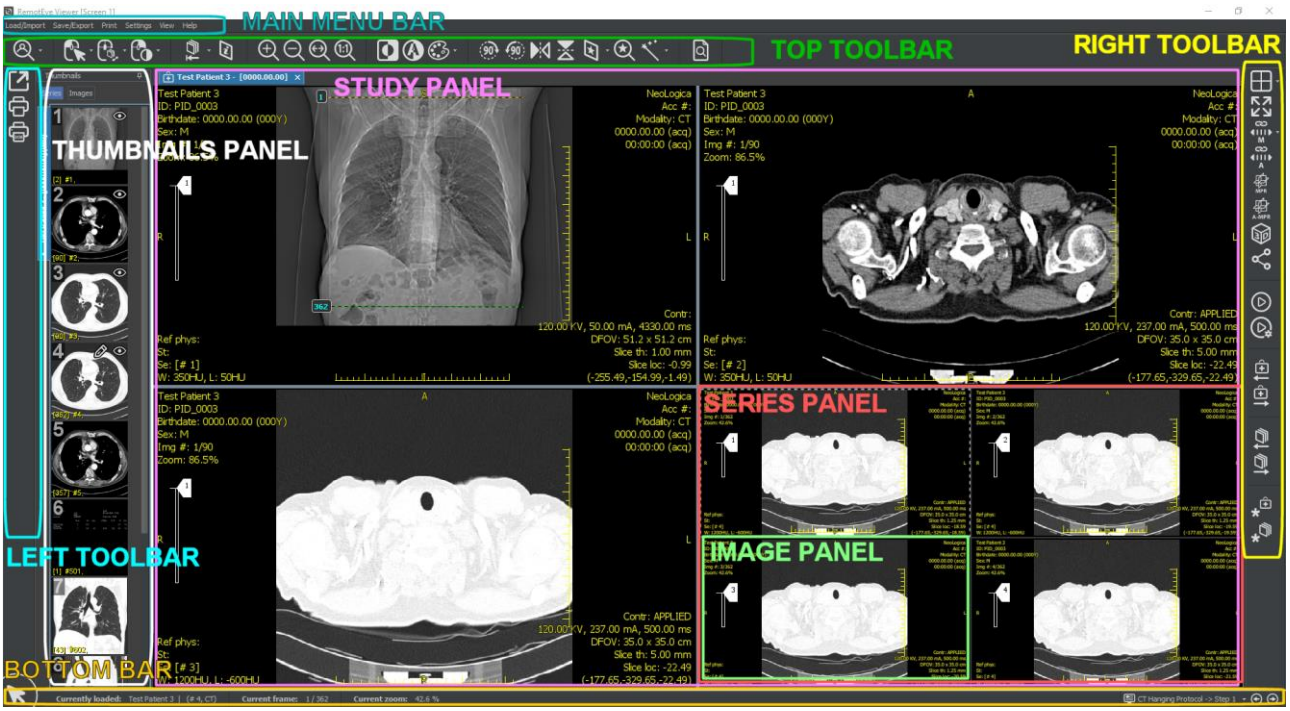
- *Study panel(s)*: each study loaded in RemotEye Viewer is displayed in its own dedicated *study panel*. By default, multiple study panels are arranged in a "tabbed" fashion. However, it is possible to manually drag the tab title of each study panel to arrange and dock the panel according to the user's preference (e.g., in a side-by-side fashion). A study panel contains one or more series panels, depending on the "series tiling" (or series layout) currently set on that study panel.

- *Series panel(s)*: each study panel contains one or more *series panels*, depending on the series tiling currently set on the study panel. Each series panel contains and shows images belonging to a given series or sequence. In turn, each series panel contains one or more *image panels*, depending on the "image tiling" (or image layout) currently set on that series panel.

- *Thumbnails panel*: this panel displays thumbnail images. The thumbnails may represent the available series or all available images, depending on the user's choice. This thumbnails panel can be dragged (through the panel's title bar) to a different position within the viewer' window, and can be arranged either vertically or horizontally, according to user's preference.

- *Bottom bar*: this thin bar located at the bottom of the viewer's window contains several context-specific tools and information. In the left edge, it shows the currently-active mouse tool. Next to the currently-active tool, it shows the *tool options panel* related to this currently-active tool, showing the options and information related to this tool. Hence, the content of this tool options panel changes according to the currently-active mouse tool. Then, in the right portion of the bottom bar we can find the *hanging steps / hanging views selection and iteration panel*. Finally, in the right edge of the bottom bar we can find the *viewer jobs panel*, showing the progress of eventual active jobs within the viewer (e.g., a loading operation).

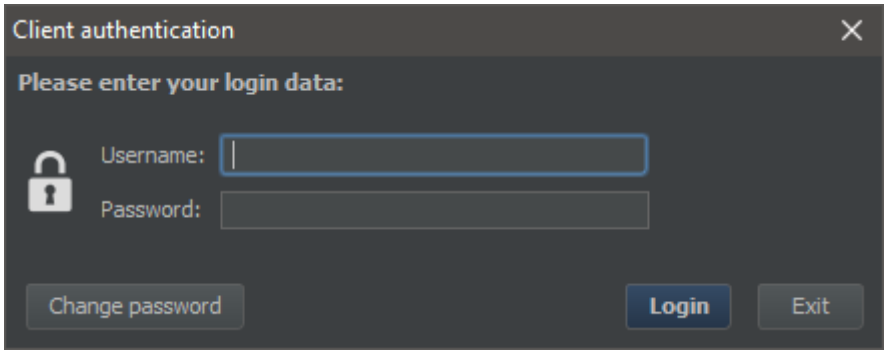
The following picture shows a screenshot of RemotEye Viewer's GUI, with the main panels clearly shown:



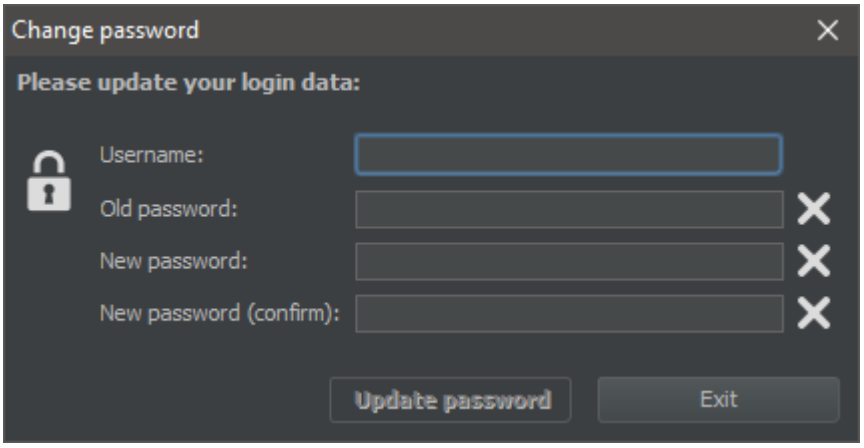
The following sections provide a detailed description of each element of the GUI, as well as of the related features.

5.1 Authentication

If user authentication is enabled, upon viewer startup a *Client authentication* dialog box will appear, asking user to enter his login credentials:

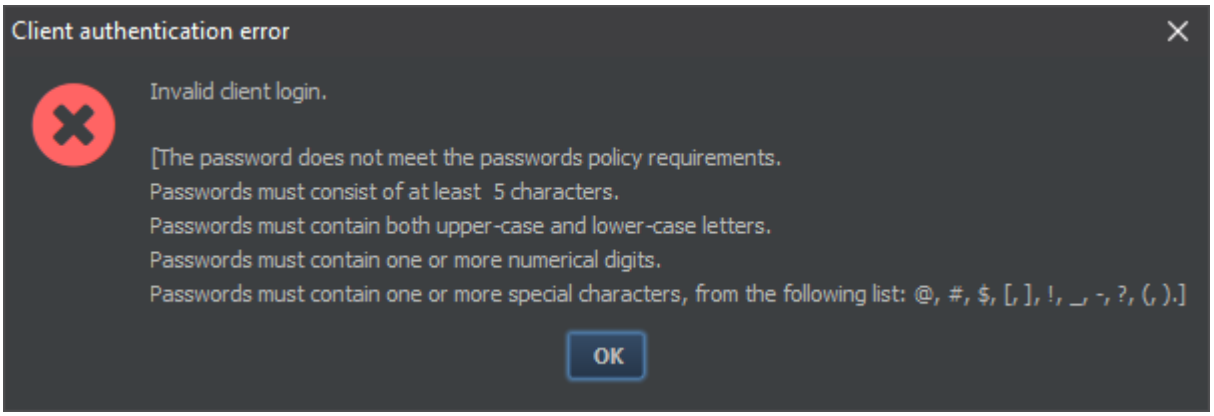


The *Change password* button allows users to update their login data:



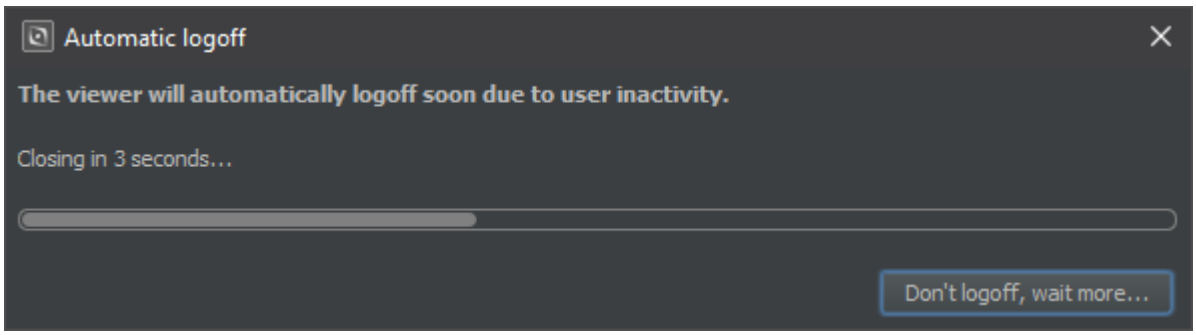
The same window will be displayed in case of password expiration, when supported and enabled on the backend.

Eventual restrictions on passwords syntax and minimum complexity shall be taken into account in order to correctly update login data. In case a non-compliant password is entered, an error message will appear, summarizing the requirements defined by the system administrator:



Once valid login data are entered, or following to a correct change of the password, the viewer's main GUI will appear, as outlined in the previous paragraph.

It is worth to point out that if the system administrator has enabled the automatic logoff option, then the following message will appear after the user is inactive for the configured amount of time:

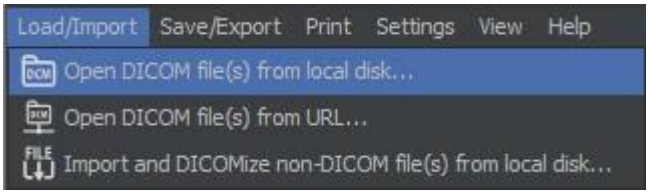


If the timeout shown in the previous message runs out, then the user will be logged off, and the viewer application will be closed.

6 Main menu

6.1 Load/Import

Here is a screenshot of the *Load/Import* menu:



Loading some DICOM studies in the viewer normally is the starting point for any usage of the RemotEye Viewer application, so this menu contains very important functionalities. Depending on the integration scenario, also the *Patients / Studies* functionality may be used to load available patients or studies.

6.1.1 Loading DICOM files from local disk

Pressing the *Open DICOM file(s) from local disk…* menu item, a file-chooser dialog will appear, allowing selection of one or more DICOM files from the local filesystem, or of an entire folder containing DICOM files. The multiple-file selection can be performed as usual for the target operating system (e.g., under Windows hold the *Ctrl* key down while clicking on the files to include in the multiple selection).

6.1.2 Loading DICOM files from URL

Pressing the *Open DICOM file(s) from URL…* menu item, a dialog box will appear, where user can enter the URL of remote DICOM file(s). The URL may be a HTTP, HTTPS or FTP URL of a single DICOM file, of a DICOMDIR file or of a ZIP archive containing multiple DICOM files.

Pre-configured set of remote DICOM files (if available) may be loaded by selecting the appropriate item in the *Load*/Import menu.

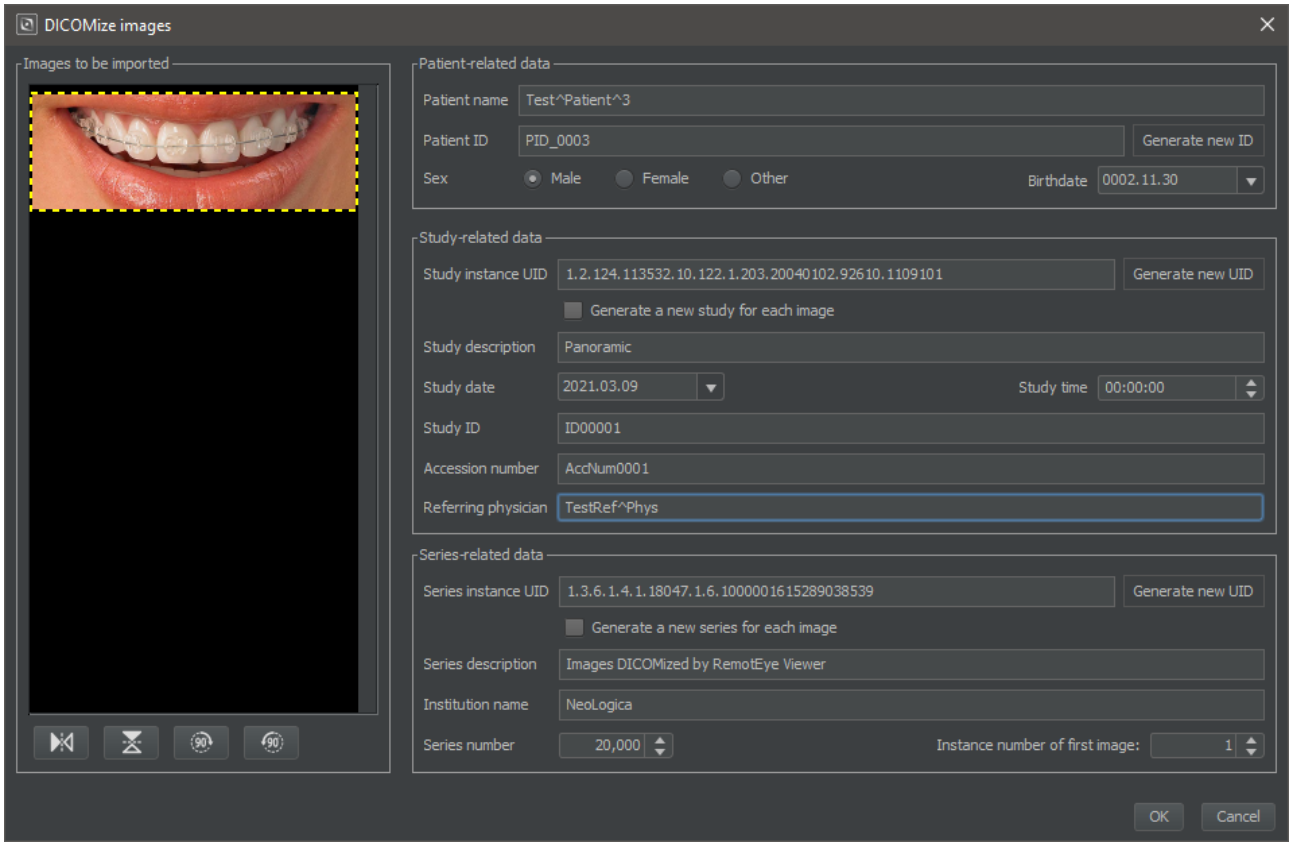
After a loading operation has completed, the related DICOM images and thumbnails will be displayed. Drag&drop from the *Thumbnails* panel to the main imaging panel is supported. Double-clicking on an image on the *Thumbnails* panel will load the entire display matrix with the scene starting at the double-clicked frame or series (depending on the currently active mode).

6.1.3 Importing and DICOMizing images

RemotEye Viewer allows converting non-DICOM images to DICOM format. Acceptable input formats for non-DICOM images are JPG, PNG, GIF, TIF, BMP.

If you already have a DICOM study open in the viewer, and you would like some non-DICOM images to become part of that DICOM study, then DICOMizing these non-DICOM image files is as easy as dragging them onto the open DICOM images. As an alternative, you may select the *Import and DICOMize non-DICOM file(s) from local disk…* menu item of the *Load/Import* menu.

The “DICOMize images” dialog box will appear:



This window will show the preview of the images to be converted to DICOM format. Through the small image manipulation toolbar which can be found at the bottom of the preview panel, it is possible to rotate and flip the input images, if necessary, before conversion to DICOM format. The right portion of this window, on the other side, specifies all DICOM attributes which will be used to generate the DICOM dataset of the output DICOM images (DICOM Secondary Capture SOP Class). All these attributes are pre-loaded from the attributes of the currently-loaded DICOM study (the one which was the target of the initial drag&drop operation with non-DICOM images to be converted), if any. However, it will always be possible to manually manipulate the values of these attributes.

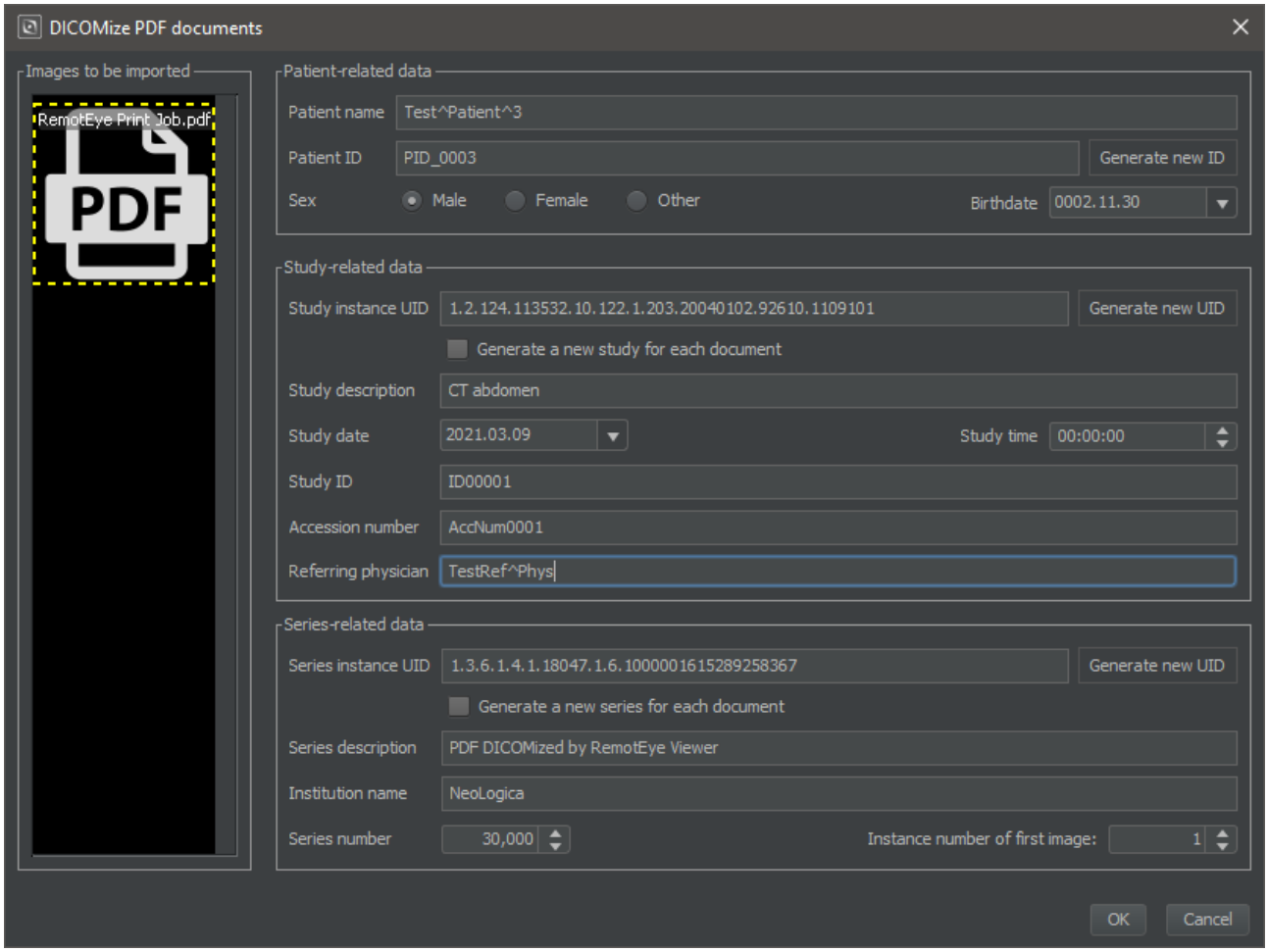
Several options are also supported, in order to determine how the new DICOM images will be separated in terms of DICOM studies and series.

6.1.4 Importing and DICOMizing PDF documents

RemotEye Viewer allows converting PDF documents to DICOM Encapsulated PDF format.

If you already have a DICOM study open in the viewer, and you would like some PDF documents to become part of that DICOM study, then DICOMizing these PDF files is as easy as dragging them onto the open DICOM images. As an alternative, you may select the *Import and DICOMize non-DICOM file(s) from local disk…* menu item of the *Load/Import* menu.

The “DICOMize PDF documents” dialog box will appear:



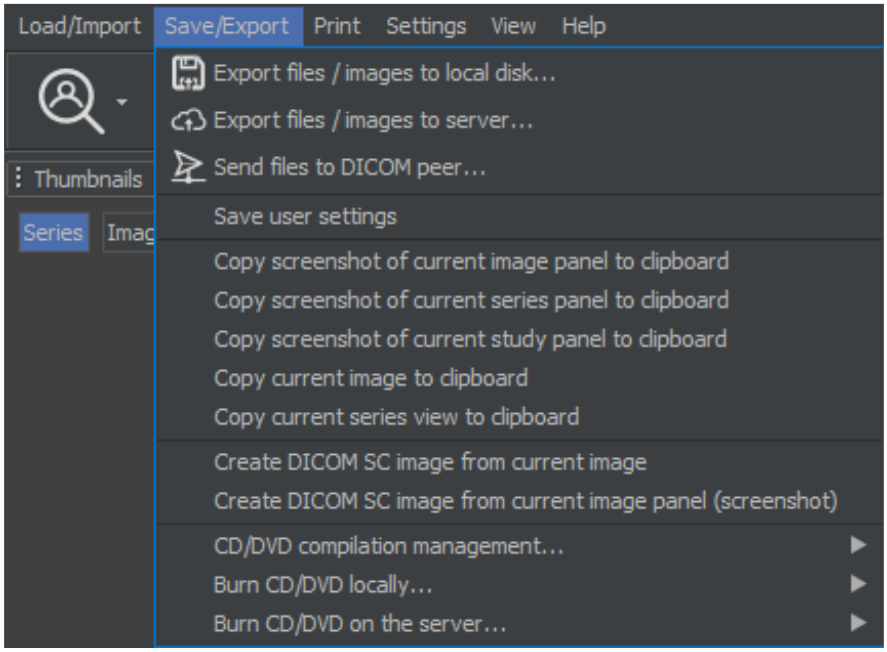
This window will show the preview of the PDF files to be converted to DICOM Encapsulated PDF format.

The right portion of this window, on the other side, specifies all DICOM attributes which will be used to generate the DICOM dataset of the output DICOM Encapsulated PDFs. All these attributes are pre-loaded from the attributes of the currently-loaded DICOM study (the one which was the target of the initial drag&drop operation with PDF files to be converted), if any. However, it will always be possible to manually manipulate the values of these attributes.

Several options are also supported, in order to determine how the new DICOM Encapsulated PDFs will be separated in terms of DICOM studies and series.

6.2 Save/Export

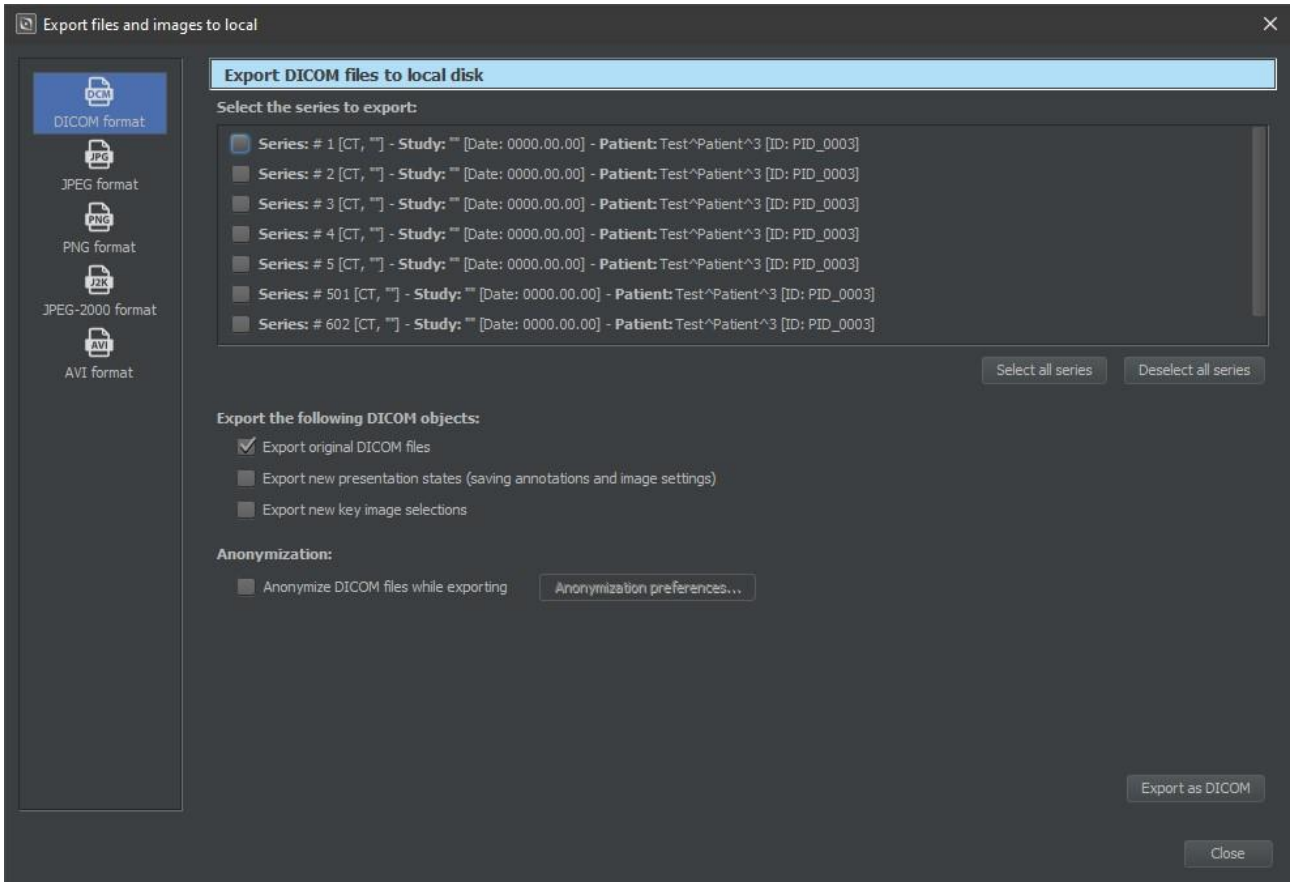
Here is a screenshot of the *Save/Export* menu:



The functions reachable through this menu allow exporting content (typically, images, but also other DICOM content) outside of the viewer application.

6.2.1 Exporting to local disk...

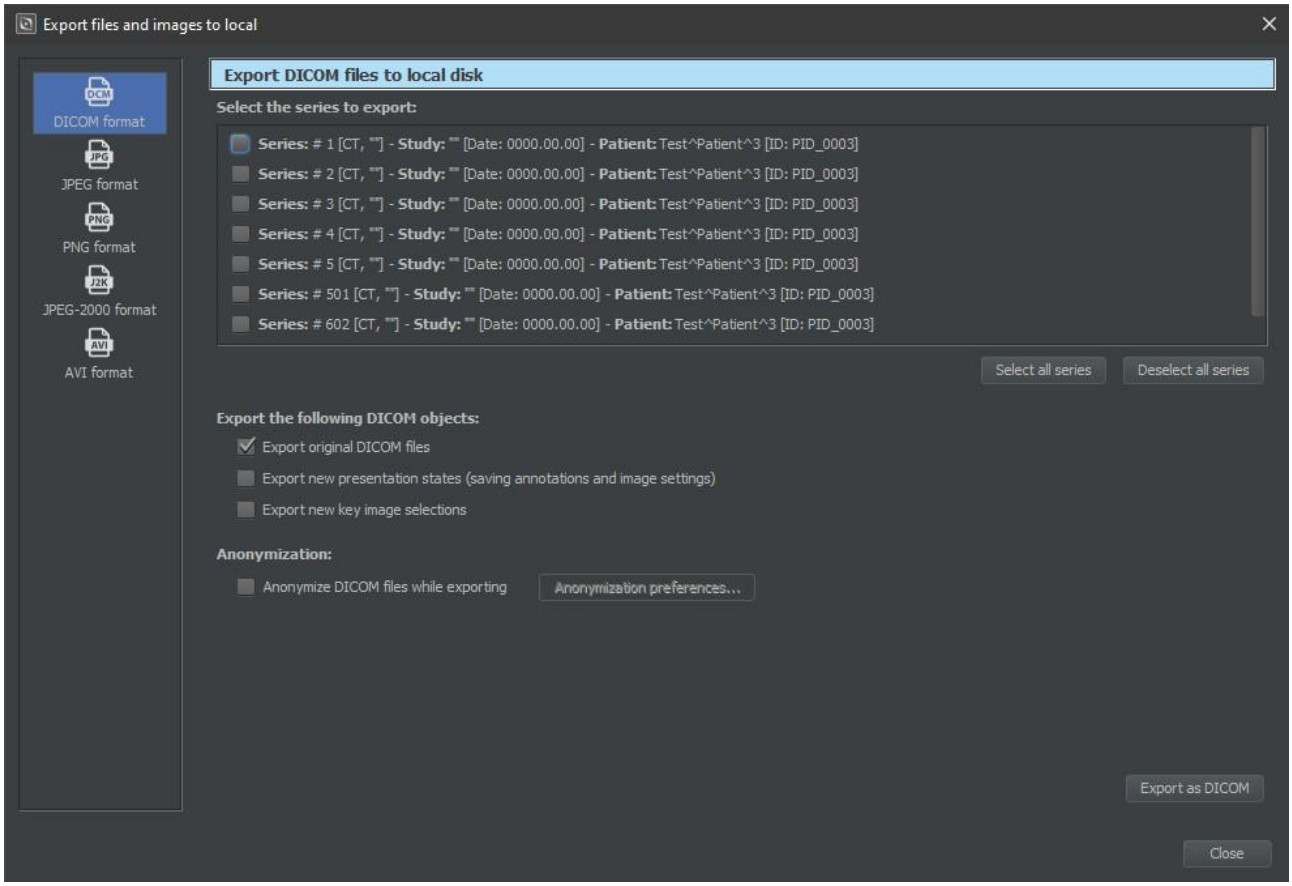
The *Export files / images to local disk*… menu item can be used to export currently-loaded files / images to the local file system or to save to the local file system modifications and settings made on images. If you select the *Export files / images to local disk*… menu item, the *Export files and images to local* dialog box will appear, as shown in the following picture:



Through this dialog, user can select which output format to use for the "export to local disk" operation.

6.2.1.1 Export DICOM files to local disk

The *Export DICOM files to local disk* page can be displayed by selecting the *DICOM format* item from the left-hand list:



This page can be used to export currently-loaded DICOM images to the local file system, or to save to the local file system modifications and settings made on images, through the Presentation State or Key Object Selection DICOM objects.

Through this dialog, user can select which series (among the loaded ones) need to be included in the "export to local" operation.

User can also choose to select all series pressing the *Select all series* button or to deselect all series pressing the *Deselect all series* button.

In addition, you can choose whether DICOM files need to be "anonymized" upon export. If the *Anonymize DICOM files while exporting* option is selected, then personal identifying information will be removed from exported DICOM datasets, according to the currently-set anonymization preferences.

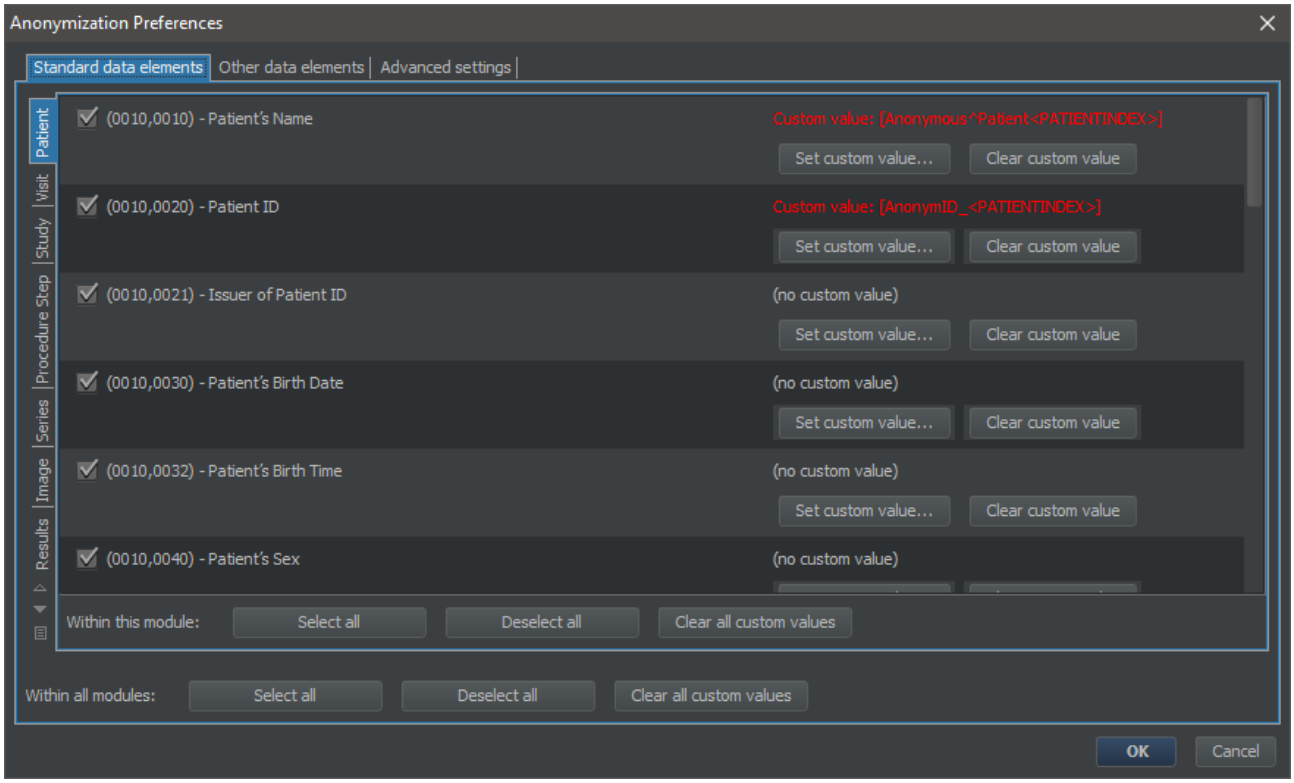
⚠ **Warning**: RemotEye Viewer performs dataset-level anonymization. This means that it is able to clear or modify the value of the data elements which are present inside the DICOM dataset. RemotEye Viewer *won't* clear eventual patient names or other identifying texts which were burnt inside the image pixels by the modality which generated the DICOM images, since it would be impossible to automatically and reliably distinguish these texts from the "real" pixel data.

On the *Export DICOM files to local disk* page, you can choose to export the original DICOM files of the series which have been selected in the top list. You can also choose whether to create and export new

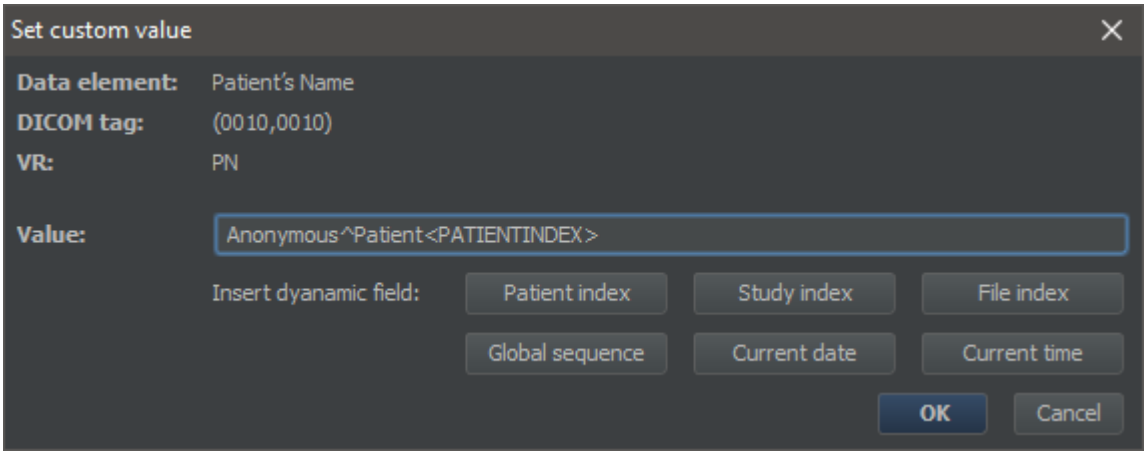
Presentation States for the selected series. Presentation State objects are able to save and store all settings performed by the user on the medical images, including contrast settings, rotation, flipping, annotations, etc. They don't contain the image, but only the transformations to be applied to images. They are the preferred way to save all modifications and annotations performed on the displayed DICOM images. Usually, the Presentation State files are quite small in size, so the store operation is efficient. In addition, you can choose whether to export the selections of Key Images for the selected series: this option allows supporting persistence of the Key Image information, which can be maintained the next time the study will be loaded.
When the *Export as DICOM* button is pressed, a *Save* file dialog is shown, through which the user will be able to select the path to be used to save the appropriate DICOM files.

Anonymization preferences

In order to modify the DICOM anonymization preferences, press the *Anonymization preferences...* button on the *Export DICOM files to local disk* page. The *Anonymization Preferences* dialog box will appear:



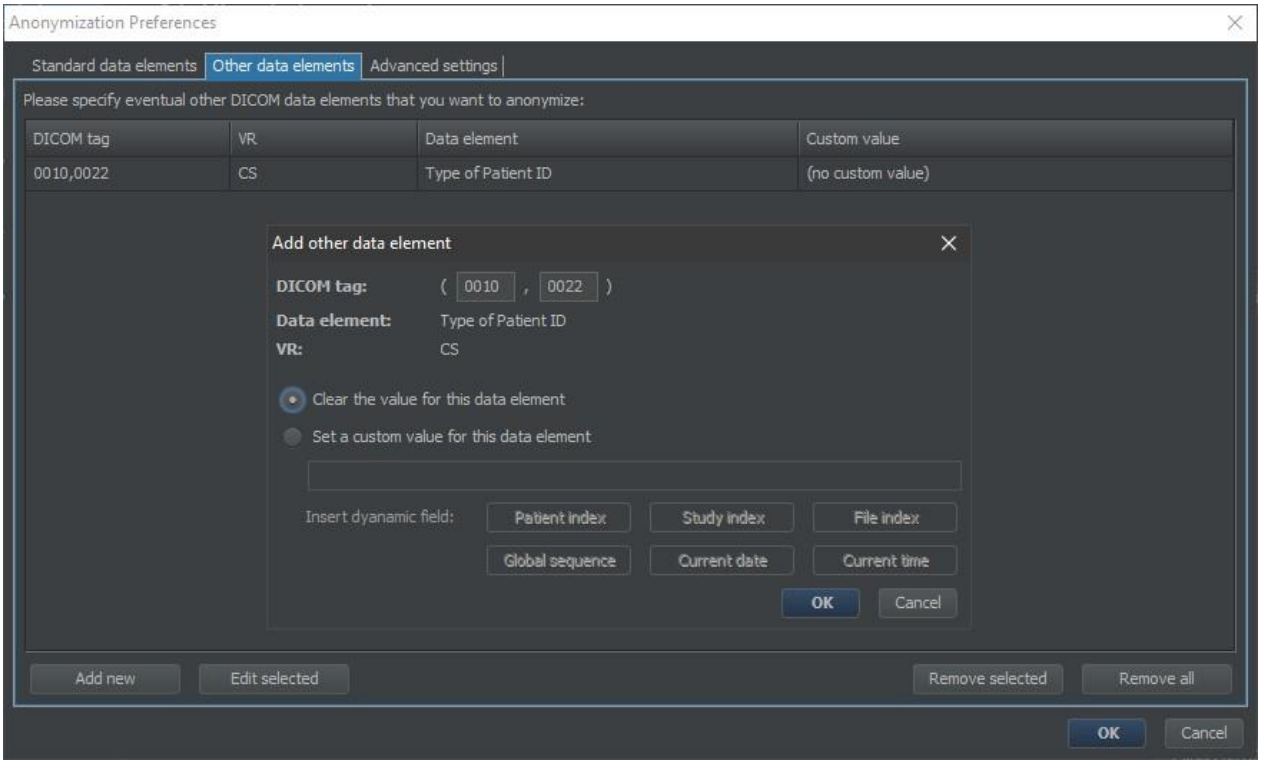
Through this dialog, you can choose which DICOM data elements to anonymize, and eventually set a custom value for each data element:



The custom value of the data element may also include dynamic fields, which are then automatically substituted by RemotEye Viewer during the anonymization process. The initial values of the "index" dynamic fields for each export operation may be set in the *Advanced settings* tab of the *Anonymization Preferences* dialog box. Each "index" is meant with reference to the single export operation; it will restart from its initial value on a subsequent export operation. The *Global sequence* dynamic field, on the other side, will be replaced with a new auto-incrementing value each time it will be encountered in the anonymization process, also within the same DICOM dataset.

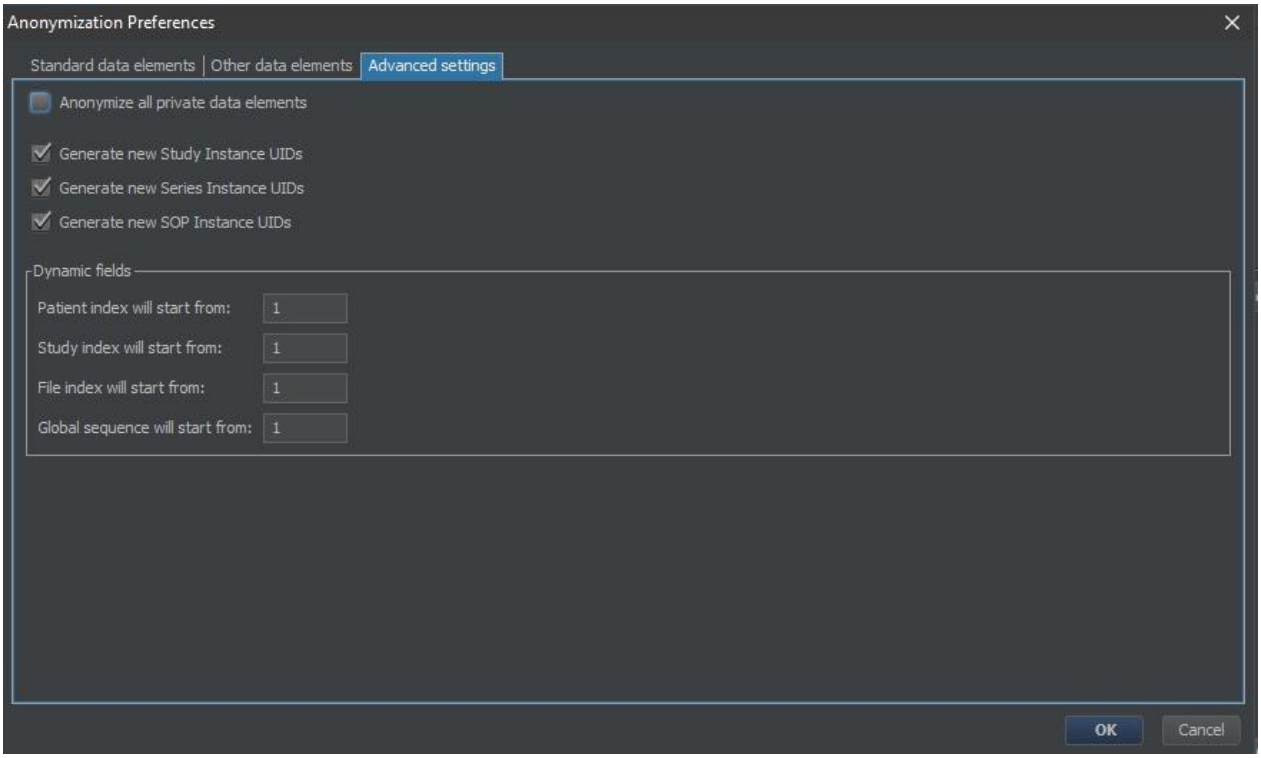
If a data element is selected, but no custom value is set for it, then RemotEye Viewer will simply clear the value of that data element upon export.

In addition to the *Standard data elements* provided by RemotEye Viewer, the user has the opportunity to add other data elements which need to be anonymized, through the *Other data elements* tab of the *Anonymization Preferences* dialog box:



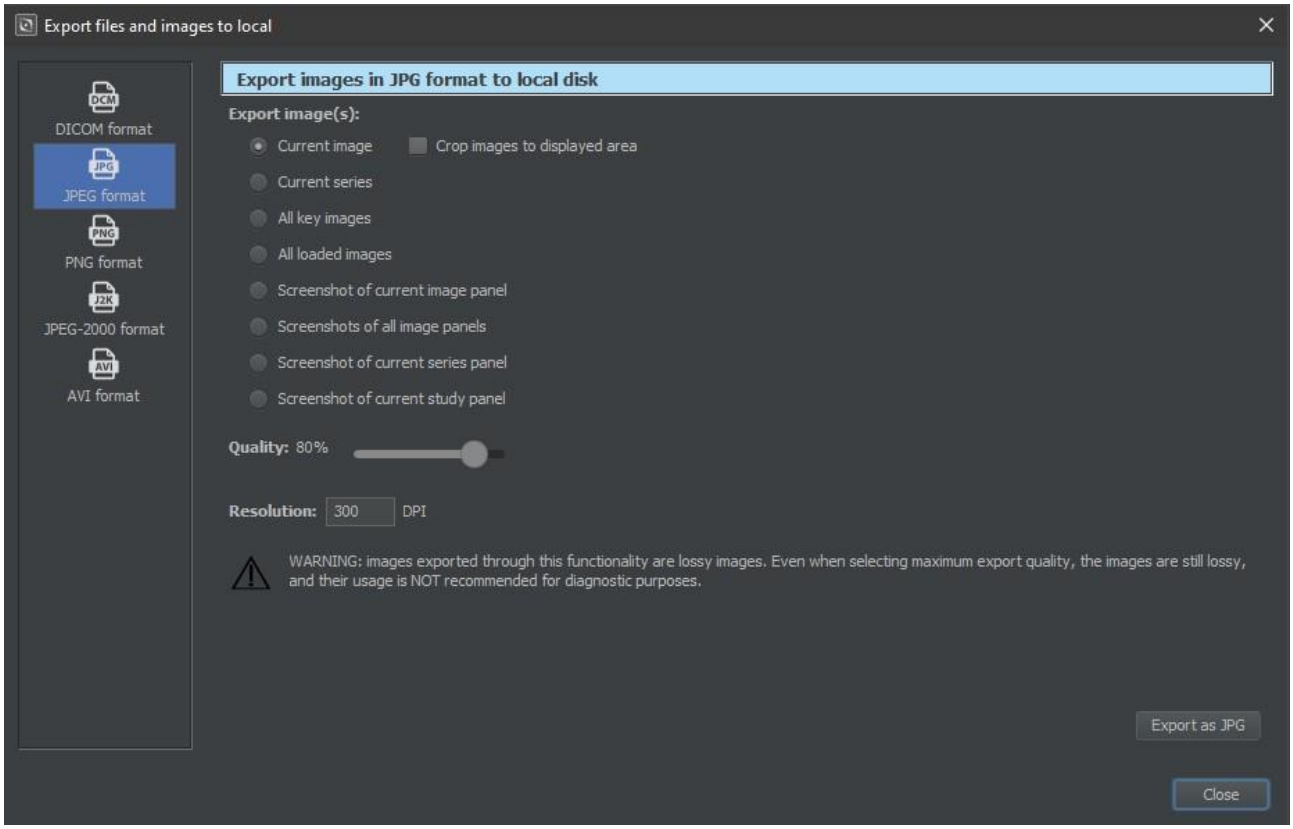
Even in this case, the user has the opportunity to eventually set a custom value for each added DICOM data element, also including dynamic fields.

Finally, the *Advanced settings* tab allows setting other advanced preferences about the anonymization process, including whether RemotEye Viewer should generate new unique IDs for the anonymized DICOM files (recommended), or whether RemotEye Viewer should anonymize all private data elements in the exported DICOM files.



6.2.1.2 Export images in JPG format to local disk

The *Export images in JPG format to local disk* page can be displayed by selecting the *JPEG format* item from the left-hand list:



This page can be used to export currently-loaded medical images to the local disk in JPEG format; it allows selecting which images need to be exported in JPEG format, as well as the quality and resolution of the JPEG images to be created.

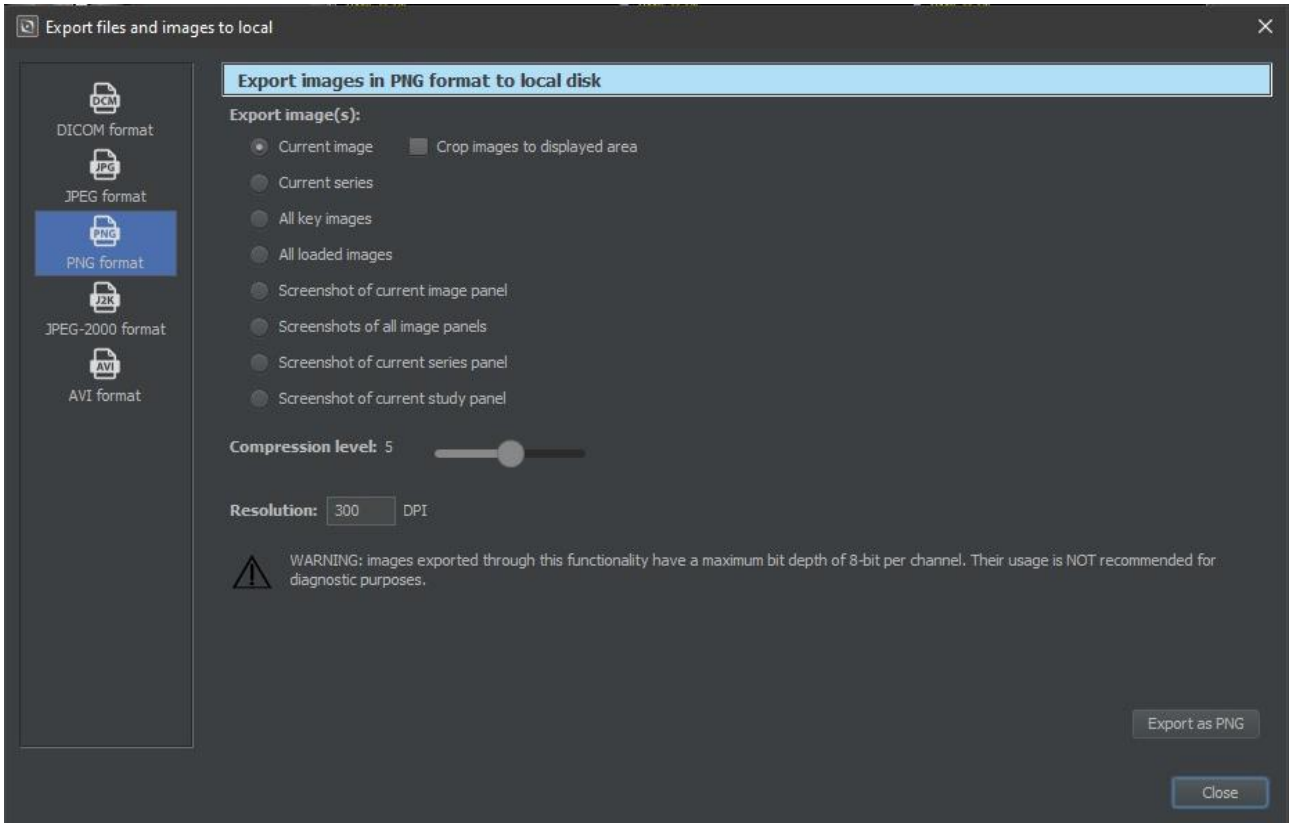
Also, by selecting the *Crop images to displayed area* option, it is possible to crop images to be exported to the portion which is visible in the currently displayed area. This option is only available when the export selection is set to *Current image* or *Current series*.

When the *Export as JPG* button is pressed, a *Save* file dialog is shown, through which the user will be able to select the path to be used to save the appropriate JPEG files.

⚠ **Warning**: the supported JPEG export format is a *lossy* compression format. Even if a “100 %” quality is specified, the output image is still *lossy*.

6.2.1.3 Export images in PNG format to local disk

The *Export images in PNG format to local disk* page can be displayed by selecting the *PNG format* item from the left-hand list:



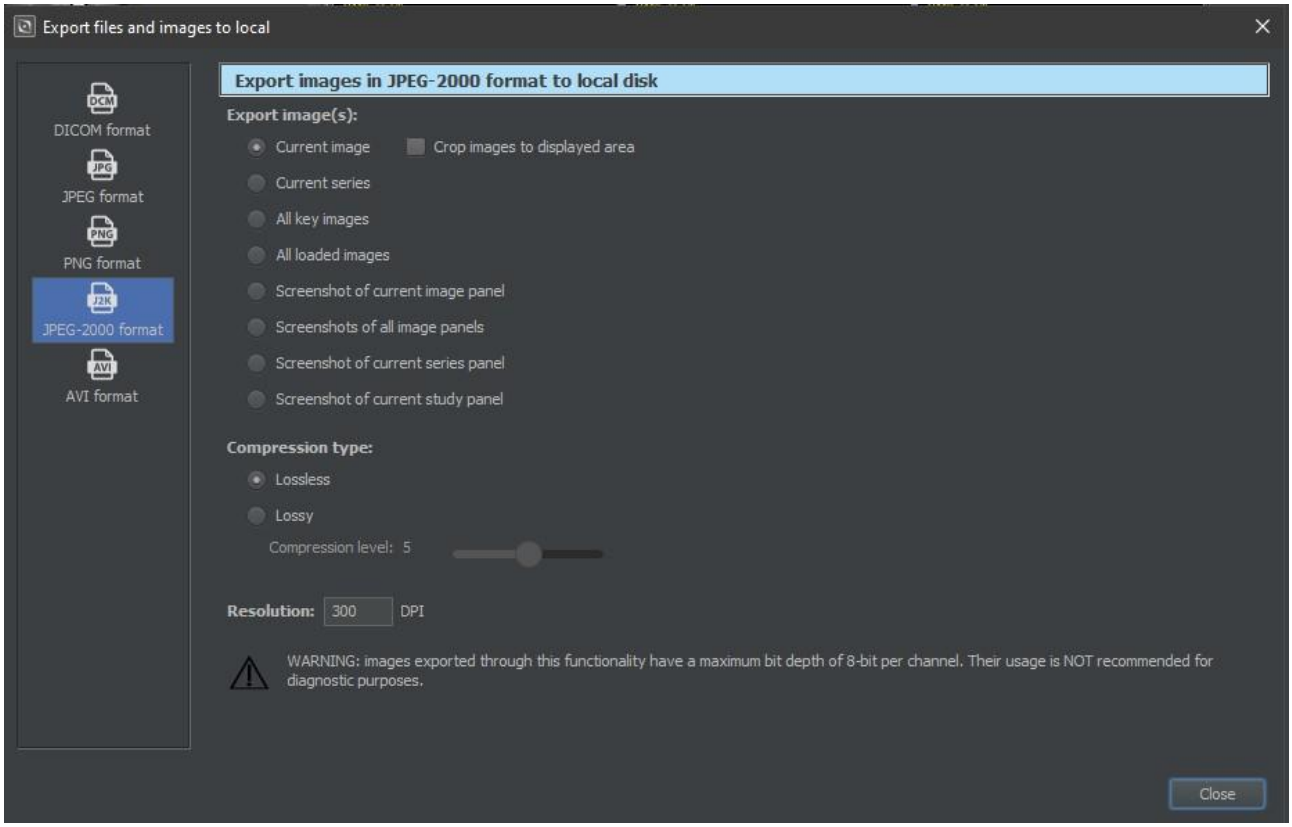
This page can be used to export currently-loaded medical images to the local disk in PNG format; it allows selecting which images need to be exported in PNG format, as well as the compression level and resolution of the PNG images to be created

Also, by selecting the *Crop images to displayed area* option, it is possible to crop images to be exported to the portion which is visible in the currently displayed area. This option is only available when the export selection is set to *Current image* or *Current series*.

When the *Export as PNG* button is pressed, a *Save* file dialog is shown, through which the user will be able to select the path to be used to save the appropriate PNG files.

6.2.1.4 Export images in JPEG-2000 format to local disk

The *Export images in JPEG-2000 format to local disk* page can be displayed by selecting the *JPEG-2000 format* item from the left-hand list:



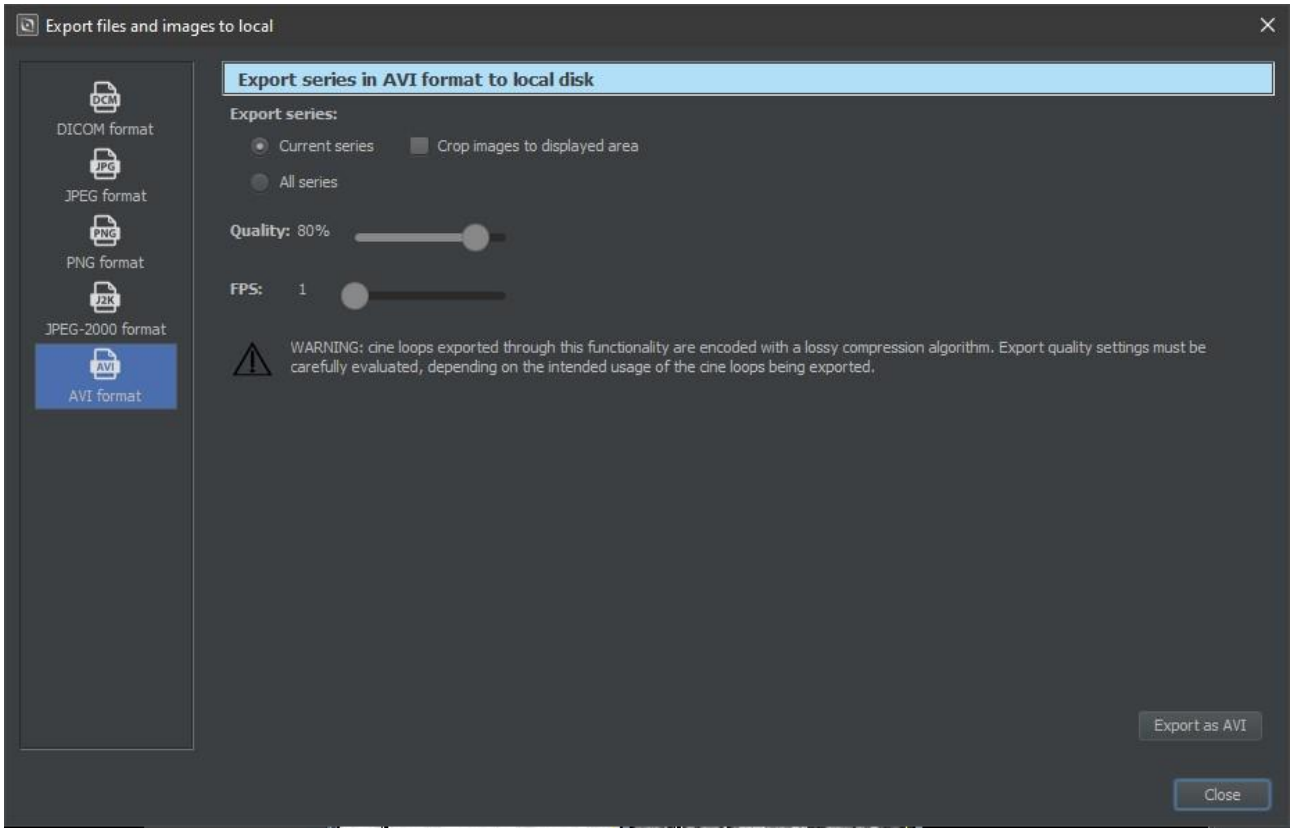
This page can be used to export currently-loaded medical images to the local disk in JPEG-2000 format; it allows selecting which images need to be exported in JPEG-2000 format, as well as the compression type (*Lossless* or *Lossy*) and resolution of the JPEG-2000 images to be created. In case the *Lossy* compression type is selected, it is possible to specify the compression level to be used.

Also, by selecting the *Crop images to displayed area* option, it is possible to crop images to be exported to the portion which is visible in the currently displayed area. This option is only available when the export selection is set to *Current image* or *Current series.*

When the *Export as JPG-2000* button is pressed, a *Save* file dialog is shown, through which the user will be able to select the path to be used to save the appropriate JPEG-2000 files.

6.2.1.5 Export series in AVI format to local disk

The *Export series in AVI format to local disk* page can be displayed by selecting the *AVI format* item from the left-hand list:



This page can be used to export currently-loaded series to the local disk in AVI format, as movies; it allows selecting which series need to be exported in AVI format, as well as quality and frame rate of the AVI movie to be created.

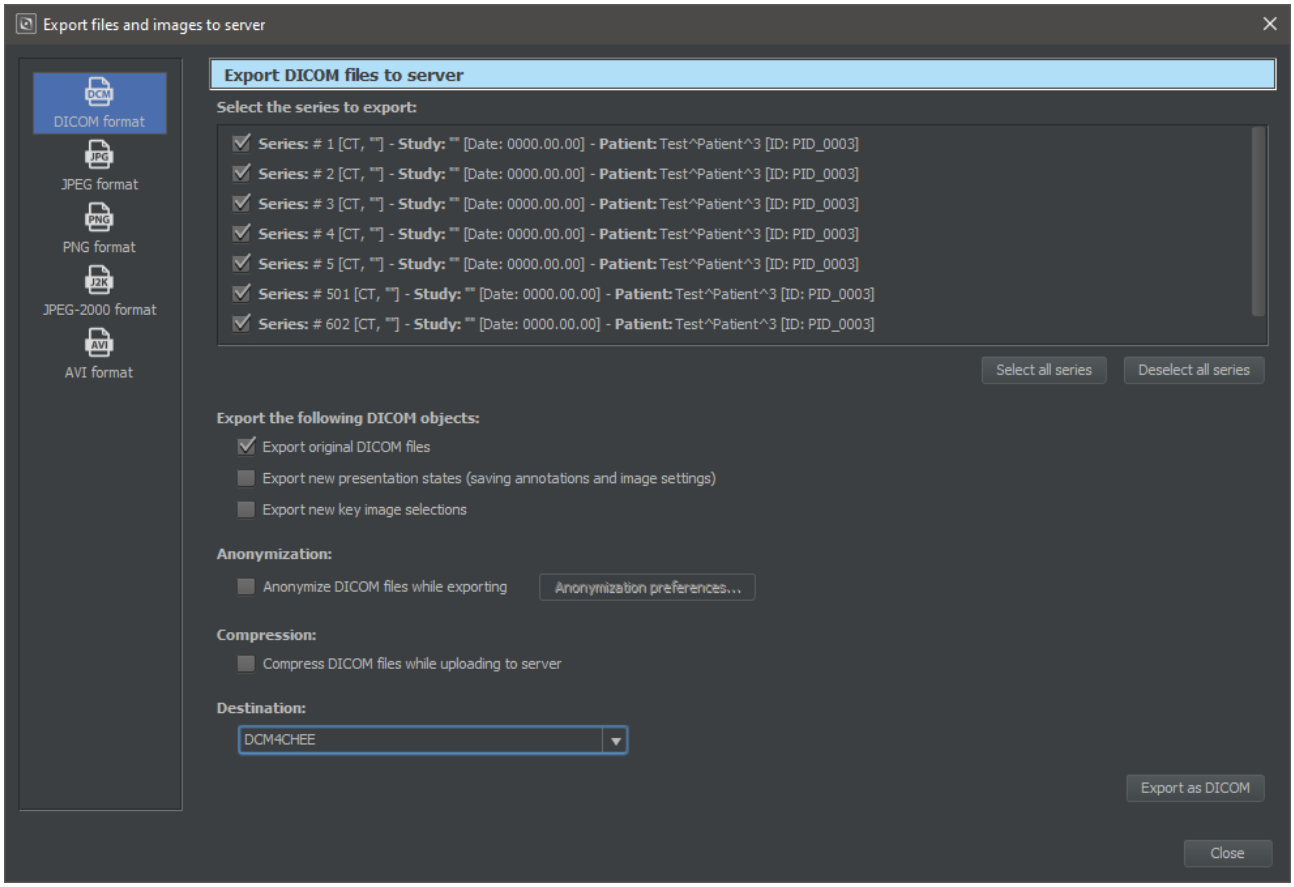
Also, by selecting the *Crop images to displayed area* option, it is possible to crop images to be exported to the portion which is visible in the currently displayed area. This option is only available when the export selection is set to *Current series*.

When the *Export as AVI* button is pressed, a *Save* file dialog is shown, through which the user will be able to select the path to be used to save the appropriate AVI files.

6.2.2 Exporting to server...

The *Export files / images to server*… menu item can be used to export currently-loaded files / images to server, or to save to server modifications and settings made on images. This menu item is only available when RemotEye Viewer is configured to communicate with server-side scripts for the remote storage operation.

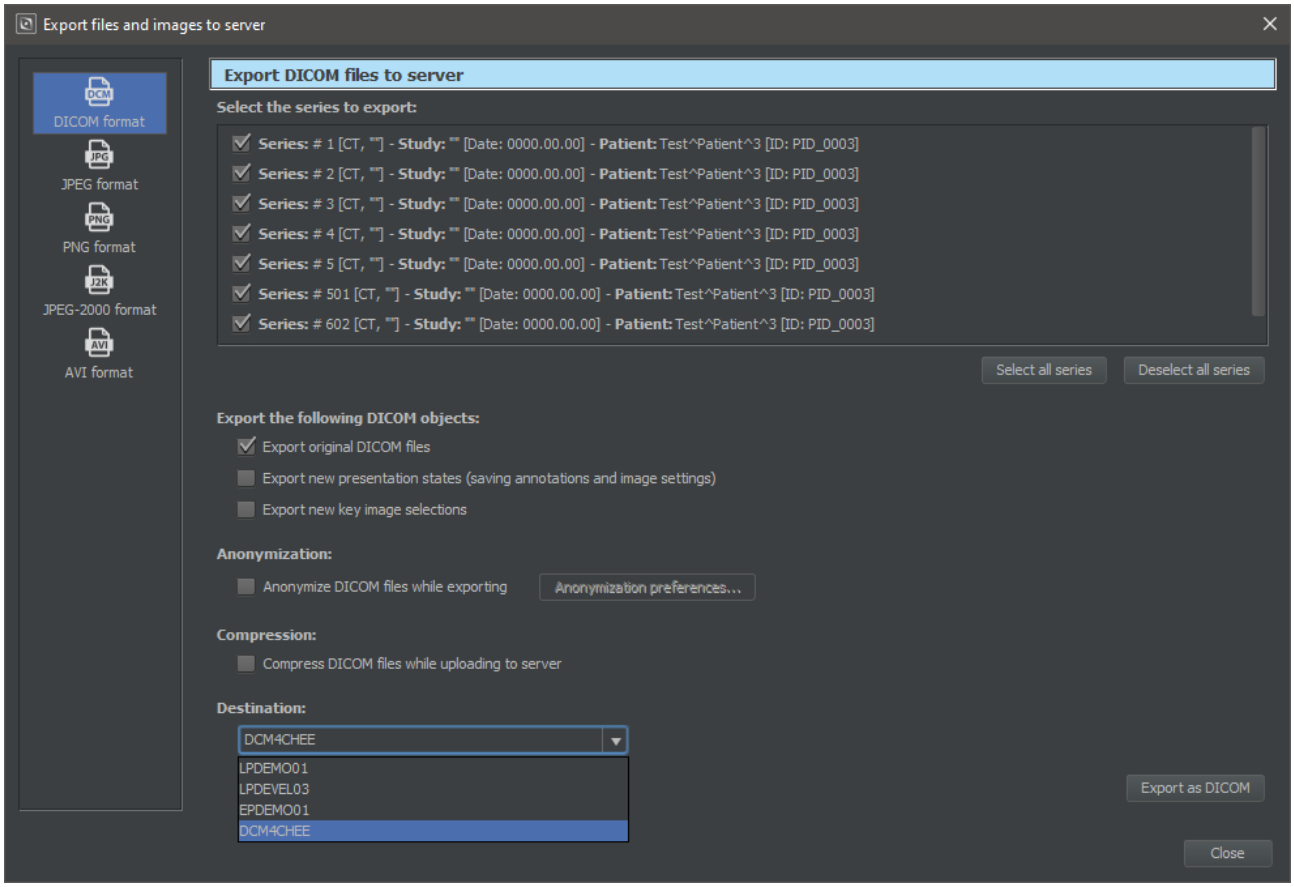
If you select the *Export files / images to server*… menu item, the *Export files and images to server* dialog will appear, as shown in the following picture:



Through this dialog, user can select which format to use for the "export to server" operation.

6.2.2.1 Export DICOM files to server

The *Export DICOM files to server* page can be displayed by selecting the *DICOM format* item from the left-hand list:



This page can be used to export currently-loaded DICOM images to server, or to save to server modifications and settings made on images, through the Presentation State or Key Object Selection DICOM objects.

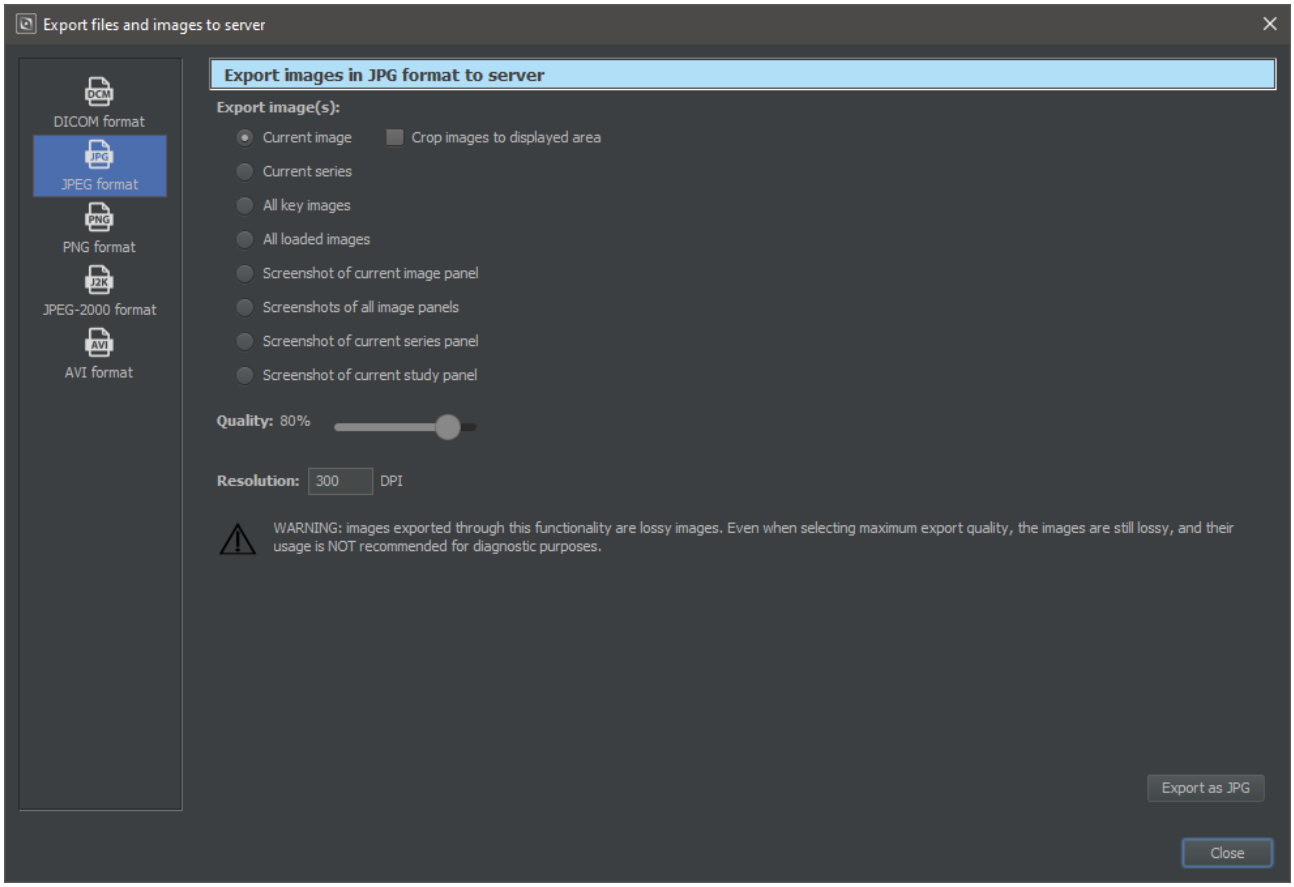
The options are exactly the same as explained in the previous paragraph for the *Export DICOM files to local disk* functionality. The only difference is that when the *Export as DICOM* button is pressed, the *Save* file dialog is not shown, but DICOM files are automatically saved to the server.

In addition, if the server-side of RemotEye Viewer supports compression, you can choose to compress DICOM files while uploading them to server. If working on a slow network link (such as an Internet connection), compression can significantly reduce uploading time.

Finally, if the DICOM back-end supports multiple export AE titles, the *Export DICOM files to server* window allows selecting the destination AE title, through a drop-down box.

6.2.2.2 Export images in JPG format to server

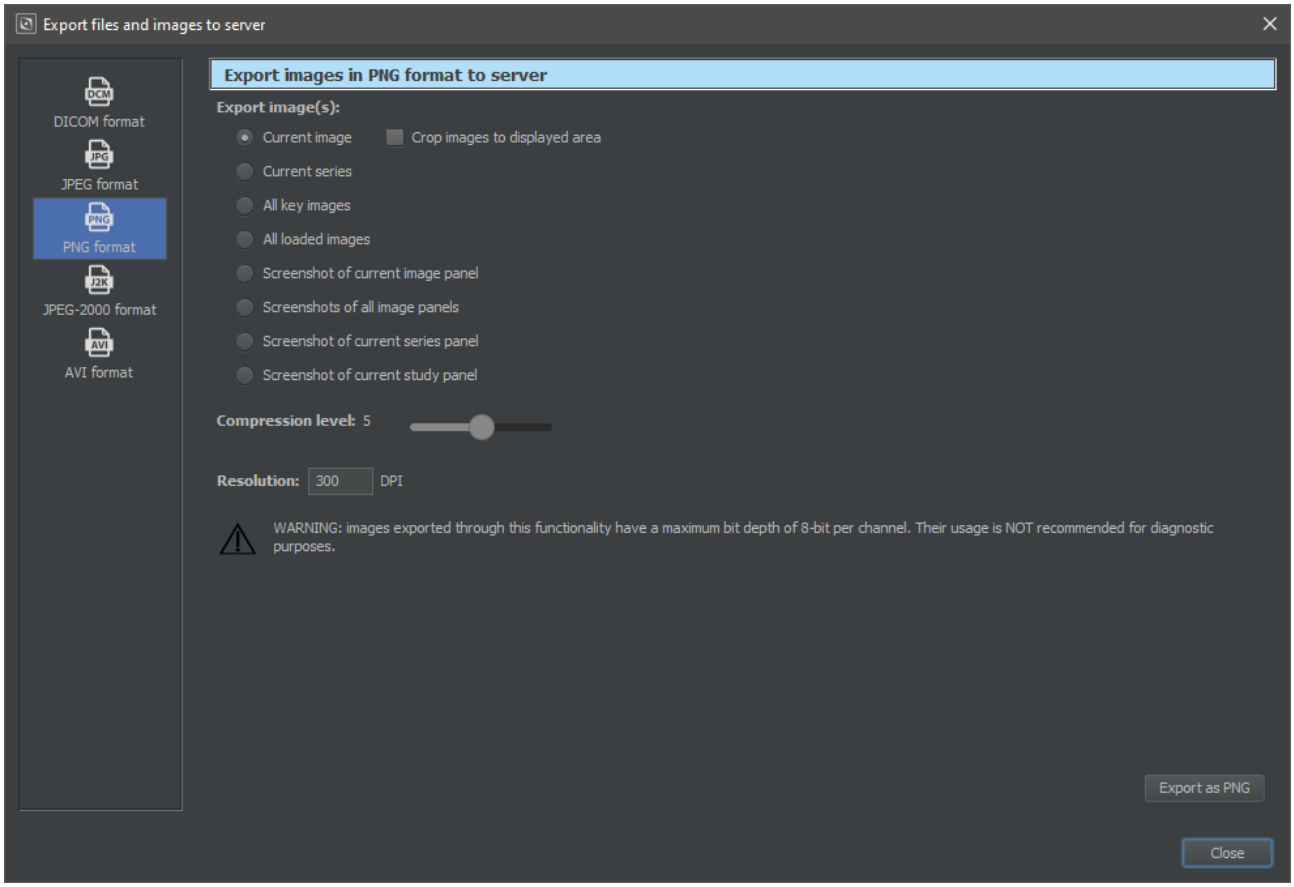
The *Export images in JPG format to server* page can be displayed by selecting the *JPEG format* item from the left-hand list.



The options are exactly the same as explained in the previous paragraph for the *Export images in JPG format to local disk* functionality. The only difference is that when the *Export as JPG* button is pressed the *Save* file dialog is not shown, but JPEG files are automatically saved to the server.

6.2.2.3 Export images in PNG format to server

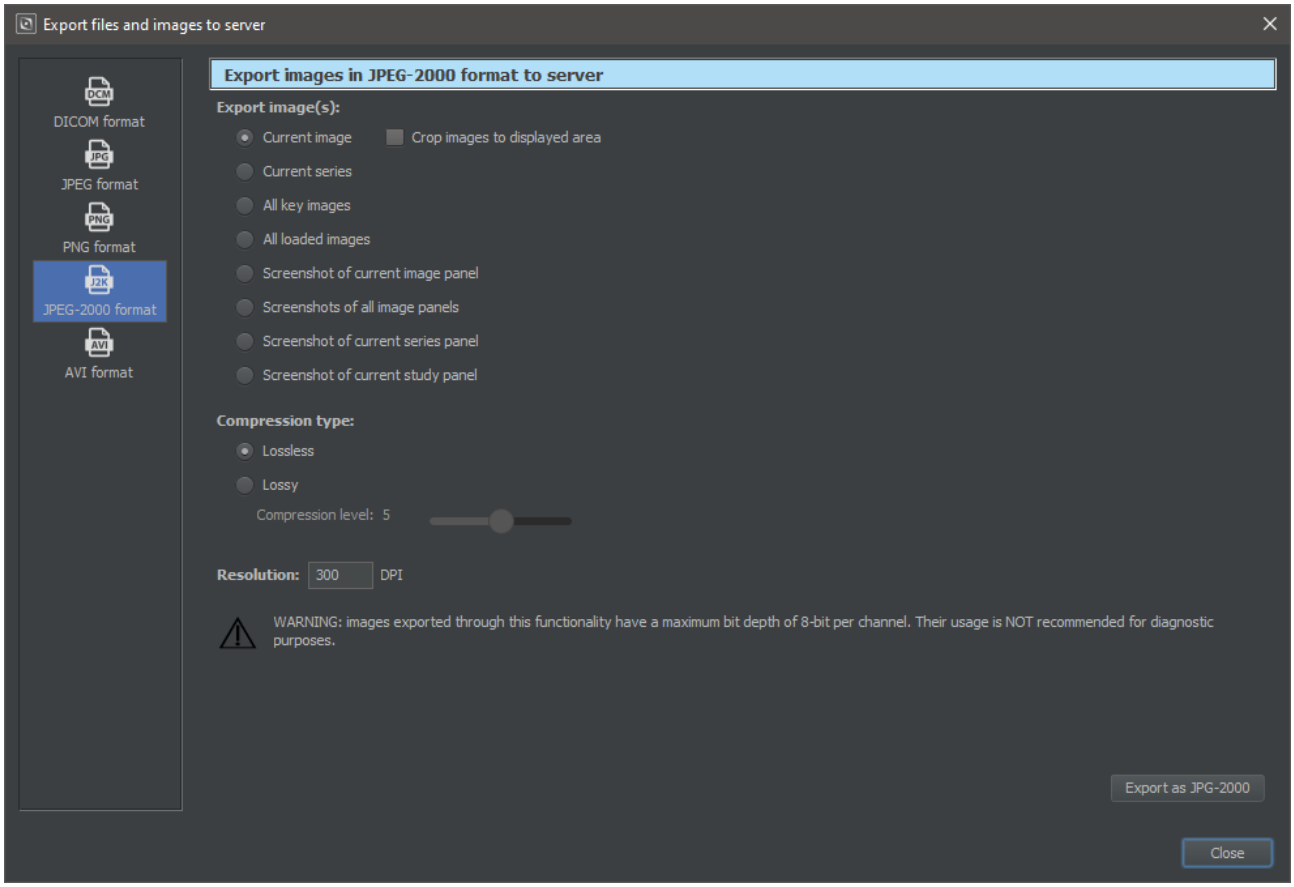
The *Export images in PNG format to server* page can be displayed by selecting the *PNG format* item from the left-hand list:



The options are exactly the same as explained in the previous paragraph for the *Export images in PNG format to local disk* functionality. The only difference is that when the *Export as PNG* button is pressed, the *Save* file dialog is not shown, but PNG files are automatically saved to the server.

6.2.2.4 Export images in JPEG-2000 format to server

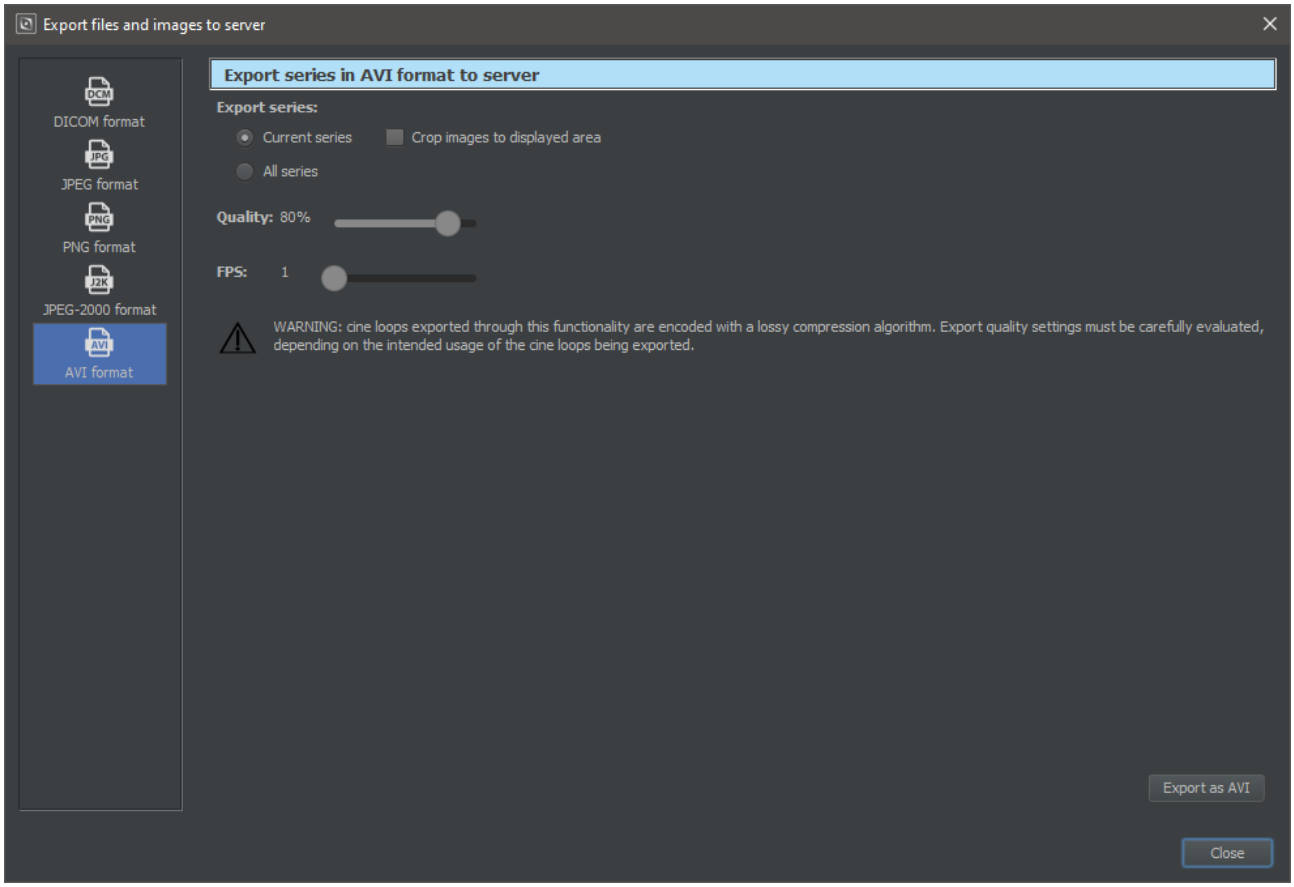
The *Export images in JPEG-2000 format to server* page can be displayed by selecting the *JPEG-2000 format* item from the left-hand list:



The options are exactly the same as explained in the previous paragraph for the *Export images in JPEG-2000 format to local disk* functionality. The only difference is that when the *Export as JPG-2000* button is pressed, the *Save* file dialog is not shown, but JPEG-2000 files are automatically saved to the server.

6.2.2.5 Export series in AVI format to server

The *Export series in AVI format to server* page can be displayed by selecting the *AVI format* item from the left-hand list:

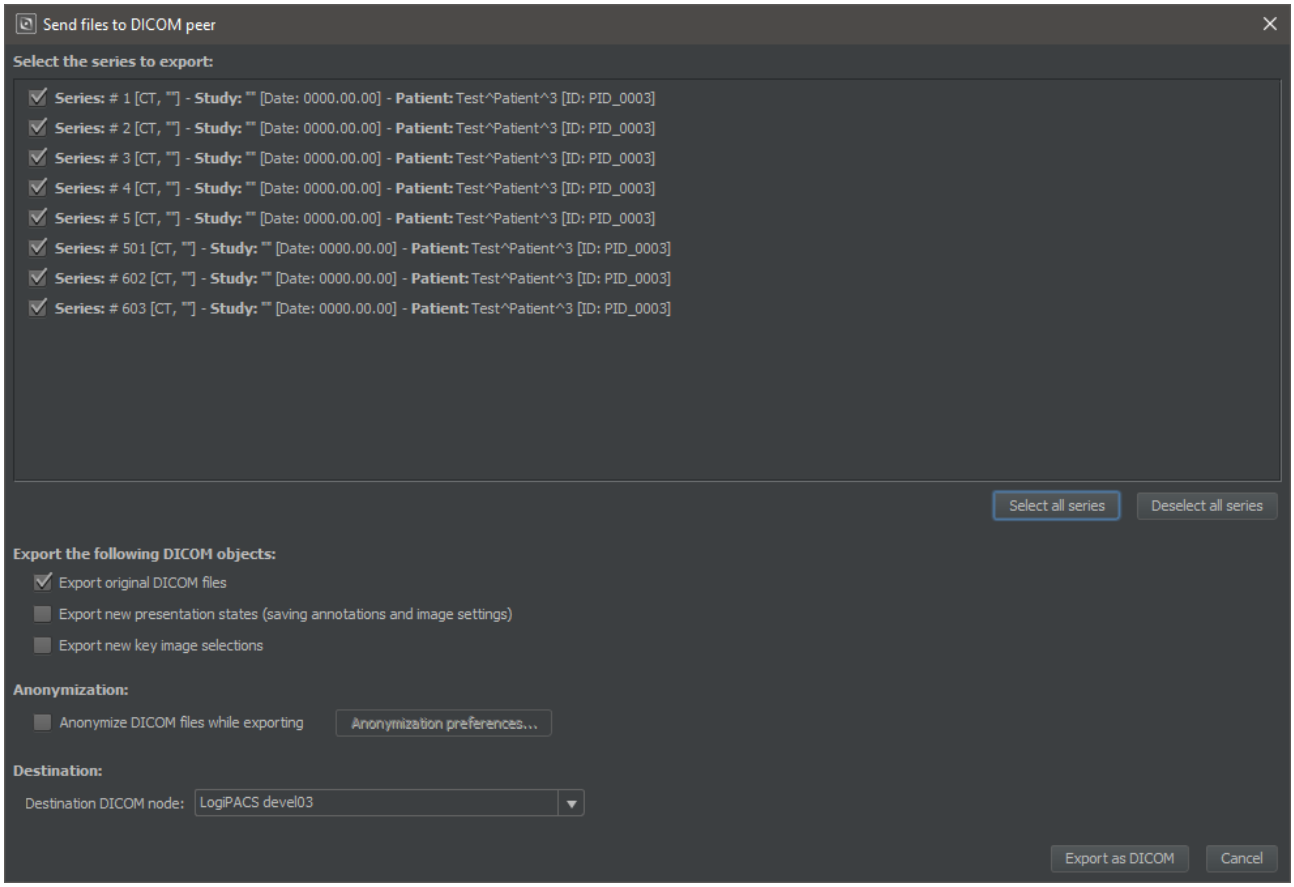


The options are exactly the same as explained in the previous paragraph for the *Export series in AVI format to local disk* functionality. The only difference is that when the *Export as AVI* button is pressed, the *Save* file dialog is not shown, but AVI files are automatically saved to the server.

6.2.3 Sending files to DICOM peer

The *Send files to DICOM peer…* menu item can be used to export DICOM datasets (including currently-loaded files / images, new Presentation State objects, new Key Object Selection objects) to other DICOM nodes acting as DICOM Storage SCP's.

If you select the *Send files to DICOM peer…* menu item, the *Send files to DICOM peer* dialog will appear, as shown in the following picture:



As usual, in this dialog box you will be able to select which DICOM series to send, which DICOM content to include in the transfer, whether to anonymize the DICOM content and in which way.
Finally, you will be able to select the *Destination DICOM node* (i.e., the DICOM node which will be the target of the "send" operation), among the ones which have been configured in the *DICOM devices* section of the viewer's *Settings*, and which have the *Storage SCP* option enabled.

6.2.4 Saving user settings

The *Save user settings* menu item of the *Save/Export* menu allows saving the current user settings (i.e., user selections, default choices, screens setup, enabled options, etc.) to the server. RemotEye Viewer will show this menu item only if it has been configured to support storage of user settings to the server.
A further opportunity to save the current settings will be given to the user upon exit from the RemotEye Viewer application.

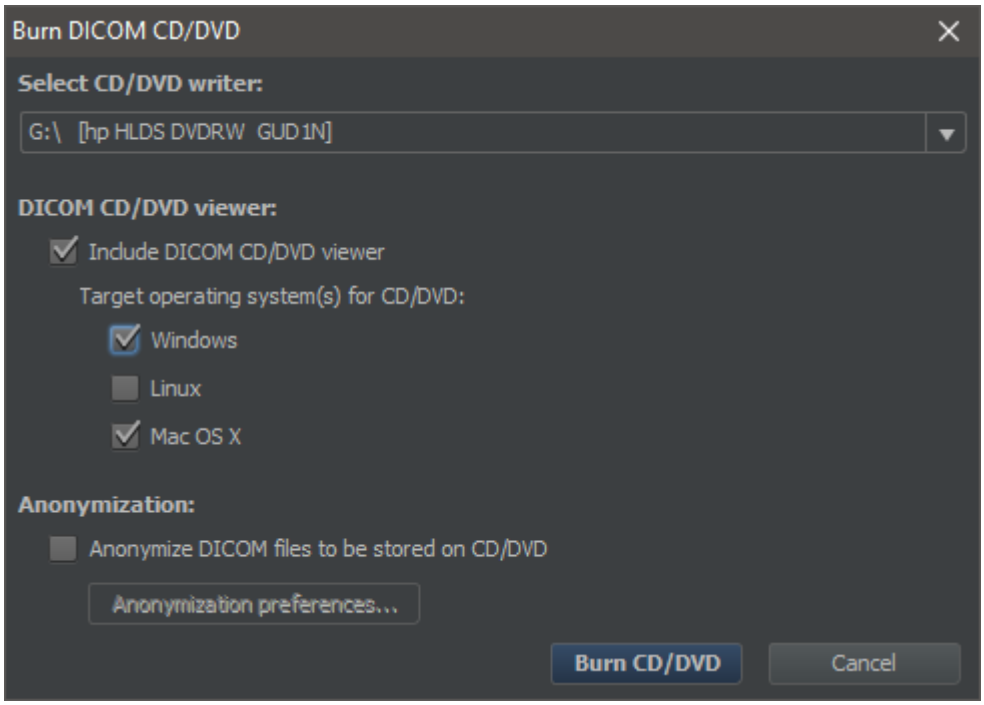
6.2.5 Copying images to the system clipboard

RemotEye Viewer supports a set of *Copy to clipboard* functions, which allow copying medical images to the system clipboard.

The "*Copy screenshot...*" set of functions perform a real snapshot of the content of the on-screen display panels, and copy it to the system clipboard. This implies that in this case the images copied to the system clipboard have the same pixel size as the related on-screen display panels, hence they are influenced by the current screen resolution and display mode.
On the other side, the remaining "*Copy ... to clipboard*" functions copy the medical images to clipboard at their original pixel size / resolution.
The *Ctrl+C* keyboard shortcut may be used to copy a screenshot of the current image panel to the system clipboard.

6.2.6 CD / DVD creation

The *Save/Export* menu includes a set of menu items which may be used to create CDs or DVDs containing DICOM images, as well as a dedicated DICOM viewer which will allow displaying those images on every PC.
Depending on the configuration of RemotEye Viewer, DICOM CDs or DVDs may be created either through the local CD/DVD writers of the client PC, or on the server side, through a dedicated server software.
In order to create locally a CD or DVD containing the images of the current patient or study, it is sufficient to select the *Burn CD/DVD locally… → Burn current Patient* or the *Burn CD/DVD locally… → Burn current Study* menu items.
If the user desires to create CDs or DVDs with a more complex content (e.g., several patients or studies on a single media) the concept of *CD/DVD compilation* must be used. The *CD/DVD compilation management…* menu contains menu items which allow adding and removing patients and studies from the current CD/DVD compilation, as well as displaying its current content. Once the CD/DVD compilation is complete, the *Burn CD/DVD locally… → Burn content of current CD/DVD compilation* menu item can be used to create a CD or DVD with the content of the current CD/DVD compilation. The *Burn DICOM CD/DVD* dialog box will appear:



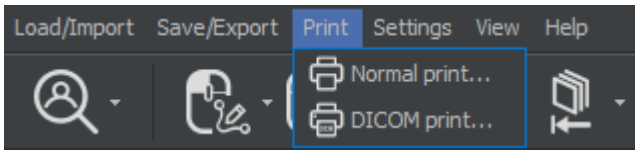
You will need to select the CD/DVD writer to use, through the *Select CD/DVD writer* drop-down box. Also, you will be able to choose whether a dedicated DICOM viewer should be included on the CD/DVD, and the Operating Systems this viewer should be compatible with.
Eventual reports associated with the studies present in the CD/DVD compilation will be included in the produced CD or DVD, and will be viewable through the embedded DICOM viewer.

⚠ **Important note:** please consider that selecting compatibility of the viewer with multiple Operating Systems will require more space on the CD/DVD, and more time will be needed to burn the media. So we suggest enabling compatibility with multiple Operating Systems only if required.

The explained concepts also apply to server-side burning of DICOM CDs or DVDs, when available.
In the case of the *Burn DICOM CD/DVD locally* functionality, DICOM anonymization is supported: it is possible to produce CDs or DVDs containing an anonymized (i.e., de-identified) version of the selected DICOM studies or patients. Please refer to the previous chapter related to DICOM export for details about the anonymization preferences.

6.3 Print

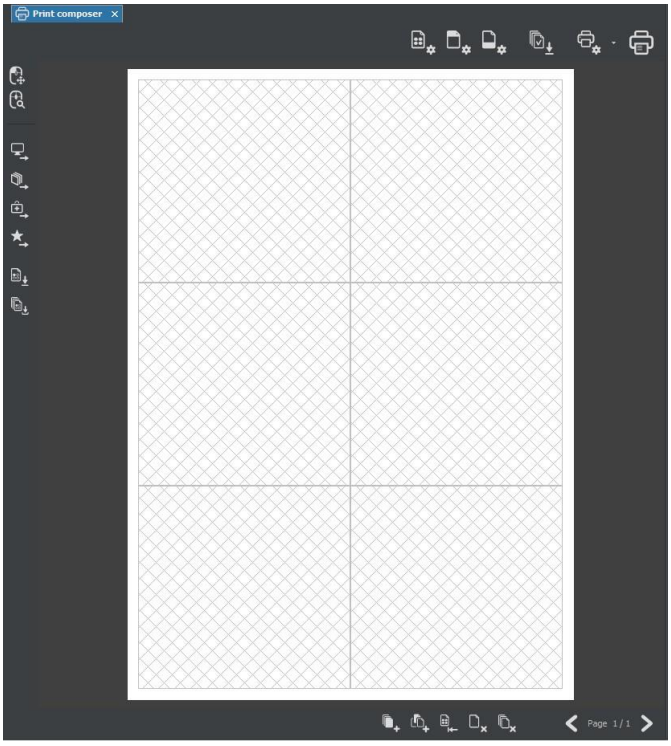
Here is a screenshot of the Print menu:



The functions reachable through this menu allow printing DICOM images to standard office printers as well as to DICOM printers, with configurable layouts and print attributes.

6.3.1 Printing to standard printers

In order to print medical images on standard PC or network printers, the *Normal print…* menu item must be selected. Once you select the *Normal print…* menu item, the *Print composer* panel will appear, as shown in the following picture:



The *Print composer* panel provides a real-time and interactive preview of the sheet(s) to be printed. The set of sheets to be printed will be referred to as the "print booklet" in the following sections. It is possible to populate the sheets with medical images, as well as to specify several preferences related to the sheets layout and appearance.

Population of the sheets in the print composer may happen through simple drag&drop operations from the main image panels, or through more complex operations triggered by toolbar buttons. The print composer is equipped with 3 toolbars, described in the following sections.

6.3.1.1 Content toolbar

The *Content toolbar* allows "populating" the sheets to be printed with images, and setting some common zoom and pan preferences on them.

The *Import current screen* toolbar button () allows importing all images of the current study panel to the current sheet in the print booklet. The series tiling currently set on the study panel will also be set as the layout for the current sheet.

The *Import current series* toolbar button () allows importing all images of the selected series to the print booklet. The current layout will be used, and multiple pages will be added if necessary.

The *Import current study* toolbar button () allows importing all images of the selected study to the print booklet. The current layout will be used, and multiple pages will be added if necessary.

The *Import key images* toolbar button () allows importing all images marked as "key" images to the print booklet. The current layout will be used, and multiple pages will be added if necessary.

When using the mouse on a sheet of the print booklet, special functions are associated with the mouse buttons. In particular, the *"Pan"* tool is associated with the left mouse button, as reminded by the  icon appearing on top of the content toolbar. Thus, left-dragging on an image contained in a sheet of the print booklet will pan that image, if it was previously zoomed in.

The *"Zoom"* tool is associated with the mouse wheel, as reminded by the  icon appearing on top of the content toolbar. Thus, scrolling the mouse wheel will zoom in and out the selected image of the current sheet. Finally, double-clicking the right mouse button will reset the selected image of the current sheet to its default zoom (to fit) and pan.

The *All views as selected (current sheet)* toolbar button () allows applying the zoom and pan of the current image box to all image boxes of the current sheet.

The *All views as selected (all sheets)* toolbar button () allows applying the zoom and pan of the current image box to all image boxes of all sheets in the booklet.

User can also drag&drop images from the main image panels to the current sheet of the print booklet. Also, pressing the *Canc* button on the keyboard, it is possible to remove a selected image from the sheet.

6.3.1.2 Pages control toolbar

The *Pages controls toolbar* allows adding, clearing and removing pages in the print booklet.

The *Append page* toolbar button () allows to add a page at the end of the print booklet.

The *Insert page* toolbar button () allows to insert a page anywhere in the print booklet.

The *Clear page* toolbar button () allows to clear the current page of the print booklet.

The *Remove page* toolbar button () allows to remove the current page from the print booklet.

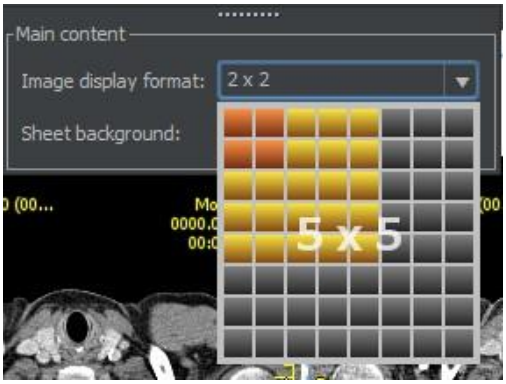
The *Remove all pages* toolbar button () allows to remove all pages from the print booklet.

6.3.1.3 Layout toolbar

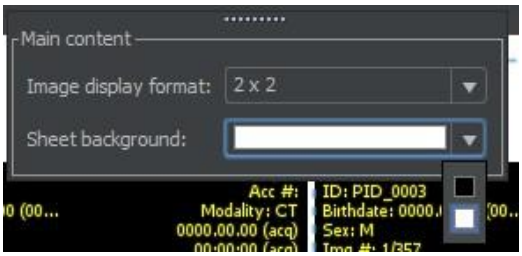
The *Layout toolbar* allows organizing the sheets layout, as well as setting page header and footer. Finally, it allows confirming the print operation.

Pressing the *Main content* toolbar button ( ) the following dialog box will appear:

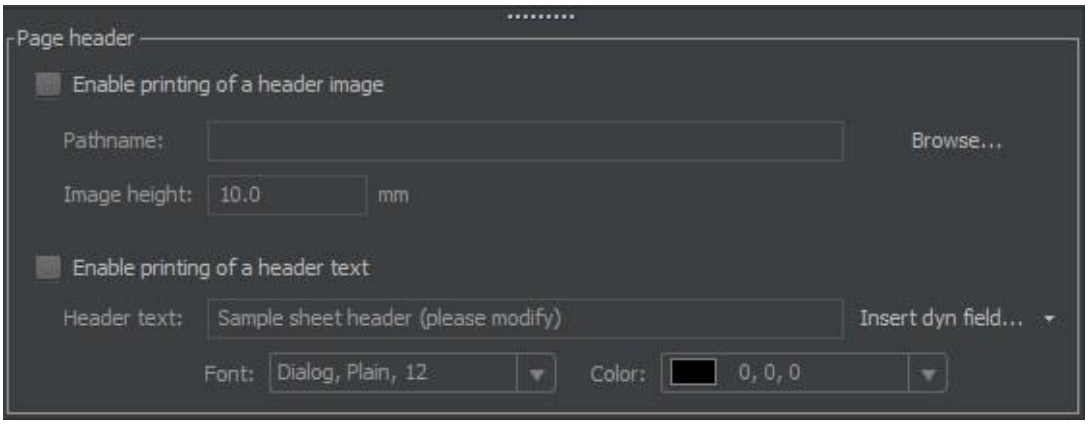
The *Image display format* drop down menu allows choosing the image layout (1x1, 2x2, 3x2, 3x3, etc.) for the current sheet:



The *Sheet background* drop down menu allows selecting the background colour of the current sheet (Black or White):

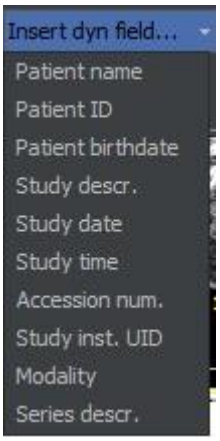


Pressing the *Page header* toolbar button ( ) the following dialog box will appear:

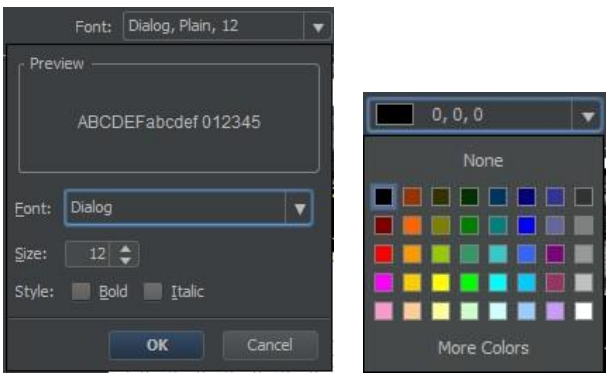


It is possible to include an image in the header of each sheet of the print booklet, by checking the *Enable printing of a header image* checkbox. User will be able to choose the pathname and the height of the header image.

Also, it is possible to include a text string in the header of each sheet of the print booklet, by checking the *Enable printing of a header text* checkbox. User will be able to insert a header text or, with the *Insert dyn field...* drop down menu, a dynamic field which will be automatically substituted by RemotEye Viewer with appropriate values before the actual printing takes place.

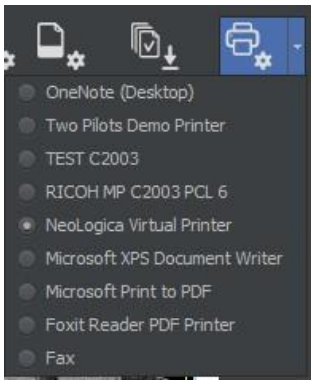


With the *Font* and *Color* drop down menus user can select, respectively, font and color of the header text:

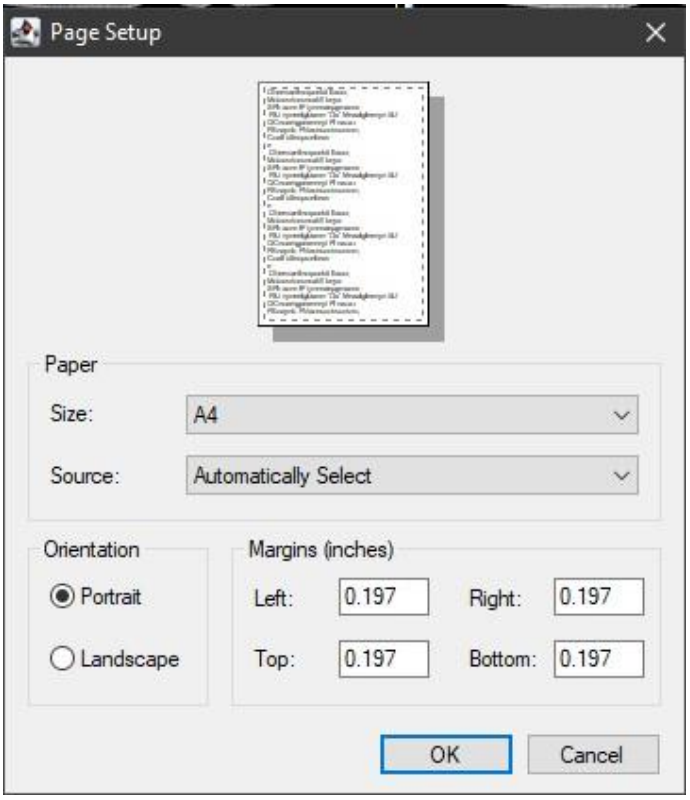


Pressing the *Page footer* toolbar button () a dialog box identical with the *Page header* dialog box will appear, allowing the same operations.

The *Apply attributes to all pages* toolbar button () allows applying the layout and appearance (including header, footer, background, etc.) of the current page to all pages of the print booklet.
The *Page format...* drop down menu allows selecting the target printer for the print operation:



Selecting the target printer is a very important step, as it will influence the available sheet formats. Pressing the *Page format...* toolbar button () the following dialog box will appear:

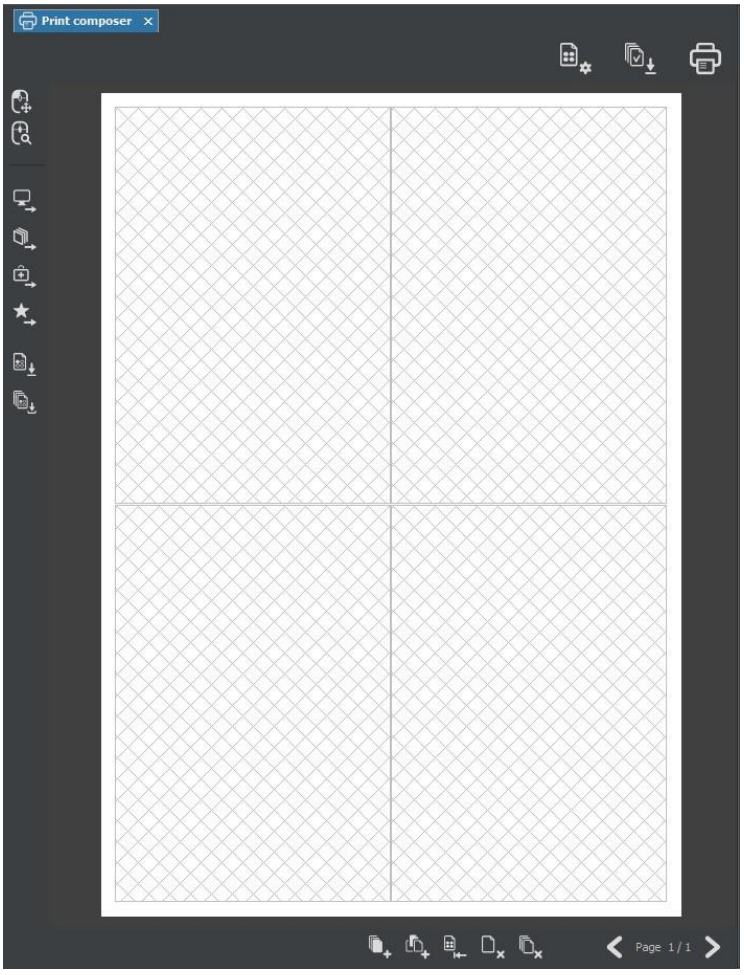


From the *Page Setup* dialog box user can set paper size and source, orientation and margins.

Finally, pressing the *Print...* toolbar button () the print dialog box related to the configured output printer will be shown, and it will be possible to actually launch the print operation.

6.3.2 Printing to DICOM printers

In order to print medical images to a DICOM printer, the *DICOM print…* menu item must be selected. In order to be able to perform a DICOM Print operation, at least one DICOM printer must be configured on the local client; please refer to the paragraph dedicated to configuration of DICOM printers for further details. Once you select the *DICOM print…* menu item, the *Print composer* panel will appear, as shown in the following picture:



The *Print composer* panel provides a real-time and interactive preview of the sheet(s) to be printed. The set of sheets to be printed will be referred to as the "print booklet" in the following sections. It is possible to

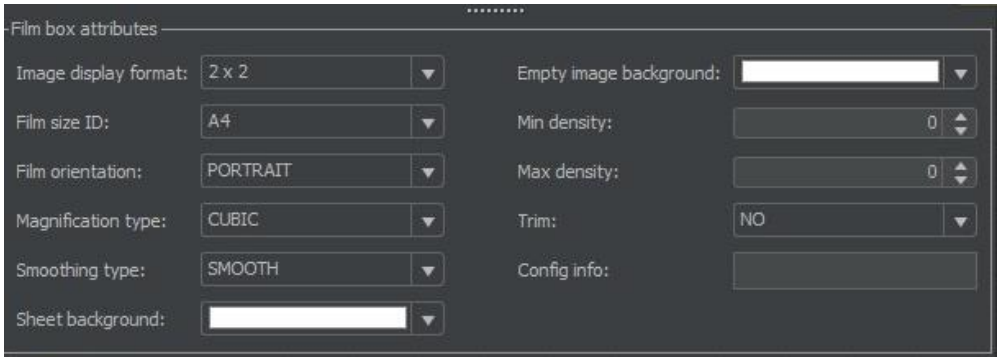
populate the sheets with medical images, as well as to specify several preferences related to the sheets layout and appearance.

Population of the sheets in the print composer may happen through simple drag&drop operations from the main image panels, or through more complex operations triggered by toolbar buttons. The print composer is equipped with 3 toolbars: the *content toolbar*, the *pages control* toolbar and the *layout toolbar*. While the *content toolbar* and the *pages control* toolbar are identical with the ones described above for the normal print functionality (see previous paragraphs for an explanation), the *layout toolbar* is significantly different in case of DICOM print.

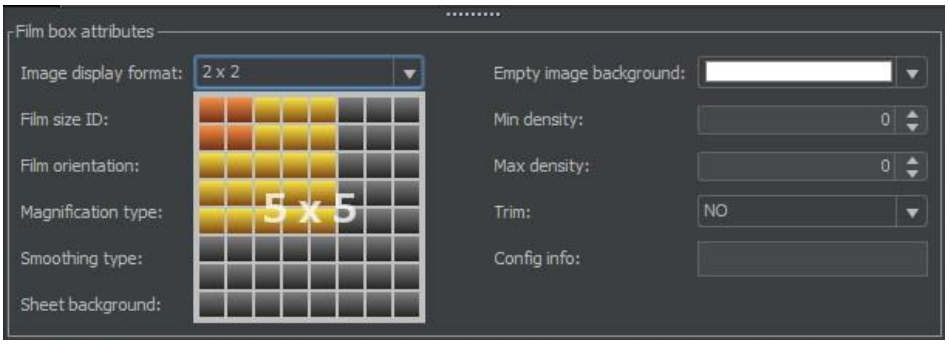
6.3.2.1 Layout toolbar

The *Layout toolbar*, in case of DICOM print, allows setting the layout and appearance of the sheets of the print booklet.

Pressing the *Main content* toolbar button () the *Film Box attributes* panel will appear; user is able to set up DICOM attributes from here:



The *Image display format* drop down menu allows choosing the image layout (1x1, 2x2, 3x2, 3x3, etc.) for the current sheet:



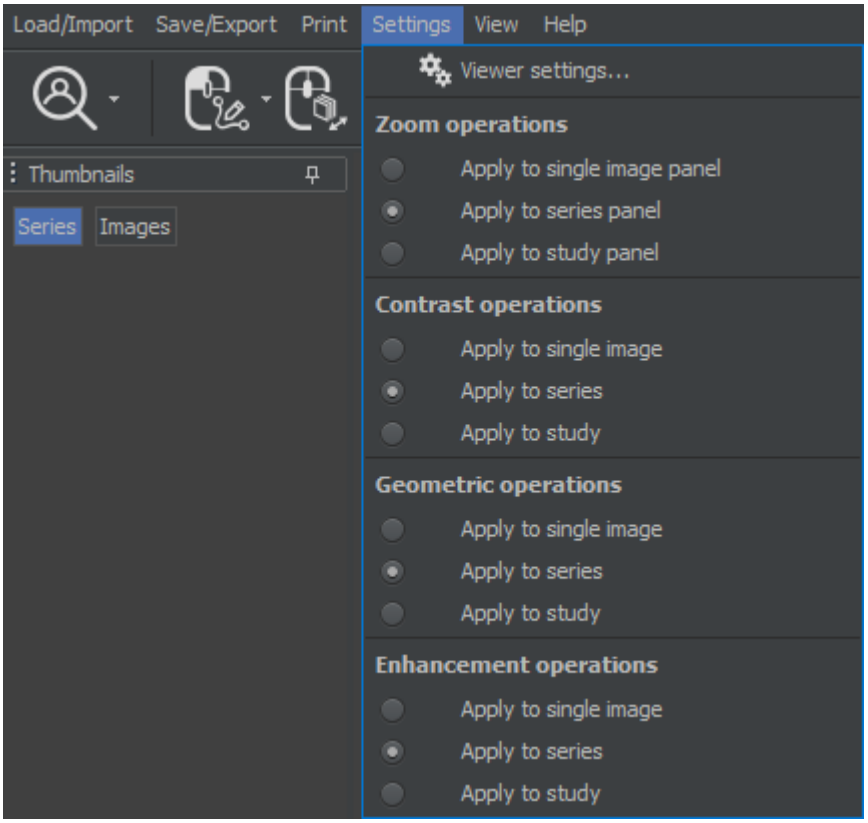
In addition, the *Film Box attributes* panel will also allow setting all other sheet-level attributes and preferences which are defined by the DICOM standard, for the DICOM print operation.

The *Apply attributes to all pages* toolbar button () allows applying the layout and appearance of the current page to all pages of the print booklet.

Finally, pressing the *Print...* toolbar button () the print dialog box related to the configured output DICOM printer will be shown, and it will be possible to actually launch the DICOM print operation.

6.4 Settings

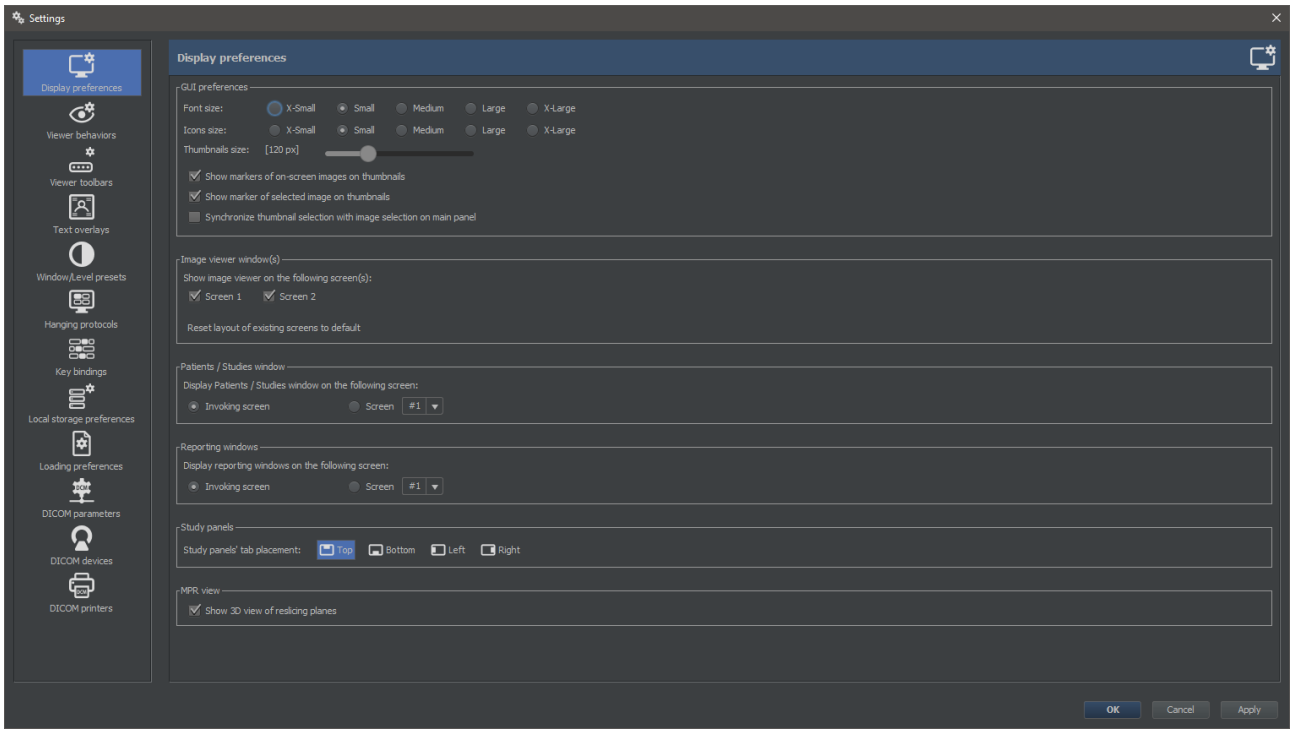
Here is a screenshot of the *Settings* menu:



This menu allows accessing the main viewer's settings, as well as to directly select a set of preferences on the scope of the operations which can be performed on the images.

6.4.1 Viewer settings

Selecting the *Viewer settings…* menu item, the *Settings* dialog-box will appear:

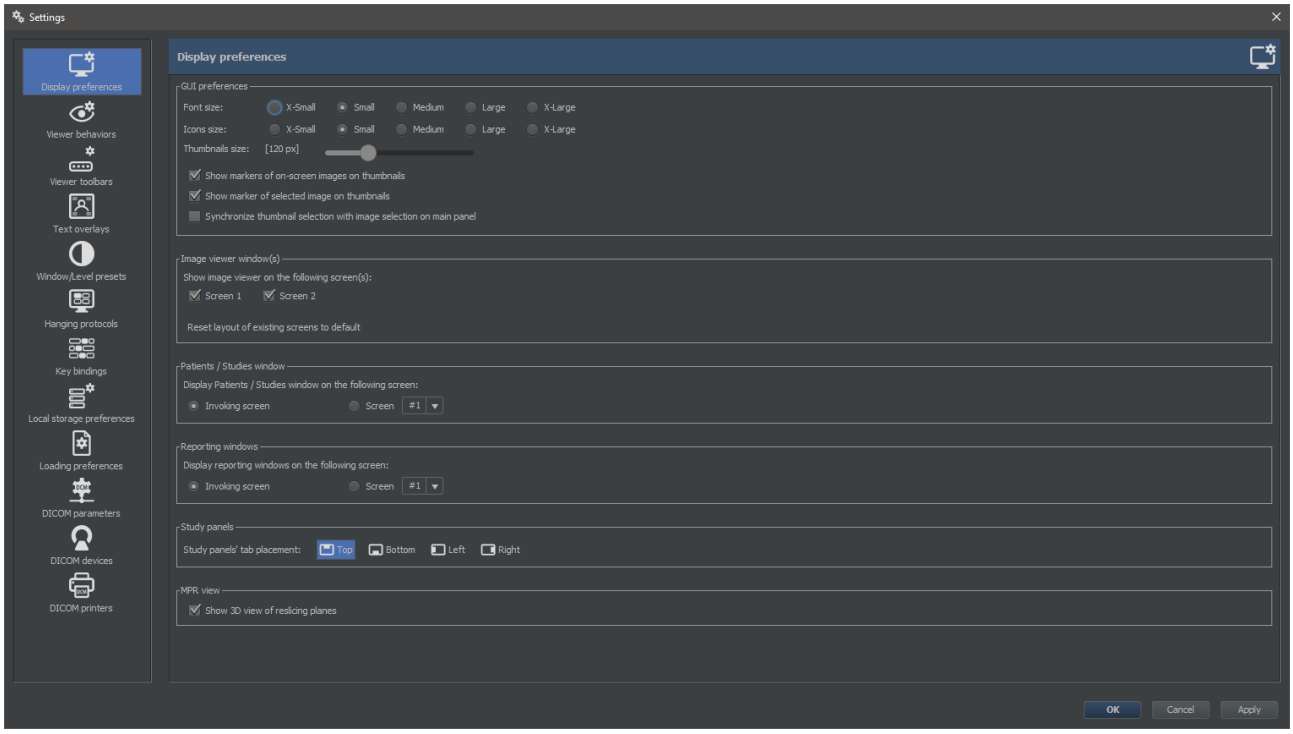


In some cases (e.g. modifications in screens configuration, font size, icons size, etc.), it is necessary to save user settings and to restart RemotEye Viewer in order to allow modifications to take effect.

6.4.1.1 Display preferences

RemotEye Viewer allows configuring several display preferences, mainly related to multi-monitor configurations.

The *Display preferences* page can be displayed by selecting the *Display preferences* item from the left-hand list.



This configuration page allows specifying the default font size and icons size for RemotEye Viewer's GUI: *Medium*, *Large* and *X-Large* sizes are recommended for high-resolution monitors, while a *Small* and *X-Small* sizes should be fine with a standard PC monitor; it is also allowed to show markers () of on-screen images on thumbnails, to show marker () of selected image on thumbnails and to synchronize thumbnail selection with image selection on main panel.

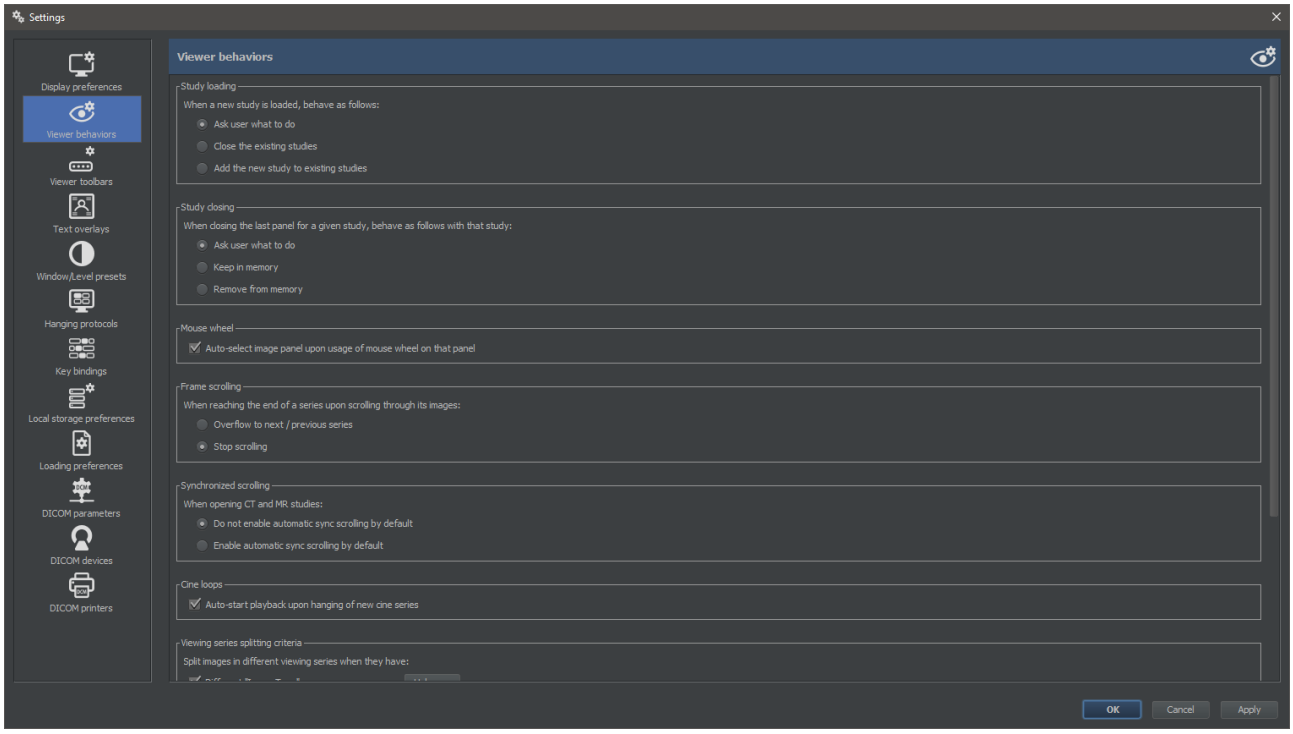
In addition, in case of multi-monitor display systems, it is possible to specify on which screen(s) the image viewer windows, the Patients/Studies window and the reporting windows shall be shown.

Some other display-related preferences can also be set through this configuration page.

6.4.1.2 Viewer behaviors

RemotEye Viewer allows configuring several viewer behaviours related to *Study loading*, *Study closing, Mouse wheel, Frame scrolling, Synchronized scrolling, Cine loops, Viewing series splitting criteria* and *Saving settings on exit*.

The *Viewer behaviors* page can be displayed by selecting the *Viewer behaviors* item from the left-hand list.



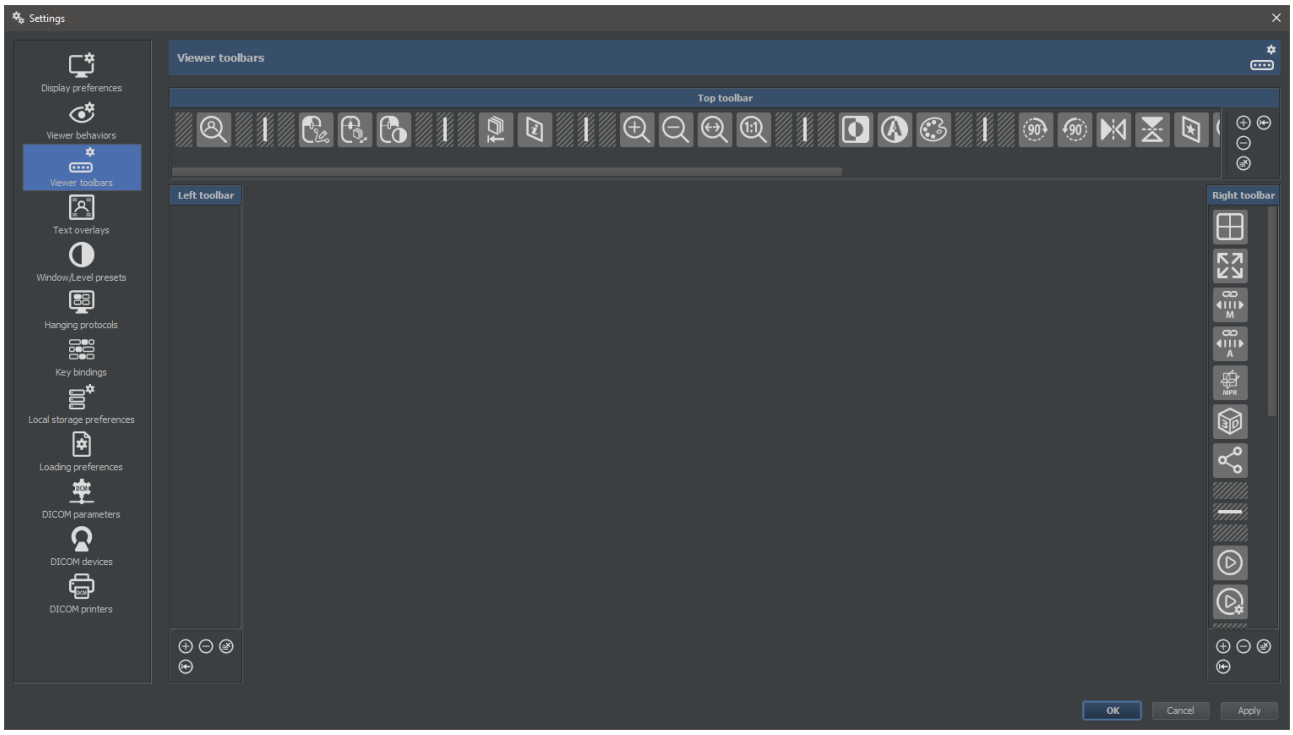
Inside the *Viewing series splitting criteria* panel, you can select which DICOM attributes the viewer shall use to determine when two DICOM images belonging to the same DICOM series (i.e., having the same Series Instance UID) shall be split in two different viewing sequences (i.e., viewing series) inside the viewer. Through the *Unless...* button, it is also possible to define some exceptions to the defined splitting rules. For instance, you can choose to split images in different viewing series when they have different "Image Type", except when "Series Description" contains the word "Sagittal".

Each value field in the above panel can contain several expressions, separated by the "||" (double pipe) sequence, which will be evaluated in logical OR. For instance, you could specify "Sagittal||Coronal" as the value for the *Unless "Series Description" contains:* field; such a value means "Unless Series Description contains the word "Sagittal" OR the word "Coronal".

6.4.1.3 Viewer toolbars

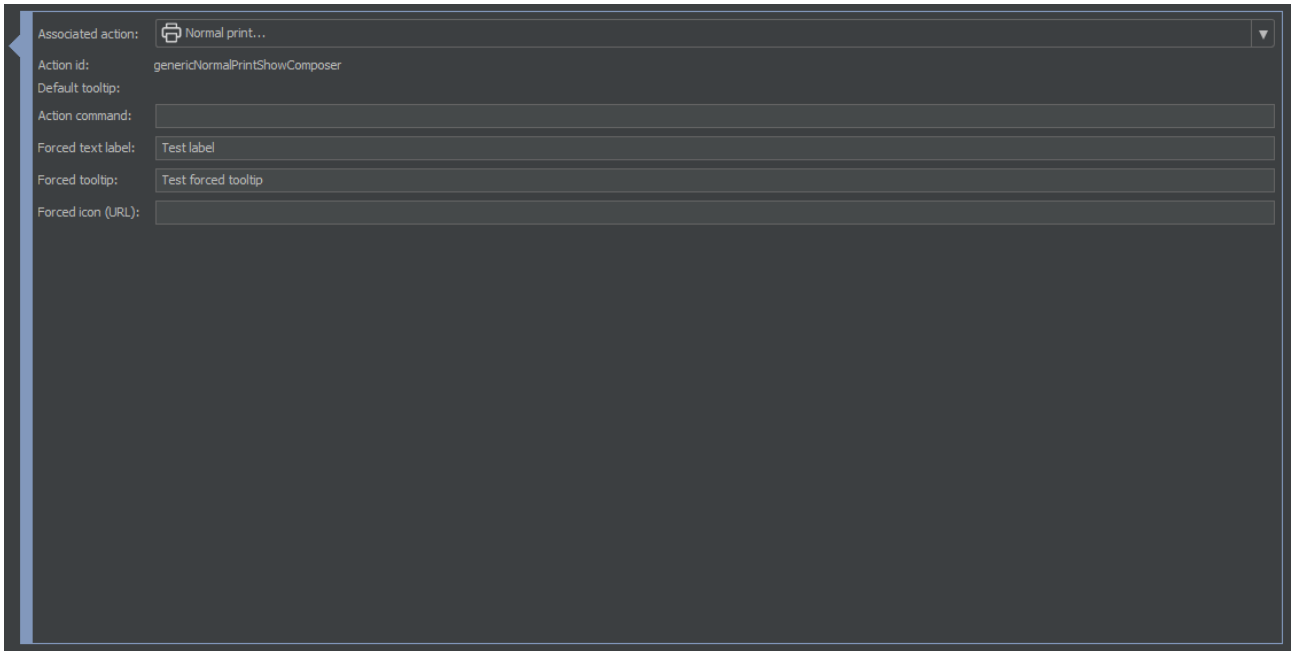
RemotEye Viewer allows complete customization of the top, left and right toolbars.

The *Viewer toolbars* page can be displayed by selecting the *Viewer toolbars* item from the left-hand list.



For each toolbar, you can add or remove buttons. Each button shall correspond with an “action” defined within RemotEye Viewer.

Pressing the *Add new toolbar button* button (), a panel appears, allowing customization of the button to be added to the toolbar:



First of all, you need to associate an “action” to the button. You are able to select the action through the *Associated action* drop-down list, which contains all actions available within RemotEye Viewer. Each action has its own associated icon and tooltip. However, if you want to override the default icon and tooltip shown on the toolbar button for that action, you are able to do so by exploiting the *Forced tooltip* and the *Force icon (URL)* text fields. The URL shall correspond with the web address of either a SVG (“.svg” filename extension) vector image file (recommended) or a PNG, JPG or GIF image file. You are also able to force a custom label / caption for the toolbar button, by exploiting the *Forced text label* text field.

You can edit an existing toolbar button by simply selecting it with a mouse click in its own toolbar within this configuration page.

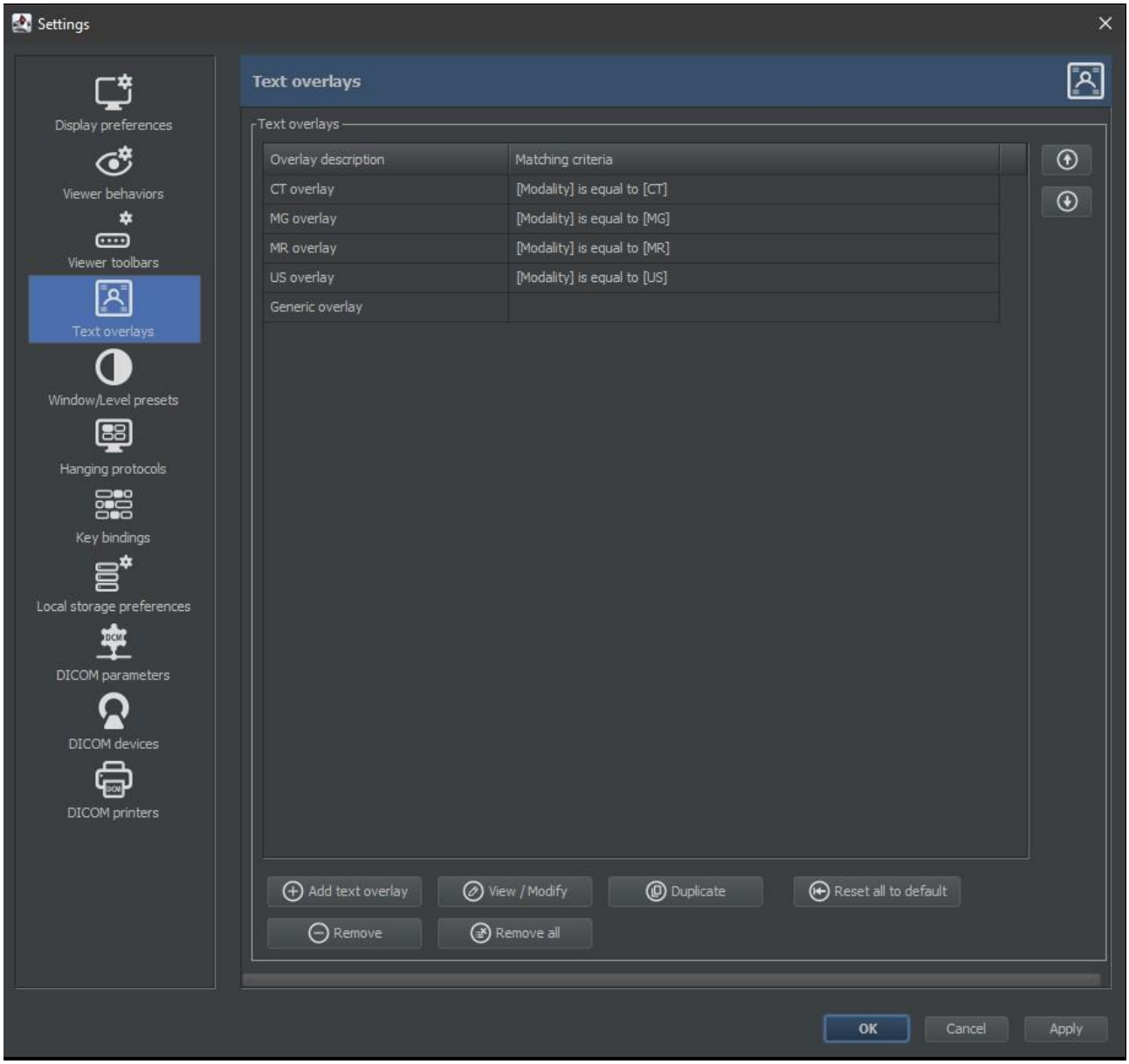
In addition, you can remove a button from its own toolbar by selecting it with a mouse click, and then pressing the *Remove toolbar button* button ().

Finally, you can remove all buttons from a toolbar ( button) or reset the toolbar to its default setting ( button).

6.4.1.4 Text overlays

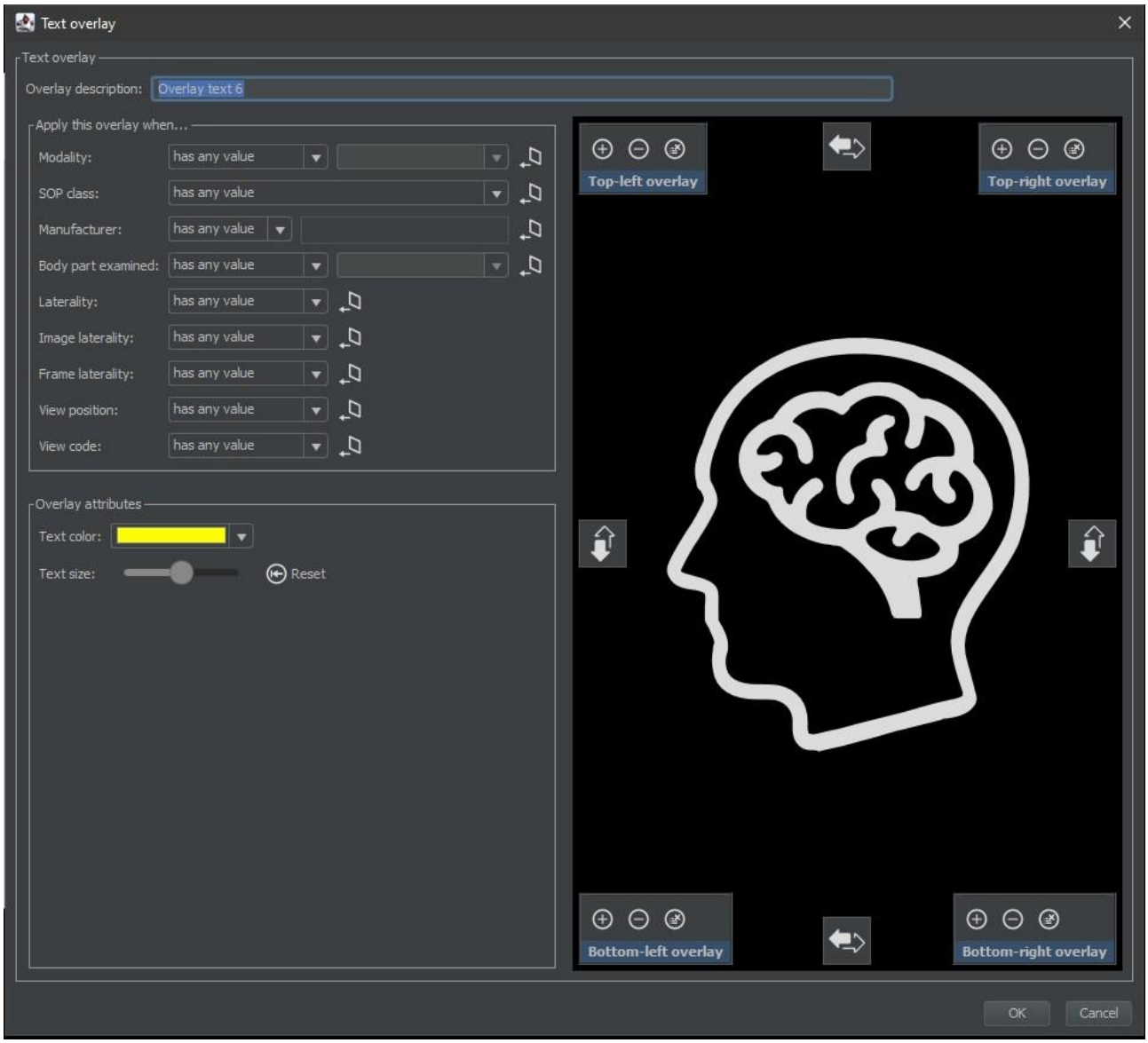
RemotEye Viewer allows displaying textual overlays on the medical images. Moreover, the information included in the text overlays is completely configurable.

Clicking on the *Text overlays* item from the left-hand list, the *Text overlays* settings page will open.



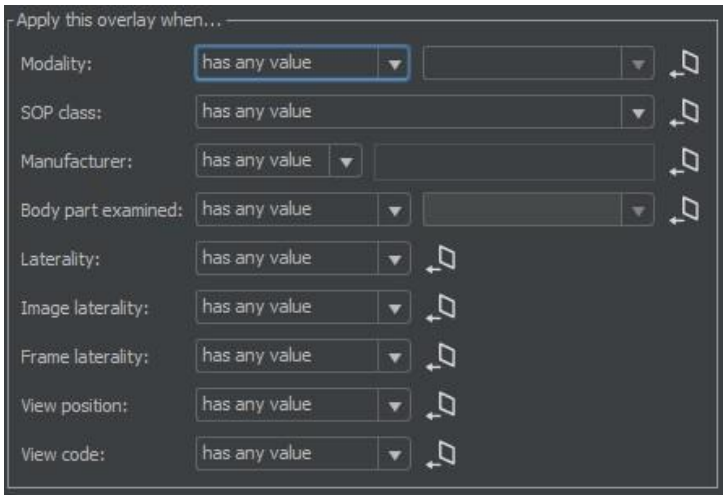
This page shows a list of all textual overlays which are currently configured in RemotEye Viewer. Each overlay is identified by a description and a set of matching criteria. For example, text overlays related to MR modality are displayed only on MR images. As detailed in the following, different parameters are settable in order to define proper matching criteria to be used for each text overlay. In addition, selecting the *High-quality delayed rendering of text overlays* checkbox, high-quality, high-contrast, anti-aliased rendering of the text strings related to overlays will be enabled. The painting of this high-quality overlay only happens when the image is in idle state for a couple of seconds (i.e., it is "delayed"), in order not to cause performance penalties in the viewer.

In order to create a new textual overlay, user has to click on the *Add text overlay* button, and the following dialog box will appear:



From here, user can insert a description of the textual overlay that is going to be created, as well as choose the related matching criteria, the color and size of the text (i.e., the color and the size in which the text will be painted over the images).

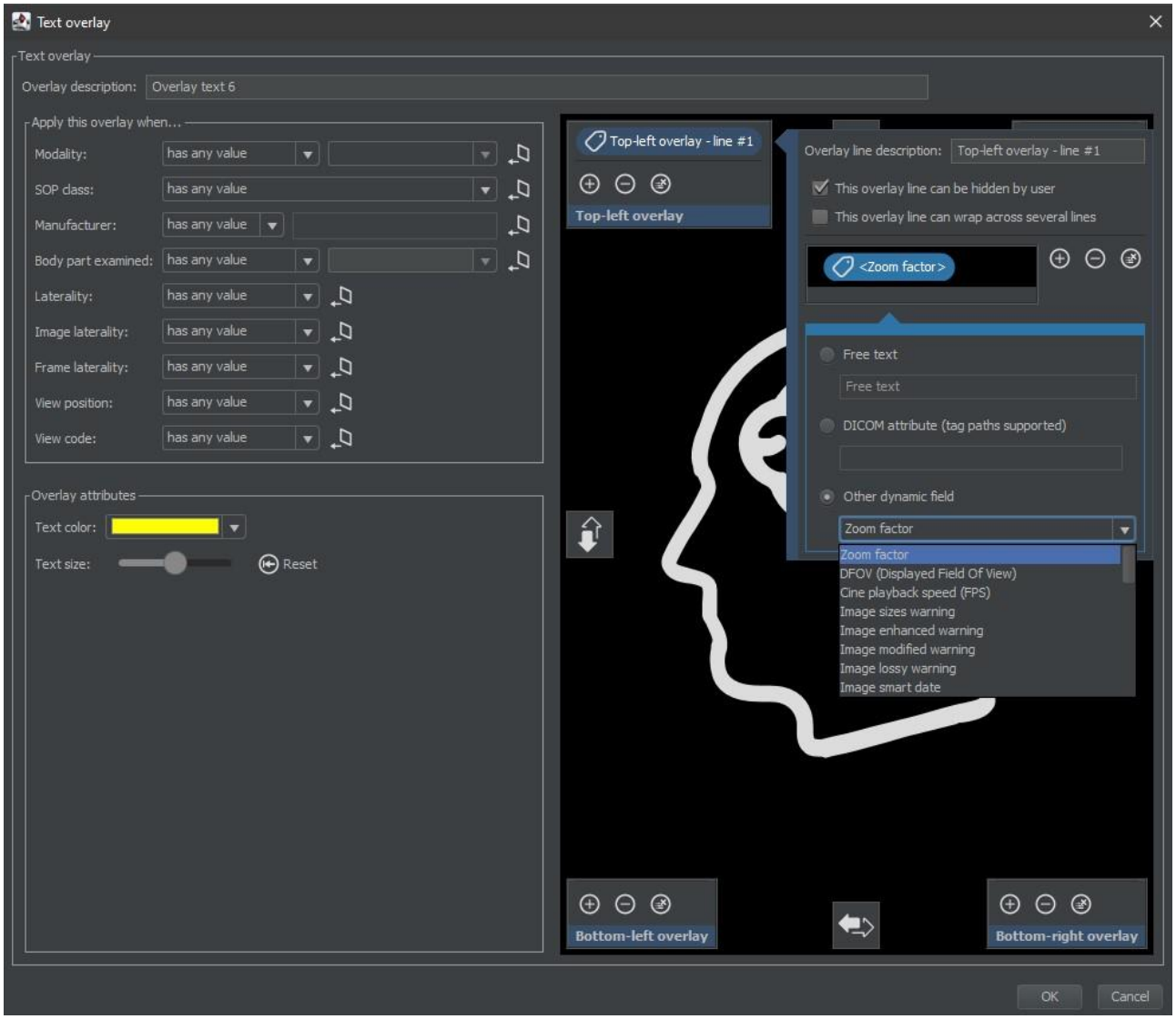
Regarding the definition of the matching criteria, many DICOM attributes are supported: the *Modality*, the *Manufacturer* and the *Body part examined* fields support several matching modes, also including regular expressions.



SOP class, *Laterality*, *Image laterality*, *Frame laterality*, *View position* and *View code* are other fields whose value can be chosen from a predetermined list.

Using the appropriate overlay areas placed at the corners of the image panel prototype, user can decide which information to display, and where to show it.

Clicking on the  button located in each corner, a new overlay text line will be added in that corner of the image, and the following panel will appear:



From here, it is possible to choose which overlay field to insert in the specific text line. User can give a description of the overlay line using the appropriate *Overlay line description* field. In addition, he can decide whether the line can be hidden or not, and if it is allowed to wrap across several lines, when its length is such that it cannot completely fit into a single line.

Clicking on the  button on this panel, user can add a new field to the current overlay text line. Once the field is selected with a mouse click, user can choose the type of overlay field. Selecting the *Free text* option, user can insert a fixed free text in the appropriate space. Clicking on the *DICOM attribute* option, user can choose a specific DICOM attribute to display (e.g., DICOM: "0010,0010" for Patient's Name). It is also possible to include the value of DICOM attributes which are nested inside hierarchical sequences, by using the tag path syntax (e.g., "0010,0024/0/0008,0080" means: data element (0010,0024) → item 0 → data element (0008,0080)). *Alternative tag paths* are also supported, i.e., multiple alternative tag paths separated by a "pipe" ('|') character. Here is an example of alternative tag paths: "0010,0024/0/0008,0080|0008,0080".

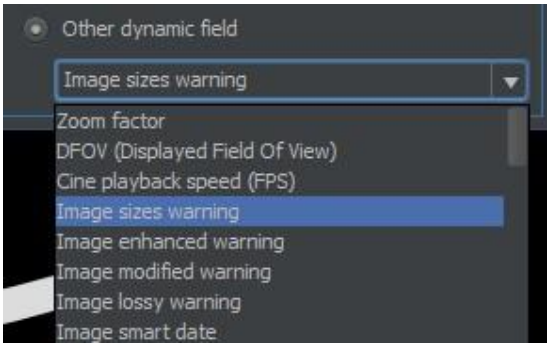
In this case, the viewer will include the value of the first tag path which is non-null, among the alternative ones.

While, selecting the *Other dynamic field* option, a drop-down menu will appear, allowing user to choose the desired dynamic field (e.g., zoom factor) from a pre-defined list. Through the button it is possible to delete the currently-selected overlay field. Finally, the button allows removing all overlay fields present in the line.

In the same way, the buttons located in the overlay areas at the corners of the panel, allow to remove the currently-selected overlay line. While, through the button it is possible to remove all the overlay lines present in a specific image corner.

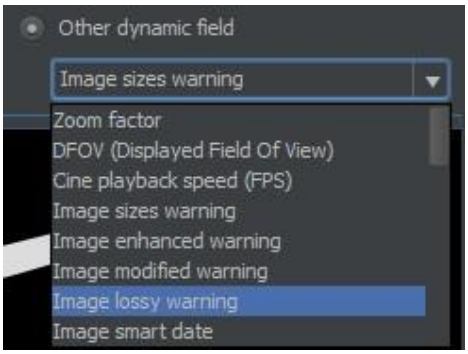
Warning: RemotEye Viewer supports an *Image sizes warning* text field, appearing when calibrations which could affect the meaning of measurements have taken place on the image being displayed. If this field is not included in an overlay, or if it is present but part of a hideable line, this may result in a safety risk.

For all overlays, it is recommended to include this overlay text field in a non-hideable overlay text line.



Warning: RemotEye Viewer supports an *Image lossy warning* text field, appearing when an image encoded with a lossy compression algorithm is displayed. If this field is not included in an overlay, or if it is present but part of a hideable line, this may result in a safety risk.

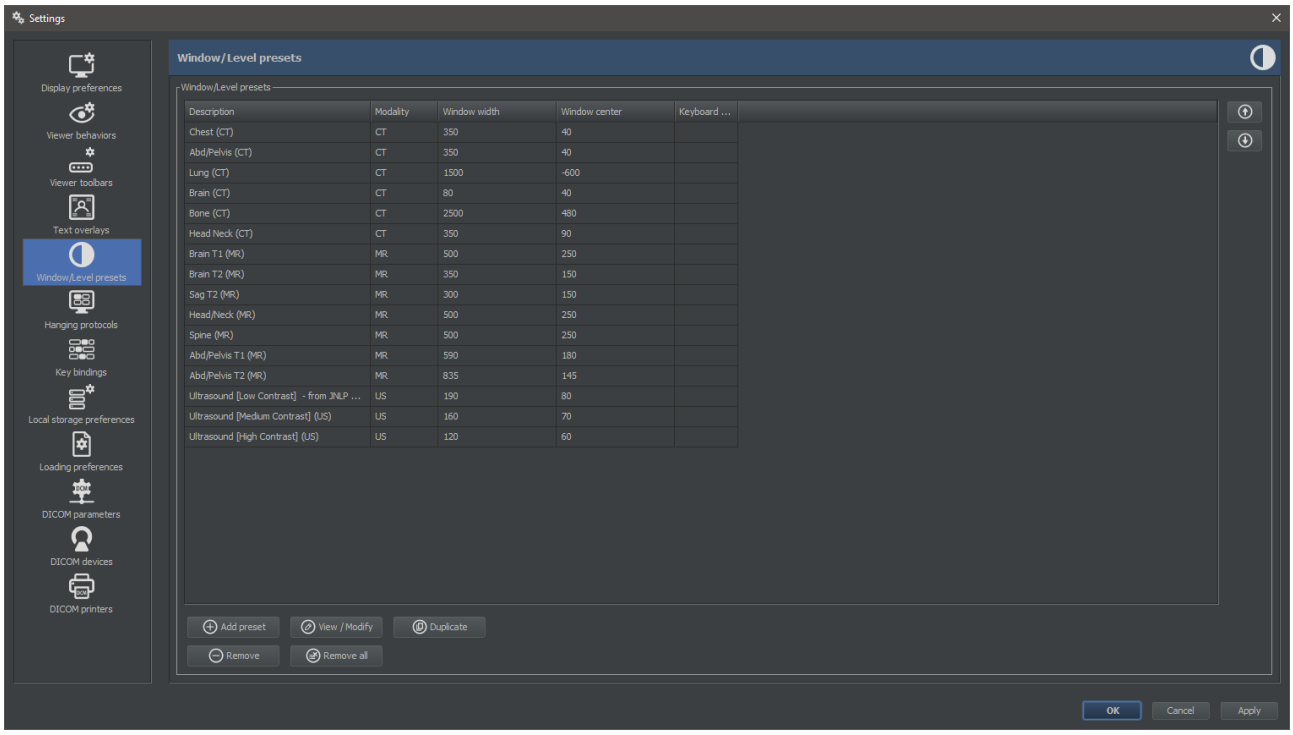
For all overlays, it is recommended to include this overlay text field in a non-hideable overlay text line.



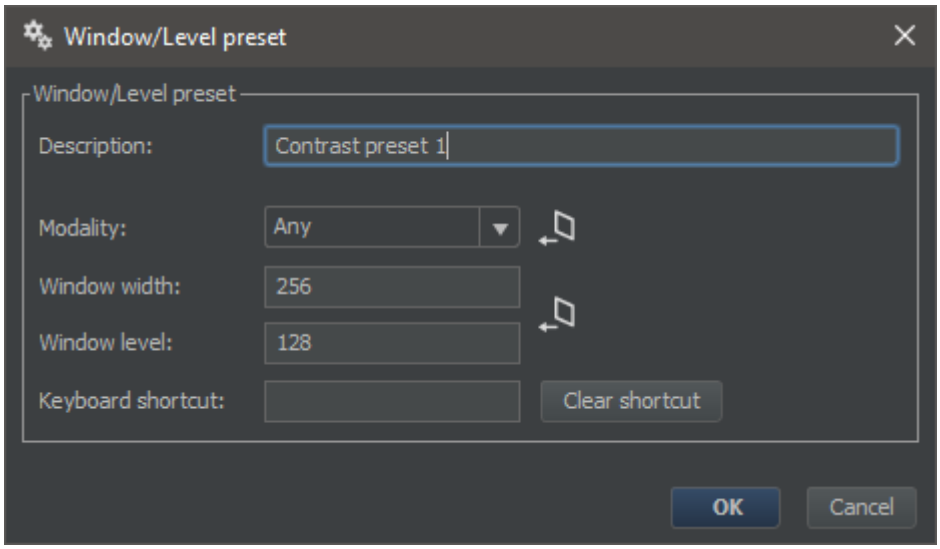
Finally, user may take advantage of the 'switch' buttons  located at the *Text overlay* panel's sides to switch the position on the panel of the relating text overlays.

6.4.1.5 Window/Level presets

RemotEye Viewer supports definition of contrast presets through the GUI. The *Window/Level presets* page, showing the contrast presets currently defined for the present user, can be displayed by selecting the *Window/Level presets* item from the left-hand list.



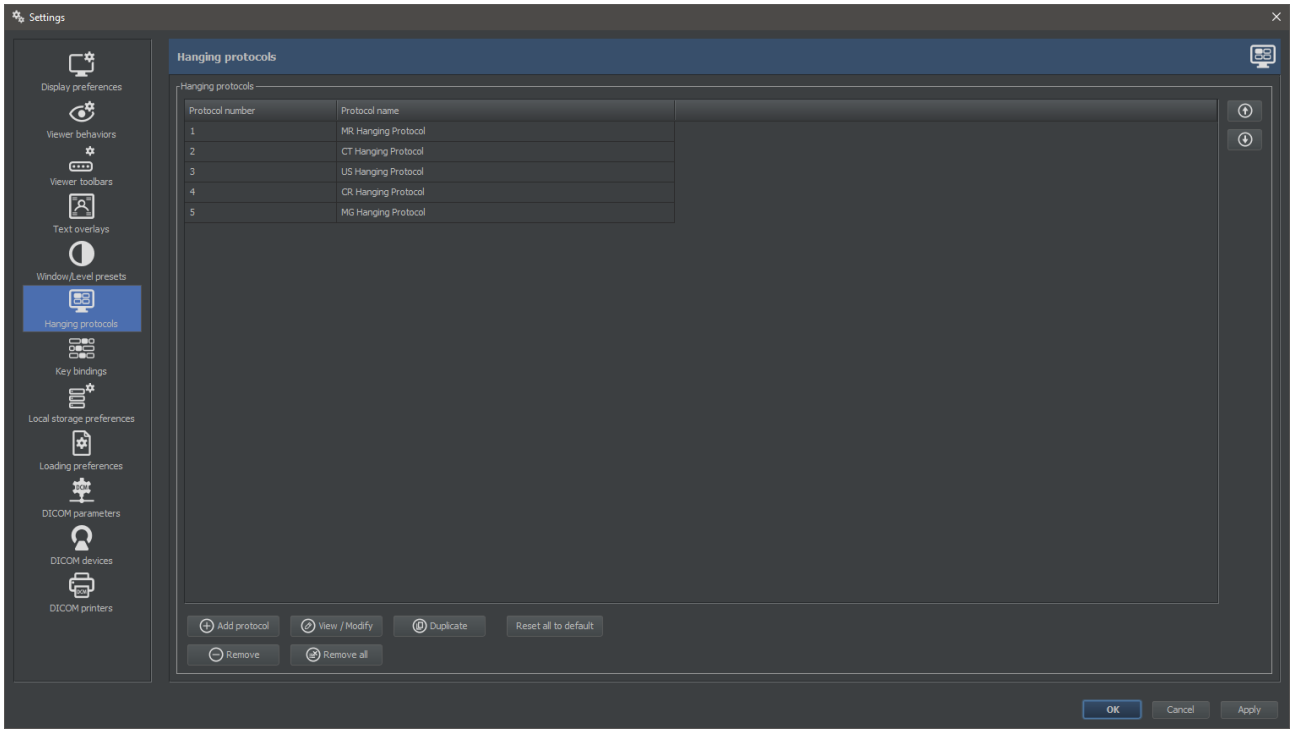
In order to create a new contrast preset, press the *Add preset* button, located at the bottom of the *Window/Level presets* configuration page. A new *Window/Level Preset* dialog box will appear, as show in the picture below:



This dialog allows specifying the *Description* (i.e., identifying name appearing on the GUI) for this *Window/Level Preset*, as well as the *Modality*, *Window Width* and *Window Level* data. If you select a specific *Modality* when building the preset, then this Window/Level preset will only be available when images of that modality are selected. Useful "*Import from current image*" buttons are available next to the preset's fields.
Finally, user can set a keyboard shortcut through which it will be possible to easily invoke application of that specific Window/Level preset.

6.4.1.6 Hanging protocols

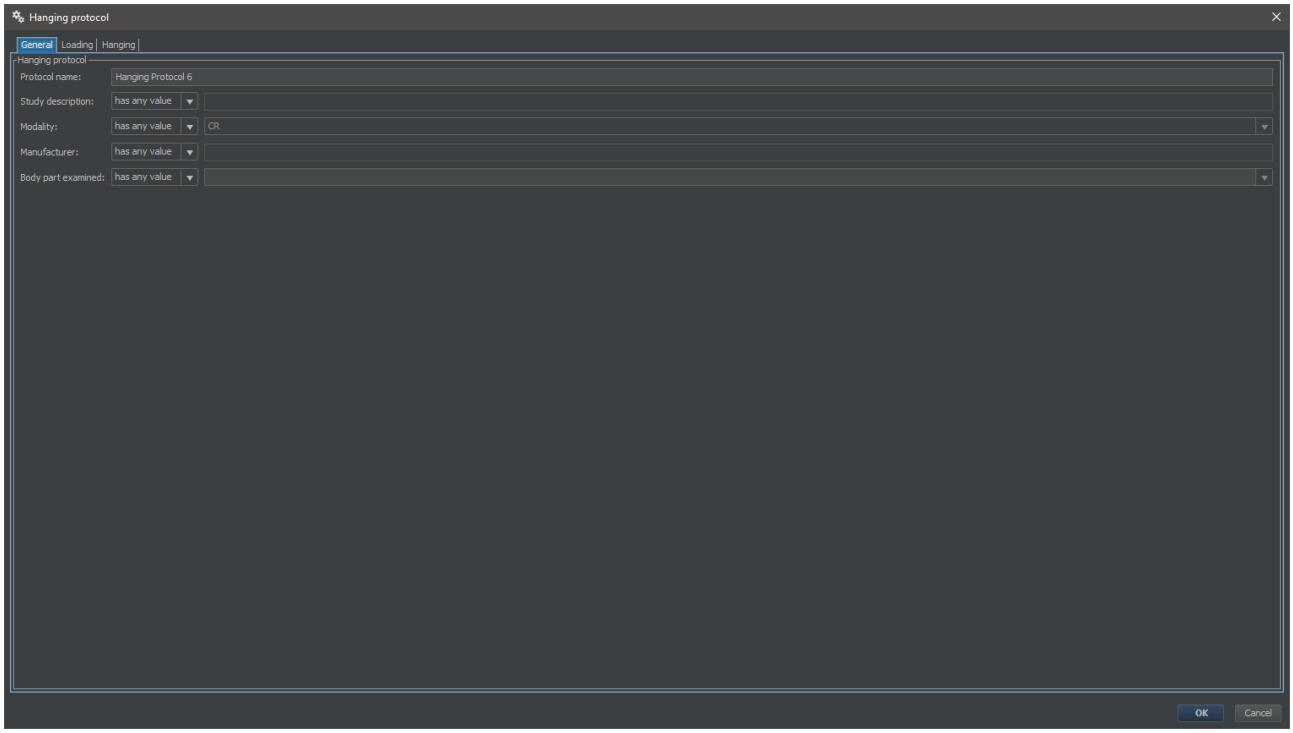
RemotEye Viewer supports *hanging protocols*. Hanging protocols allow defining and automating the way studies are displayed on screen, in terms of display layout as well as in terms of rules which specify which images must be hung to which image panels on the GUI.
The *Hanging protocols* page can be displayed by selecting the *Hanging protocols* item in the left-hand list of the *Settings* dialog box.



This window shows all hanging protocols currently defined in the viewer for the present user. Each hanging protocol is identified by a *protocol name*, which shall be unique.

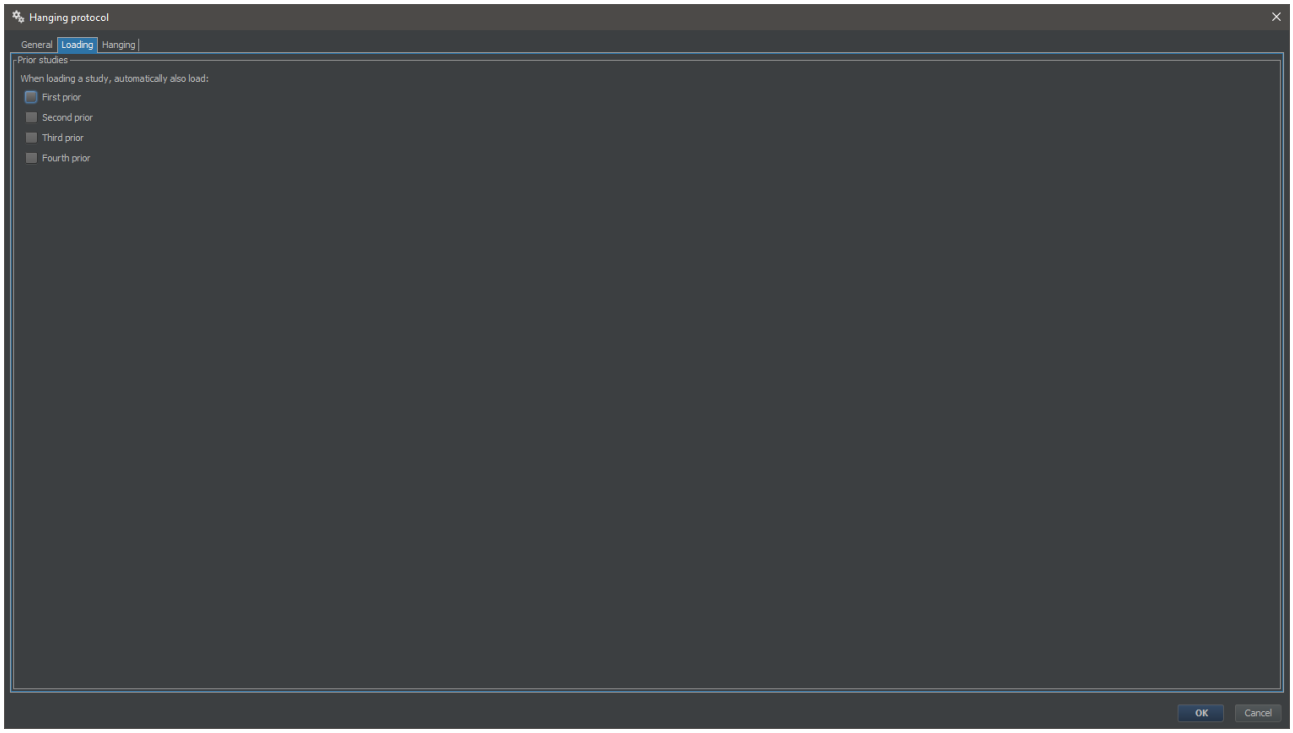
When a study is loaded, for instance by double-clicking on a study node in the *Patients/Studies* window, a check on all available hanging protocols is made. The first matching hanging protocol (if any, according to the order visible in this *Hanging protocols* configuration page) will be automatically applied upon loading of the study. The user will then be able to apply other hanging views of other matching hanging protocols once the study will be displayed on screen.

In order to create a new hanging protocol, press the *Add protocol* button, located at the bottom of the *Hanging protocols* configuration page. A new *Hanging Protocol* dialog box will appear, containing different tabs, as show in the picture below



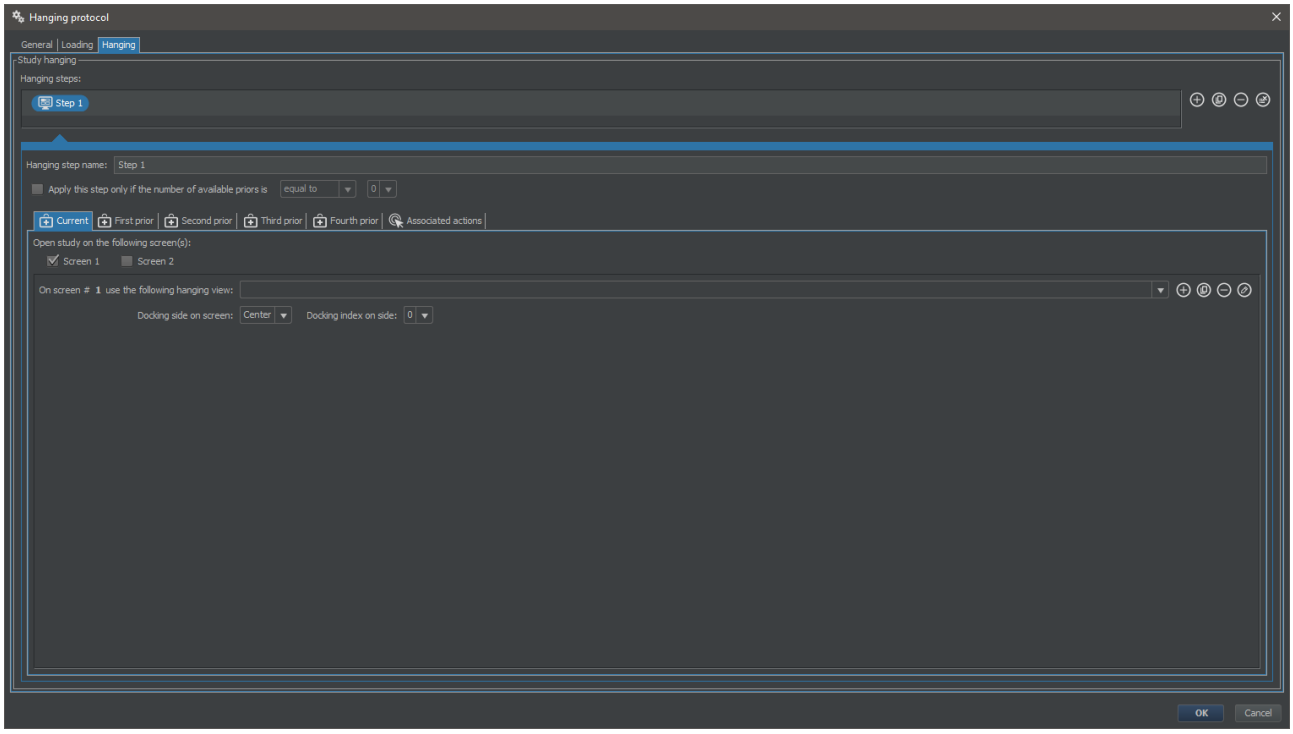
The first tab (*General*) allows specifying the *Protocol name* for the new Hanging Protocol. In addition, you need to specify which kind of studies this Hanging Protocol will apply to; in particular, the *Study Description*, the *Modality*, the *Manufacturer* and the *Body part examined* DICOM attributes are available as matching criteria. All these attributes can also be matched as result of a regular expression.

Clicking on the second tab (*Loading*), the following page will appear:



From here, it is possible to instruct RemotEye Viewer to automatically also load prior studies when loading a study, by selecting the related checkboxes. In particular, RemotEye Viewer allows choosing whether to automatically load also the first, the second, the third and/or the fourth prior studies, upon loading a study which matches this hanging protocol. The first prior study is the most recent study, prior to the selected one, matching the criteria of the current hanging protocol. In the same way, the second, the third and the fourth prior studies are the second, the third and the fourth most recent studies, prior to the selected one, matching the criteria of the current hanging protocol. The *Prior studies* options are particularly useful when one wishes to automate comparisons of exams taken by a given patient over time.

Clicking on the *Hanging* tab, the following page will be open:



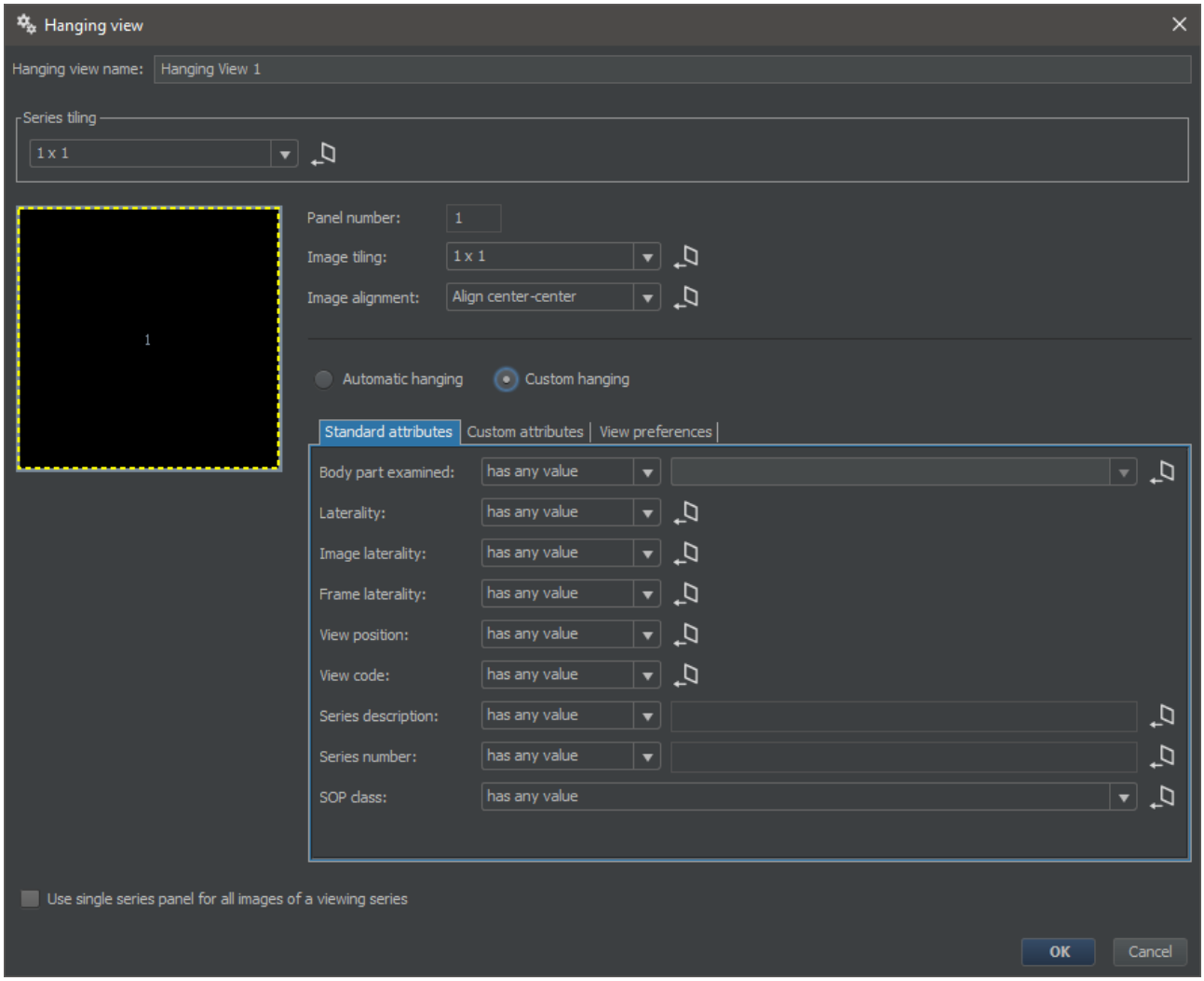
From here, user can specify the hanging preferences which will be associated with this hanging protocol, hence will be applied upon loading a study which matches this hanging protocol.

The *Hanging* section of the hanging protocol configuration interface allows defining exactly how studies and series shall be presented on screen upon study load. Moreover, this section allows defining several "*hanging steps*" within each hanging protocol. While viewing a study, it will be possible for the user to easily iterate through all "hanging steps" which are present within the hanging protocol, in a next/previous fashion, or to explicitly select the “hanging step” or “hanging view” to apply, using the dedicated panel located in the bottom right corner of the viewer’s window, as shown in the following image:

In order to define a new hanging step, user shall press the  button next to the Hanging steps area. Similarly, it is possible to remove an existing hanging step or all hanging steps by pressing, respectively, the

or the buttons. The button allows duplicating a selected hanging step. Selection of screen(s) and hanging preferences are specified separately for each study (current and/or priors) within every hanging step. The set of hanging preferences for each screen is known as a *hanging view*. Hence, the user shall define and/or select a hanging view for each hanging step, to adopt on each screen and for each study. It is possible to define a new hanging view by pressing the button next to the hanging view selection drop-down box. In addition, the button allows duplicating a selected hanging view. Furthermore, it is possible to delete an existing hanging view by pressing the button. Finally, pressing the button the user can edit the currently-selected hanging view.

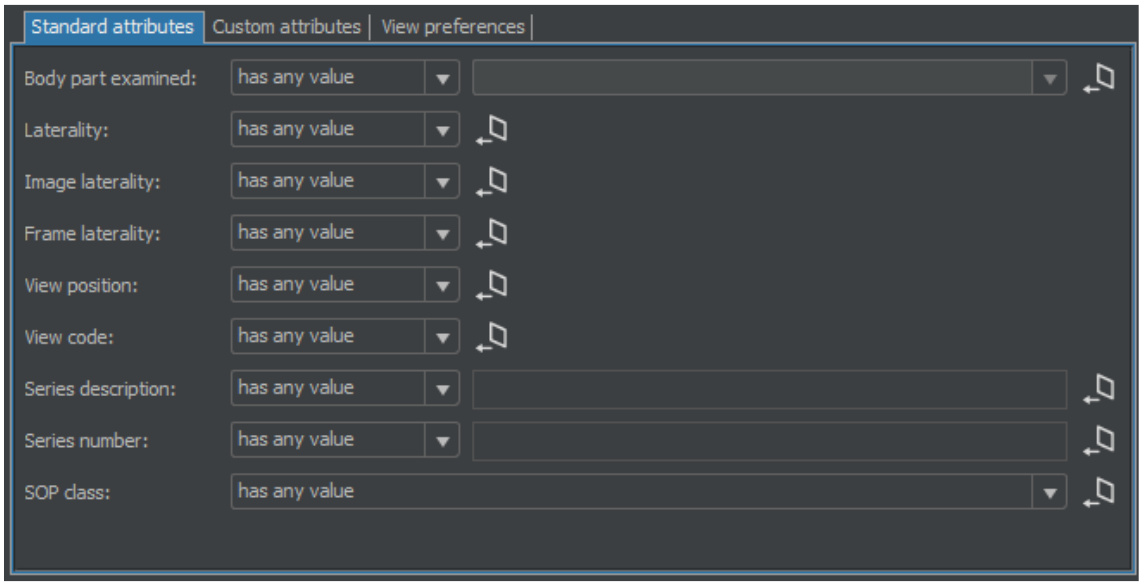
When creation or edit of a hanging view is triggered, the *Hanging view* dialog box will appear, as shown in the following picture.



A description of each parameter of the hanging view follows:

- *Hanging view name*: the unique identifying name of the hanging view.

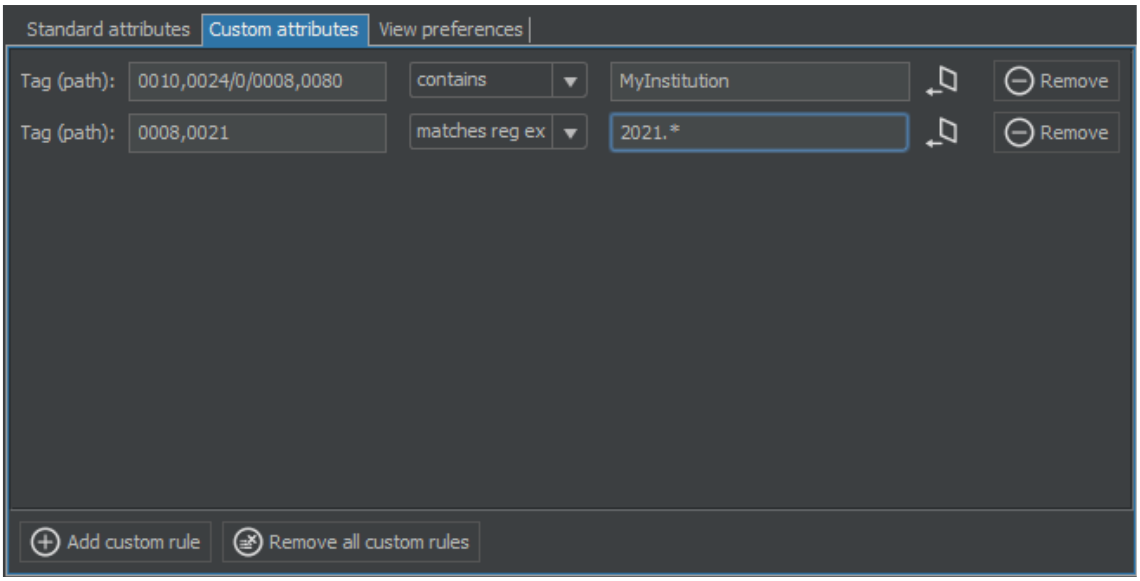
- *Series tiling*: the series tiling (i.e., series columns and series rows) to apply on the study panel where the study will be hung.
- *Image tiling*: it allows specifying the image tiling for each series panel. The image tiling determines how many images of that series will be concurrently visible in a specific series panel.
- *Image alignment.*
- *Automatic hanging*: series will be hung automatically by the software in the target study panel.
- *Custom hanging*: the user is able to specify hanging rules for each panel of the chosen display layout: upon study load, the series which first matches the hanging rule for a given series panel will be displayed in that series panel. By selecting the *Custom hanging* option, three different tabs will be activated:
    - *Standard attributes:* the main and most-commonly used DICOM attributes for a hanging rule can be set in this tab. Here are the supported standard attributes:
        - *Body Part Examined*
        - *Laterality*
        - *Image Laterality*
        - *Frame Laterality*
        - *View Position*
        - *View Code*
        - *Series Description*
        - *Series Number*
        - *SOP Class*



Where appropriate, the matching value for the DICOM attribute can be specified in terms of regular expression (*Body part examined, Series description* and *Series number* attributes).

The *Import from corresponding image/panel* buttons placed next to each matching attribute allow automatically importing the value of each attribute from the selected image/panel.

- *Custom attributes:* in case the appropriate DICOM attribute(s) for a hanging rule cannot be found in the *Standard attributes* tab, the *Custom attributes* tab can be used. In this panel, user can specify the attributes to use in the hanging rule in terms of its DICOM tag, and then specify a value to be matched for this attribute for a given panel. The *Custom attributes* panel is initially empty; a new rule based on a custom DICOM attribute can be added by pressing the *Add custom rule* button.

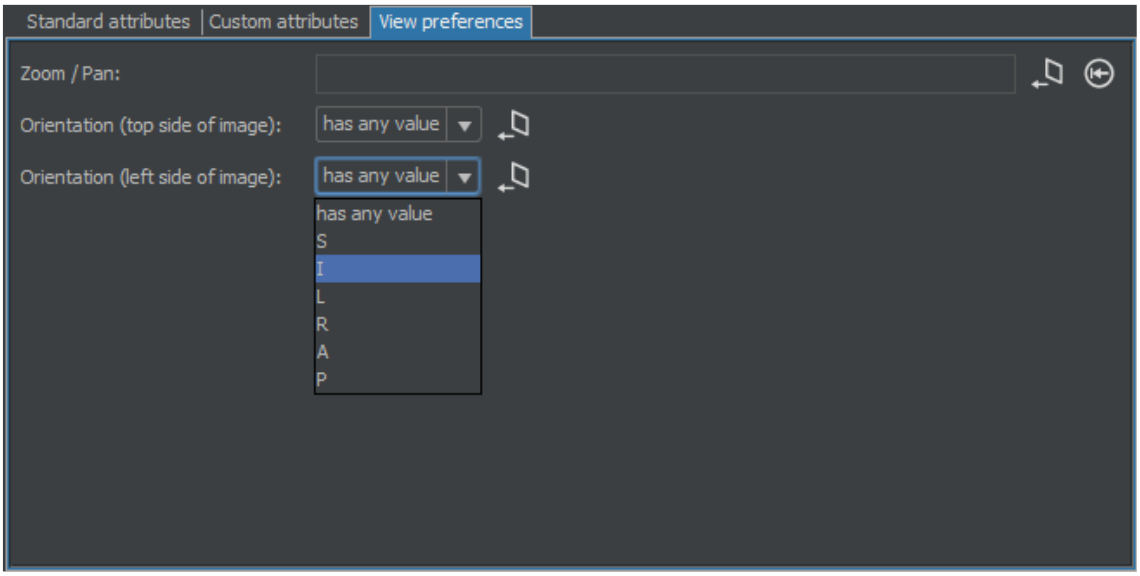


As you can see in the above image, any DICOM data element existing in a DICOM dataset can be reached by means of a proper syntax: if it is a “root” element, a single DICOM tag is sufficient to identify the attribute (as in the first row in the image above). A “non-root” data element of a DICOM dataset can also be reached, by means of a path-like syntax, as shown in the second row in the image above.

- *View preferences*: tab containing further options related to how images shall be presented for each series panel. Supported options are:
  - *Zoom / Pan*
  - *Orientation (top side of image):* the user can force the orientation for the top side of the image. The viewer will automatically rotate and/or flip the image,

if necessary, in an effort to obtain the desired orientation for the top side of the image.

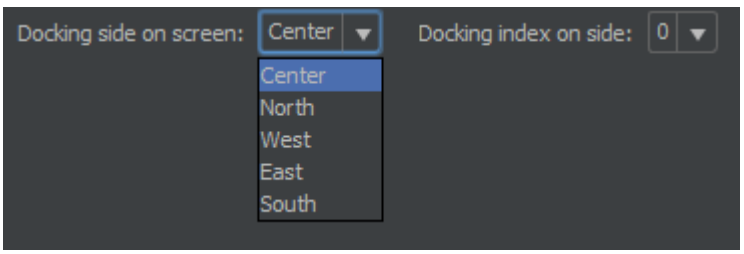
- *Orientation (left side of image):* the user can force the orientation for the left side of the image. The viewer will automatically rotate and/or flip the image, if necessary, in an effort to obtain the desired orientation for the left side of the image.



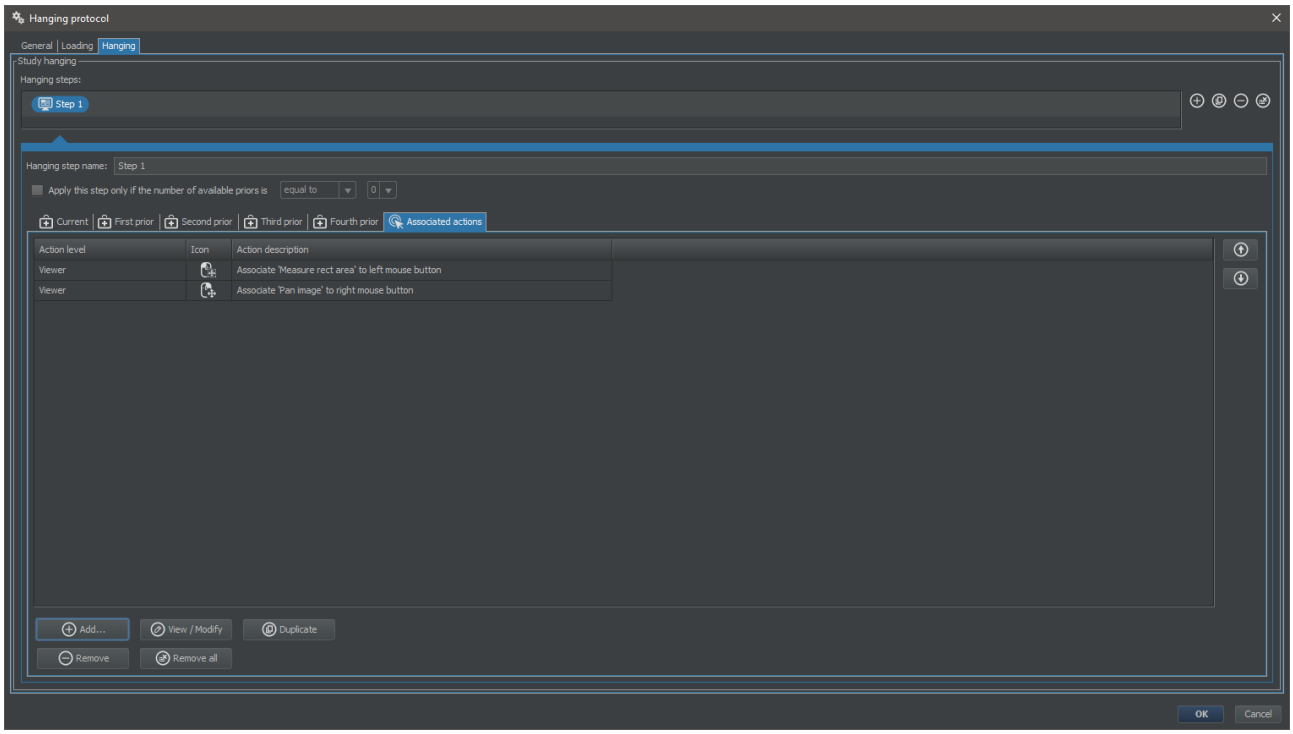
Next to the *Zoom / Pan* field, a *Reset* button ( ) is present, allowing to reset the current Zoom / Pan value.

If desired, the image hanging process can use single series panel for all images of a viewing series selecting the proper checkbox. If this option is not selected, the viewer will treat each single image independently, and will hang it to the first "free" series panel for which the hanging rules are matched.

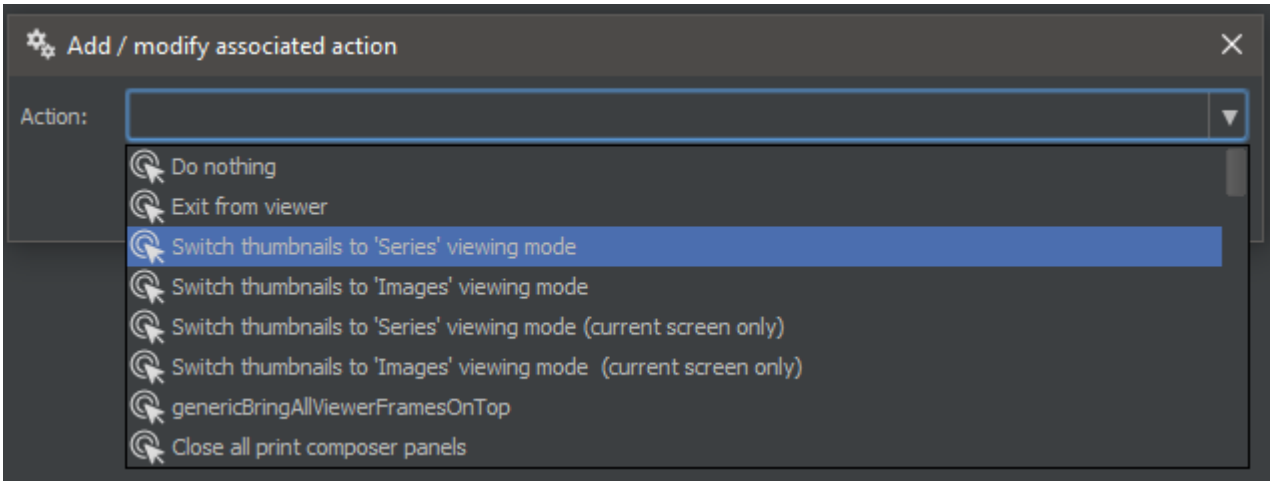
After the definition of the hanging view(s), the user can define exactly “where” the study panel (laid out according to the hanging view) shall be located within the screen, by acting on the docking properties:



Moreover, the user can add actions associated with each hanging step, through the *Associated actions* tab (see picture below). These actions will be automatically executed by the viewer when the related hanging step will be invoked by the user:



By clicking on the *Add* or *View / Modify* button, a dialog box will appear, including a drop-down list where all actions available within RemotEye Viewer are listed:

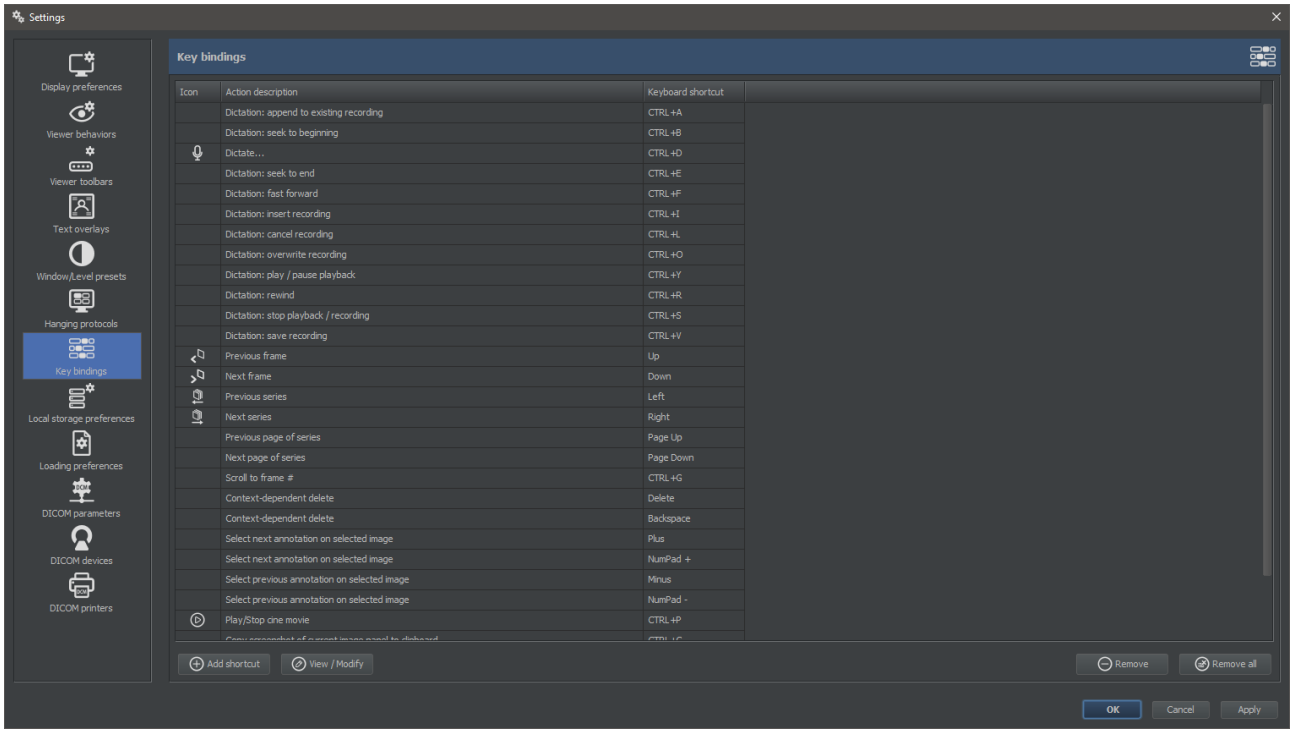


Ok and *Cancel* buttons allow adding / modifying the action or to cancelling the definition.

The order of the defined actions (which will also be the order by which these actions will be executed upon application of the hanging step) can be modified by means of the lateral arrows () when an action is selected in the *Associated actions* menu.

6.4.1.7 Key bindings

RemotEye Viewer allows associating keyboard shortcuts to all user actions available in the viewer. Clicking on the *Key bindings* item from the left-hand list, the *Key bindings* settings page will open.



Clicking on the *Add shortcut* button, the following dialog box will appear:

From here, user can associate a keyboard shortcut (or binding) to each one of the actions included in the *Action description* drop-down menu.

Here is an example of how the *Action description* drop-down list looks like:

Through the *Keyboard shortcut* field, it is possible to directly type the combination of keyboard keys (e.g., CTRL + other key, CTRL + ALT + other key, SHIFT + CTRL + other key, F keys, etc.) to be associated with the selected action.

Once an *Action / keyboard shortcut association* is saved by pressing the *OK* button, it will appear in the list related to the specific shortcuts level. Pressing the *Clear shortcut* button, the typed keys combination will be cleared.

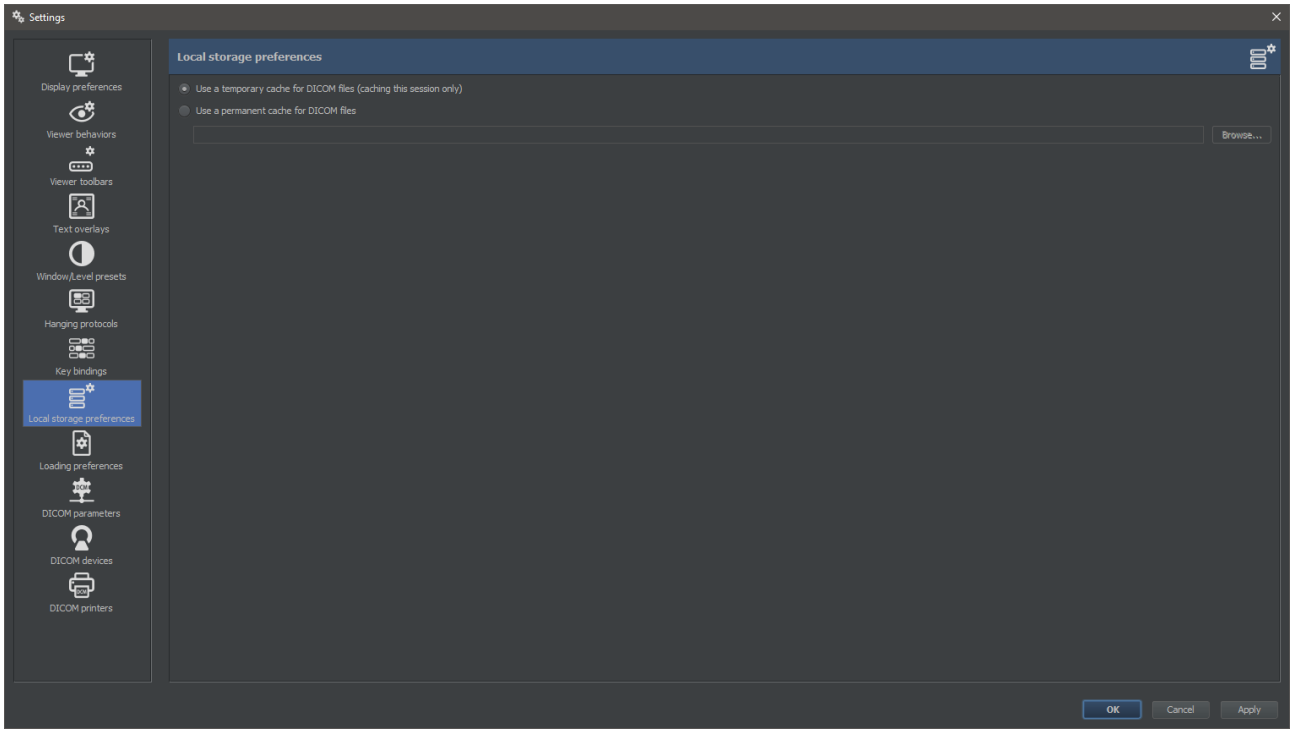
In addition, from each shortcuts level page, user can view or edit a selected association, pressing the *View / Modify* button, as well as remove a specific association or all associations related to that level, clicking respectively on the *Remove* or *Remove all* buttons.

While using keyboard shortcuts (or key bindings) during normal usage of the software, user has to consider that if input focus is on a specific study, first of all matching of a given key stroke with the study-level key bindings will be evaluated. In case no match is found, then screen-level key bindings will be evaluated. If no match is found again, then viewer-level key bindings will be evaluated. On the other side, if input focus is not on a specific study, but on a generic GUI component residing on a given screen, then screen-level key bindings will be evaluated. In case no match is found, then viewer-level key bindings will be evaluated.

6.4.1.8 Local storage preferences

RemotEye Viewer allows configuring some preferences related to local storage of DICOM files.

The *Local storage preferences* page can be displayed by selecting the *Local storage preferences* menu item of the *Settings* menu.

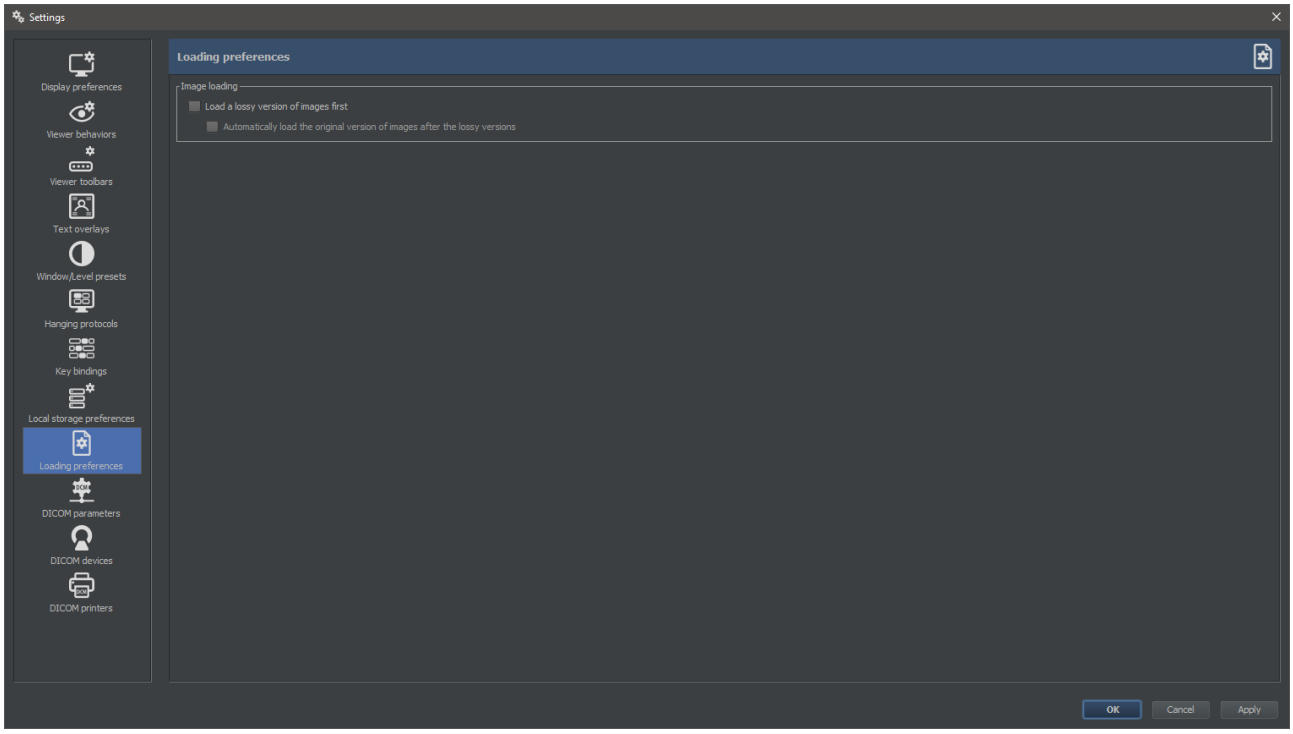


In particular, RemotEye Viewer supports a “local cache” for DICOM files, where all files downloaded or prefetched by the viewer are stored. DICOM files stored in this cache are indexed in such a way RemotEye Viewer will be able to load local files instead of downloading remote files whenever possible, thus greatly improving the efficiency and speed of the load operation.

By default, this local cache is stored in a temporary folder, in such a way it will store and cache just DICOM files downloaded or prefetched during a given execution session of RemotEye Viewer. However, it is possible to instruct RemotEye Viewer to use a fixed permanent folder for its local cache: this way, files downloaded during a given execution session of RemotEye Viewer will still be available in the cache during other successive execution sessions. Please notice that using a permanent folder for cache and accumulating a very large number of DICOM files in it may reduce the overall efficiency of the caching mechanism.

6.4.1.9 Loading preferences

The *Loading preferences* page can be displayed by selecting the *Loading preferences* item from the left-hand list.



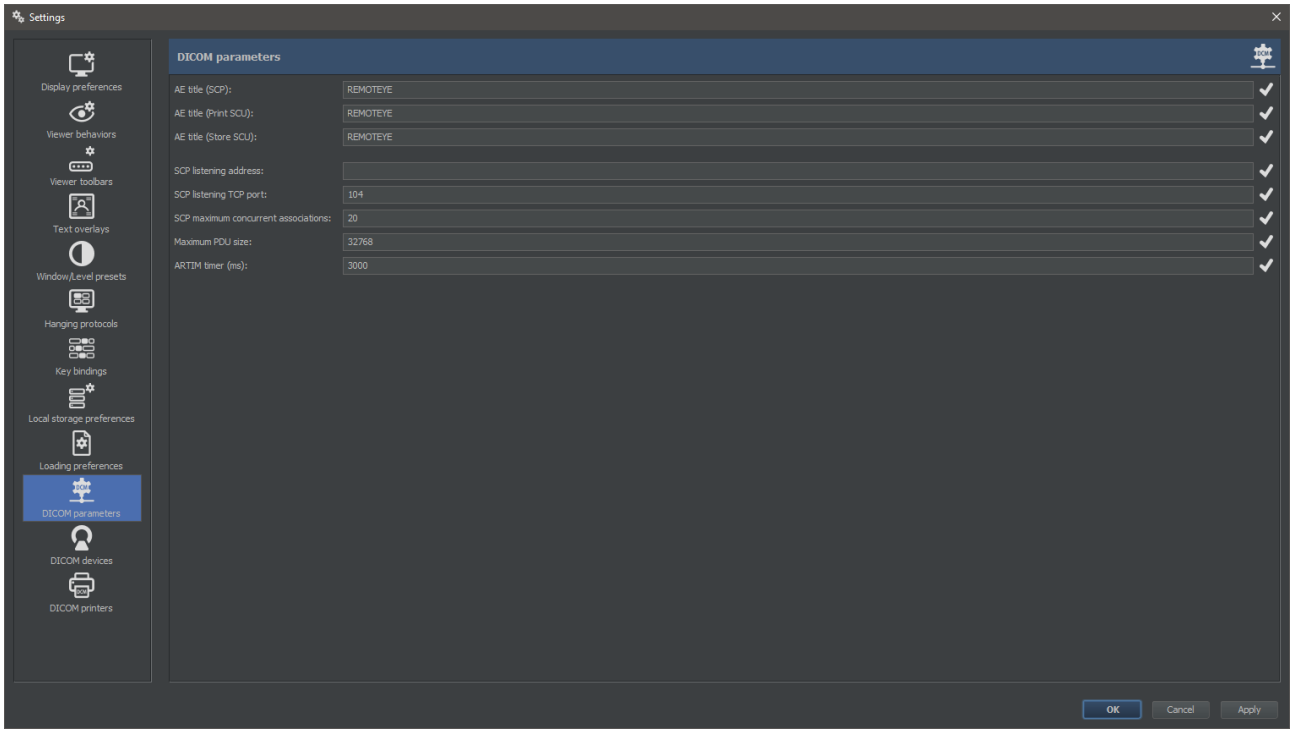
This configuration page allows specifying study and image loading preferences. In particular, RemotEye Viewer supports simultaneous management and display of several different studies, and the user may choose how to behave when a new study is loaded: RemotEye Viewer may automatically close the existing study to the existing ones, for instance for a side-by-side comparison.

Finally, if the back-end implementation supports this feature, user will be able to choose whether a lossy version of each study shall be loaded first, each time the loading of a study is requested. This feature allows to greatly reduce the initial download time of a study, since lossy images are significantly smaller than the corresponding original images. Once the user will have explored the (lossy) study and will have identified the most relevant series, it will be able to request the original version of specific series or of the entire study, through the *Load original version* button available in the Series toolbar (to download the original version of the images of a specific series) and in the Study toolbar (to download the original version of all images of the study).

⚠ **Important note:** it is strongly recommended to always use the original version of the images for every diagnostic purpose (e.g., diagnostic reporting). RemotEye Viewer will display a warning each time a critical operation (e.g., diagnostic reporting) will be attempted on a lossy version of the images.

6.4.1.10 DICOM parameters

The *DICOM parameters* page can be displayed by selecting the *DICOM parameters* item from the left-hand list.



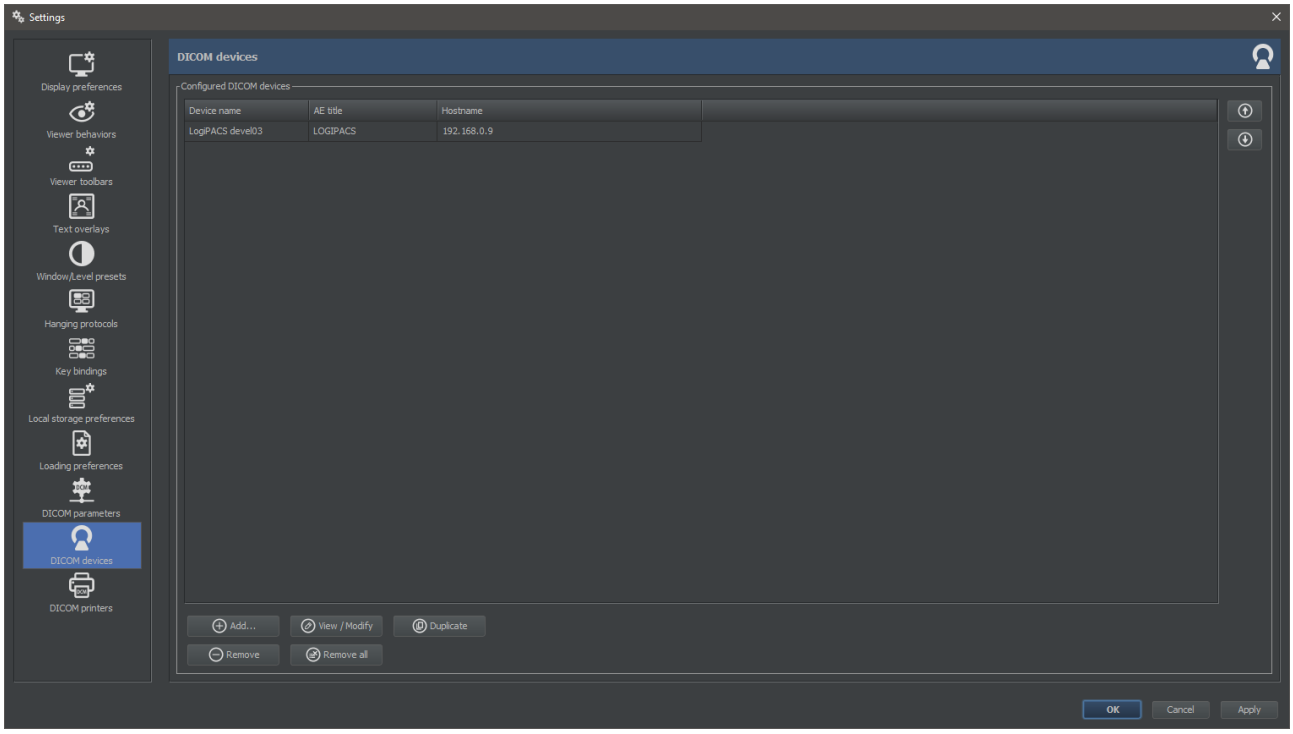
This configuration page allows setting the main parameters of RemotEye Viewer's DICOM application entities. In particular, it is possible to set different AE titles for RemotEye Viewer when acting as:

- a Service Class Provider (*AE title (SCP)* field): RemotEye Viewer acts in this role when receiving DICOM datasets sent by other DICOM nodes.
- a Print Service Class User (*AE title (Print SCU)* field): RemotEye Viewer acts in this role when sending DICOM print requests to output DICOM printers.
- a Store Service Class User (*AE title (Store SCU)* field): RemotEye Viewer acts in this role when sending DICOM files to other DICOM nodes.

In addition, in this configuration page it is possible to set the listening port and listening address of the viewer's embedded DICOM server (*SCP listening TCP port* and *SCP listening address* fields), the maximum number of concurrent connections accepted by this DICOM server (*SCP maximum concurrent associations* field) and other more technical DICOM communication parameters (*Maximum PDU size* and *ARTIM timer* fields).

6.4.1.11 DICOM devices

The *DICOM devices* page can be displayed by selecting the *DICOM devices* item from the left-hand list.



Through this configuration page, you can configure all DICOM nodes RemotEye Viewer shall be able to communicate with, except for DICOM Printers, which are configured in their own dedicated *DICOM printers* section (see next paragraph).

In order to configure a new DICOM device, just press the *Add…* button. The following dialog box will appear:

In this dialog, you shall enter the main identifying DICOM parameters of the new DICOM node being configured. The *Device name* field corresponds with a user-friendly description of the device, which will be shown inside the viewer's GUI to refer to this DICOM node. This is totally up to the user.

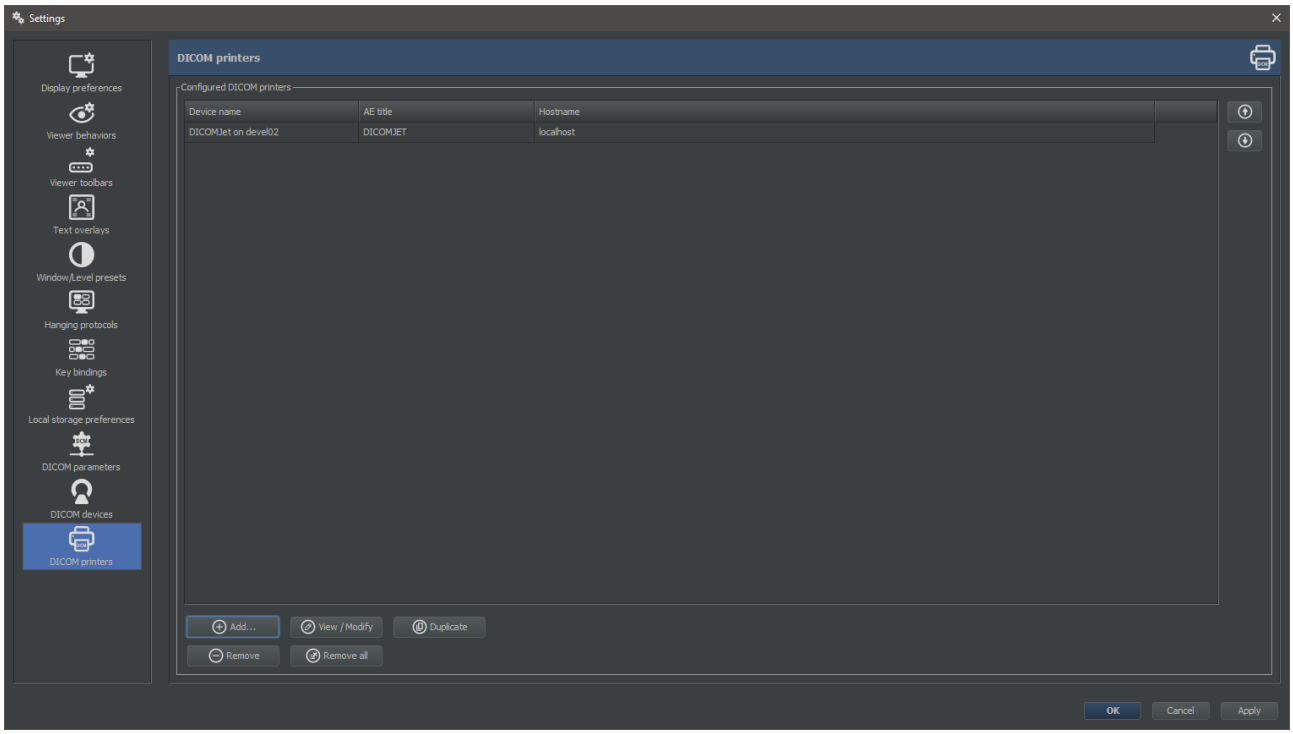
The typical DICOM identifying parameters shall then be entered:

- *AE title*: the Application Entity title of the DICOM device, as required by the DICOM protocol.
- *Host name*: the host name or IP address of the DICOM device's network node.
- *Listening TCP port*: the TCP port used by the DICOM device to listen to incoming connections for DICOM associations.

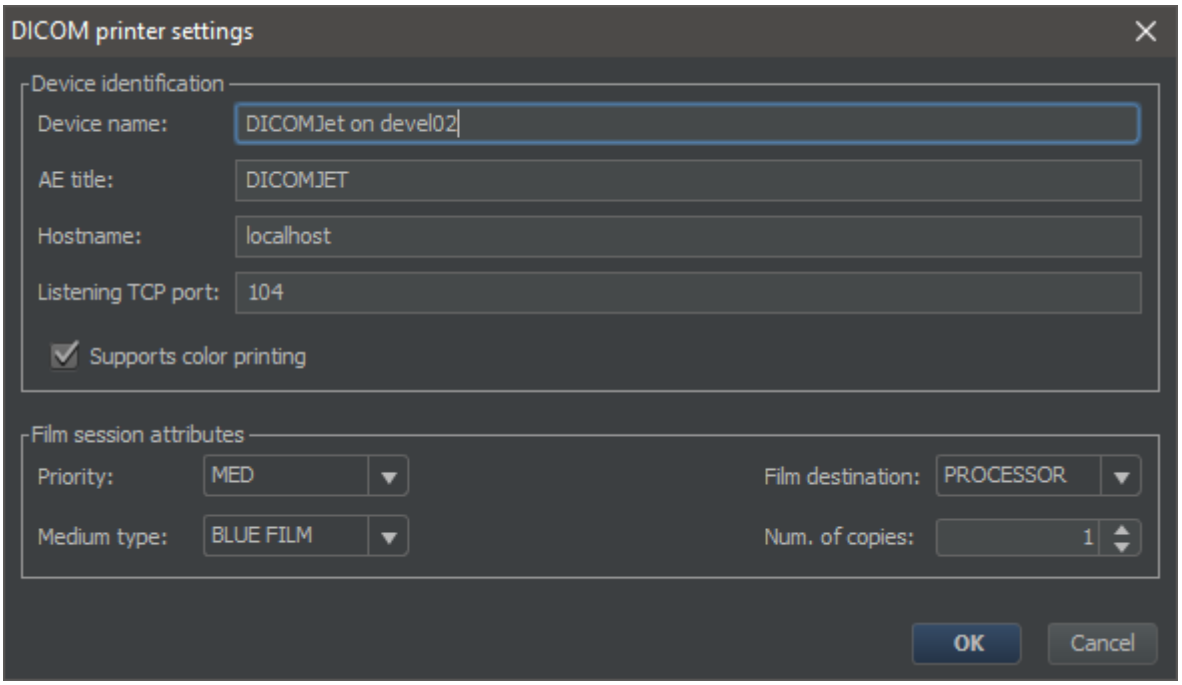
Finally, user shall also indicate whether this DICOM node is a DICOM Storage SCP or not, through the *Storage SCP* checkbox.
Once one or more DICOM devices have been configured, on the *DICOM devices* configuration page you are able to *View / Modify* the configuration of an existing DICOM device, *Duplicate* it, *Remove* it or *Remove all* configured DICOM devices.
Also, using the arrow buttons located next to the list of DICOM devices, you will be able to change the order of the DICOM devices. This order only determines the order in which available DICOM devices are displayed in lists in the viewer's GUI.

6.4.1.12 DICOM printers

In order to be able to send DICOM print commands to one or more DICOM printers, these DICOM printers must be preventively configured on RemotEye Viewer. This can be done by selecting the *DICOM printers* item the left-hand list of the *Settings* dialog box. The *DICOM printers* page will appear, as shown in the following picture:



This dialog box shows the list of available DICOM printers. A new DICOM printer may be configured by pressing the *Add…* button. The *DICOM printer settings* dialog box will appear, as shown in the following picture:



A DICOM printer is identified by the following main parameters:

- *Printer name*: a textual user-friendly name which will be used by RemotEye Viewer to identify each single DICOM printer. This must be a unique name for each DICOM printer.
- *AE title*: the Application Entity title of the DICOM printer, as required by the DICOM protocol.
- *Host name*: the host name or IP address of the DICOM printer network node.
- *Listening TCP port*: the TCP port used by the DICOM printer to listen to incoming connections for DICOM associations.
- *Supports color printing*: a flag indicating whether the DICOM printer being configured supports color printing or not.

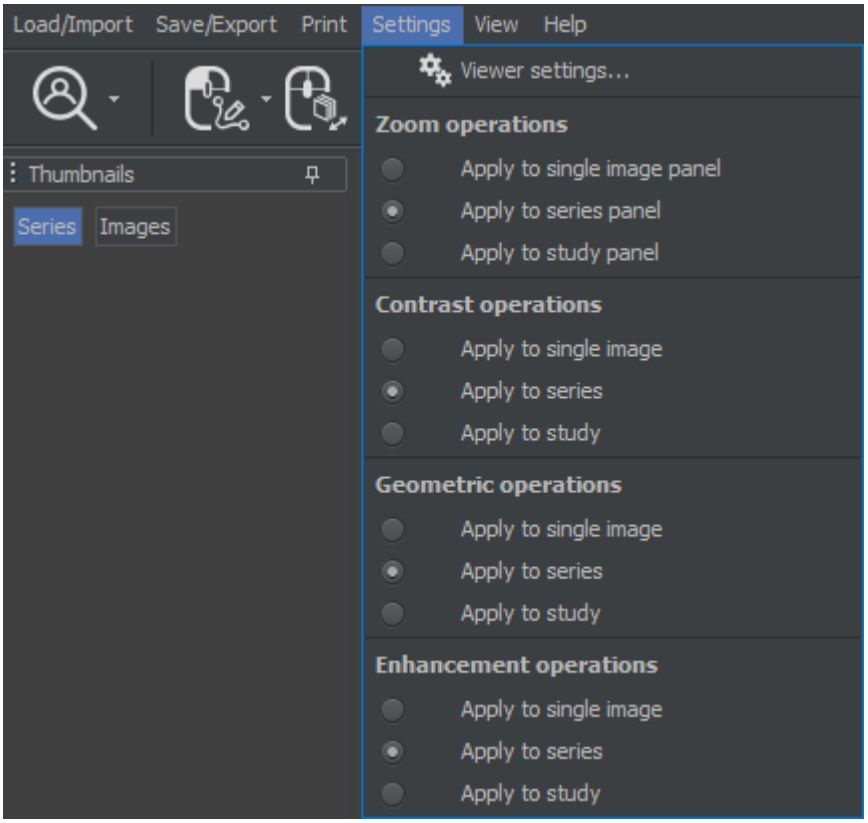
The rest of the *DICOM printer settings* dialog allows configuring *Film Session attributes*: these are the attributes which will be selected by default when performing a DICOM print operation to this DICOM Printer. It will always be possible to change these default settings upon confirmation of the actual DICOM print operation. Please refer to the DICOM standard for a detailed explanation about each single attribute related to the DICOM print operation.

Once one or more DICOM printers have been configured, on the *DICOM printers* configuration page you are able to *View / Modify* the configuration of an existing DICOM printer, *Duplicate* it, *Remove* it or *Remove all* configured DICOM printers.

Also, using the arrow buttons located next to the list of DICOM printers, you are able to change the order of the DICOM printers. This order only determines the order in which available DICOM printers are displayed in lists in the viewer's GUI.

6.4.2 Scope of operations on images

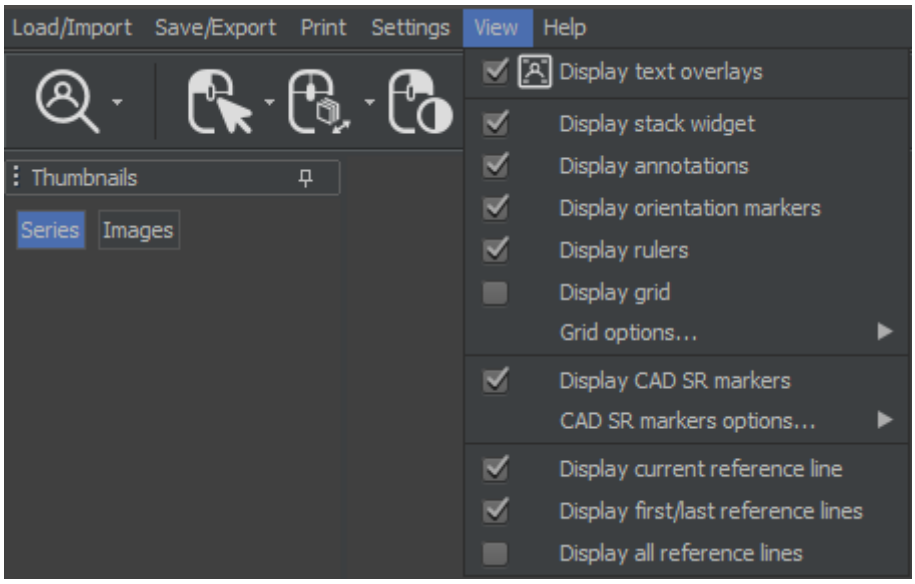
In addition to configuration of the viewer's settings, the *Settings* main menu allows setting several preferences related to the scope of application of the main image manipulation functions supported by the viewer:



Zoom operations can be applied to a single image panel, to a series panel or to the study panel; whereas contrast, geometric and enhancement operations can be applied to a single image, to a series or to the entire study, depending on the user's preference.

6.5 View

Here is a screenshot of the *View* menu:

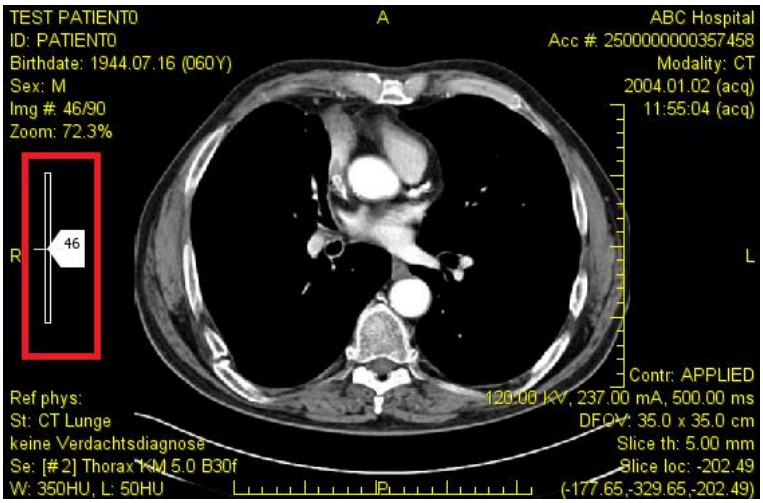


This menu allows specifying several viewing preferences about what shall be displayed and what shall be hidden on the image panels of the viewer.

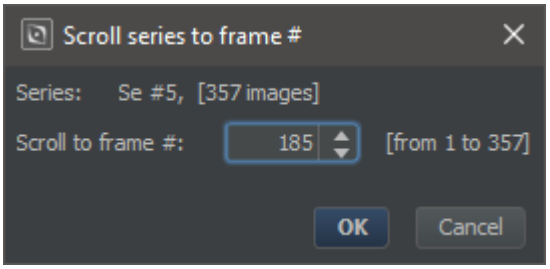
6.5.1 Basic viewing preferences

The *Display text overlays* menu item allows enabling and disabling the display of textual overlays on the medical images shown on screen. These text overlays contain fundamental information about each image, such as Patient ID, Patient name, Patient sex, Patient birth date, Study date, Study description, Modality used for acquisition, and other acquisition parameters. These acquisition parameters may sometimes be modality-specific. The specific data fields to include into text overlays related to each kind of image can be entirely configured in the *Text overlays* configuration page of the viewer settings.

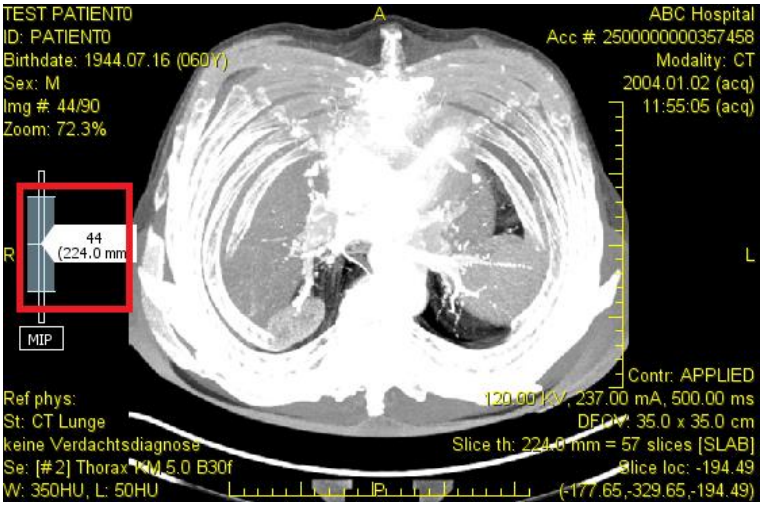
The *Display stack widget* menu item controls display on each image of a widget allowing to quickly scroll across frames of a series, as well as to enable the "thick slab" mode on the original series, as long as the series represents a volume inside the patient's body (typically, CT or MR series):



When the "thick slab" mode is disabled, the user will be allowed to scroll the series by dragging the white cursor labelled with the image number. Moreover, a double click on the cursor will allow the user to manually set the frame he wants to display:

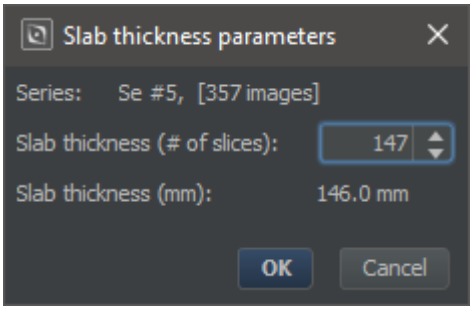


The "thick slab" mode can be enabled by vertically dragging the horizontal line located next to the white cursor:



The thickness of the "thick slab" will vary depending on the dragging operation.

When the "thick slab" mode is enabled, users will be allowed to change the projection algorithm for the slab by clicking on the box located underneath the widget (MIP, AvgIP or MinIP algorithms are available). Thick slab mode can be turned off by double-clicking on the central reference line. Finally, a double click on the horizontal lines which mark the end of the extent of the thick slab on the widget will allow user to manually set the slab thickness parameters:



The *Display annotations* menu item allows enabling and disabling the display of measurement and graphical annotations over all the displayed images.

The *Display orientation markers* menu item allows enabling and disabling the display of orientation markers, normally available on CT and MR images, and sometimes on other kinds of images. If the image orientation information is present inside the related DICOM image file, the orientation markers will be displayed at the four edges of each DICOM image. The orientation will be indicated as:

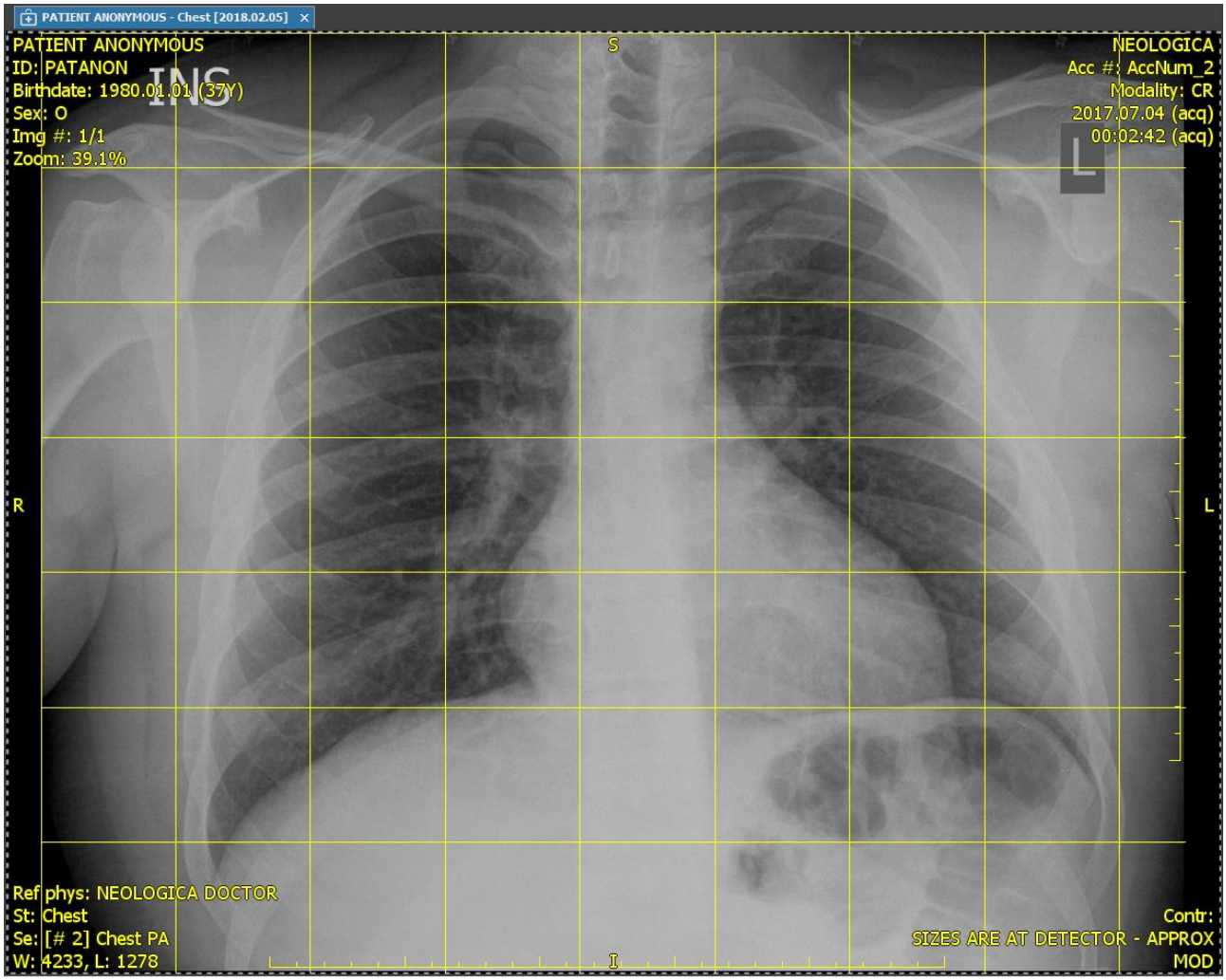
- *A*: Anterior
- *P*: Posterior
- *I*: Inferior
- *S*: Superior
- *L*: Left
- *R*: Right

⚠ **Warning**: the orientation markers are information generated by a software algorithm. As such, their correctness depends on the correctness of several information stored in the original DICOM datasets, in addition to the correctness of the implemented algorithm. The viewer itself has no mean to ensure these input data are correct. Hence, orientation markers shall be checked and treated in a very “critical” way by the user/radiologist, and any conclusion coming from the orientation markers shall be carefully evaluated.

The *Display rulers* menu item allows enabling and disabling the display of on-screen rulers showing actual distances over the displayed images. The rulers show a short tick every 1 cm on the image, and a longer tick

every 5 cm on the image. Rulers will only be displayed on images having the appropriate calibration information inside the related DICOM image file.
Finally, The *Display CAD SR markers* functionality will be described in the following paragraph.

The *Display grid* menu item allows enabling and disabling the display of an on-screen reference grid, which is shown on top of the medical image(s), like this:

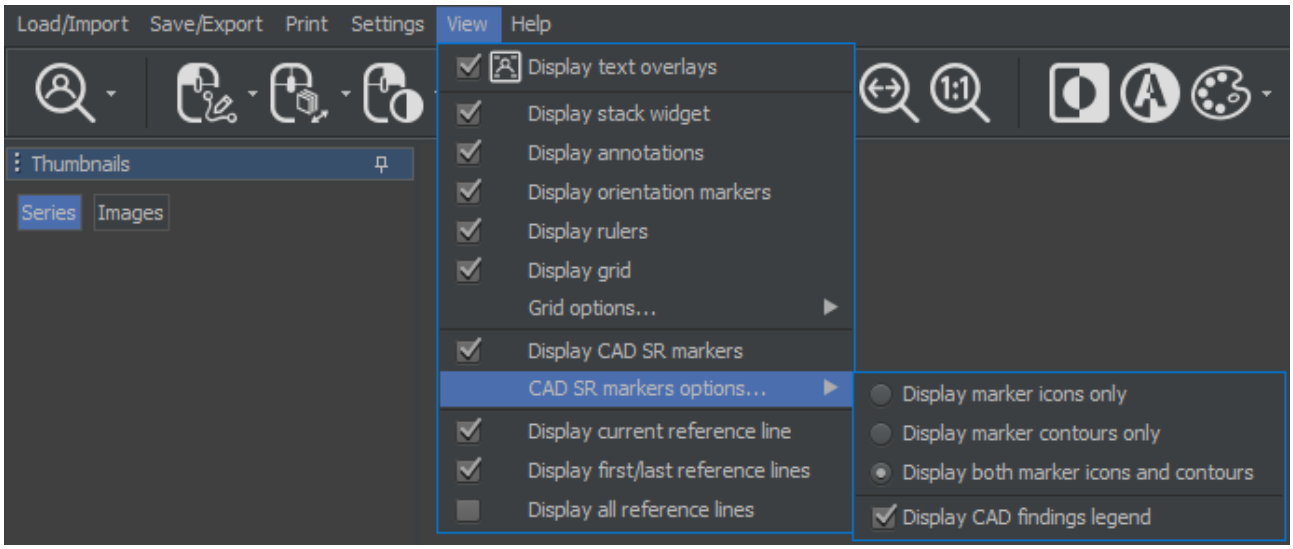


The *Grid options* menu item allows setting the distance between consecutive lines (i.e., the *step*) of the grid.

6.5.2 Viewing preferences for mammo CAD markers

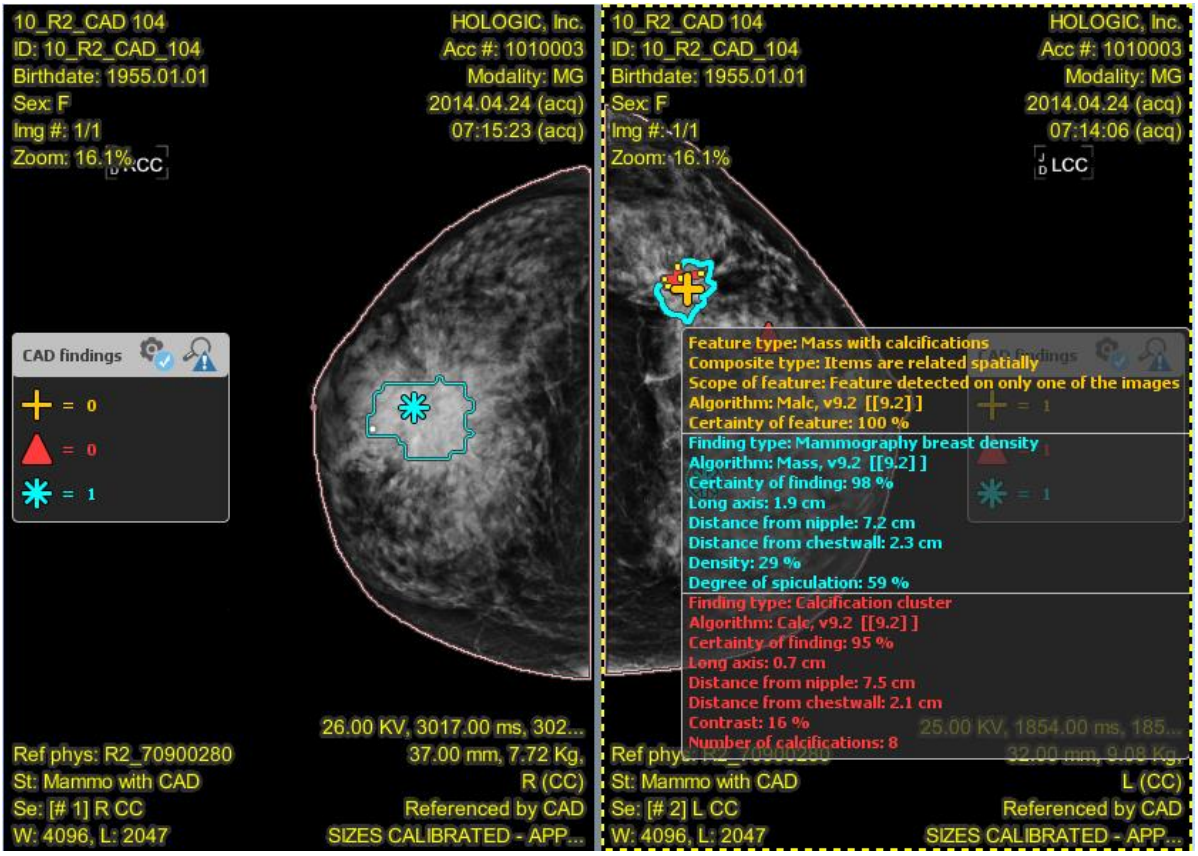
RemotEye Viewer supports decoding and display of CAD findings and markers starting from DICOM Mammo CAD SR files. These files are normally produced by mammography CAD software, and contain encoded information about the detections the CAD software has done on the images of a specific mammographic study.

The display of Mammo CAD markers can be enabled and disabled through the *Display CAD SR markers* menu item, available in the *View* menu. Once the *Display CAD SR markers* item is checked, the *CAD SR markers options...* menu item becomes active as well, as shown in the following image:



From here, it is possible to choose whether to display CAD markers icons only, or CAD marker contours only, or both. In addition, selecting the appropriate checkbox, RemotEye Viewer will show also a legend related to the detected CAD findings.

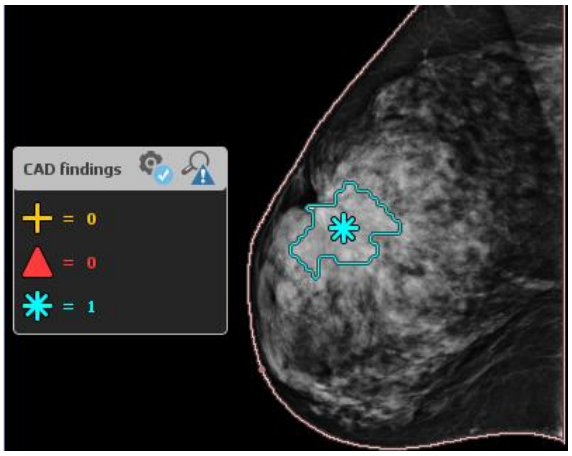
Here is a screenshot showing two images of a mammographic study on which CAD markers and CAD findings legend are displayed:



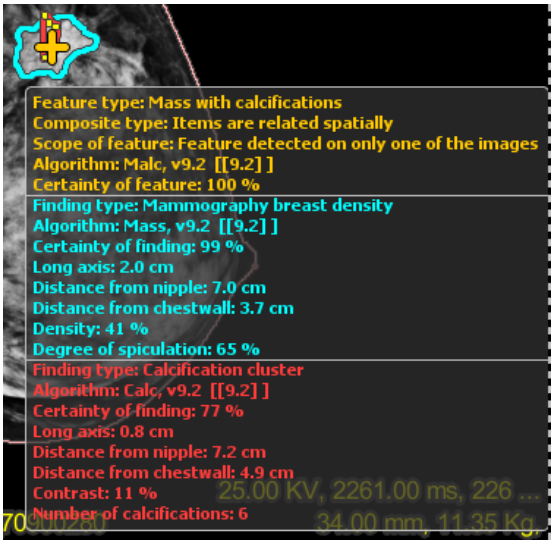
RemotEye Viewer is able to show three different types of findings / features:

- *Mammography breast density*: associated with the  icon,
- *Calcification cluster*: associated with the  icon,
- *Mass with calcifications*: associated with the  icon.

While icons are located in the centre of each finding / feature, a contour defines the entire breast area interested by the finding / feature in question. This contour is the same colour as the related icon.
As mentioned above, enabling the *Display CAD findings legend* option from the appropriate menu, a legend showing a summary of the detected findings, will be displayed on the related image.



Finally, moving the mouse over a CAD finding icon or within its contour, a panel providing all the available information about the finding(s) / feature(s) will appear, as shown in the following image:



⚠ **Important note:** Display of mammo CAD SR markers is disabled upon first display of a loaded study, in such a way not to influence the radiologist's opinion and diagnosis. For safety and diagnostic accuracy purposes, indeed, it is important that the radiologist builds its own diagnostic opinion before seeing the mammo CAD SR markers, which shall only act as an aid and diagnostic support mean.

6.5.3 Viewing preferences for reference lines

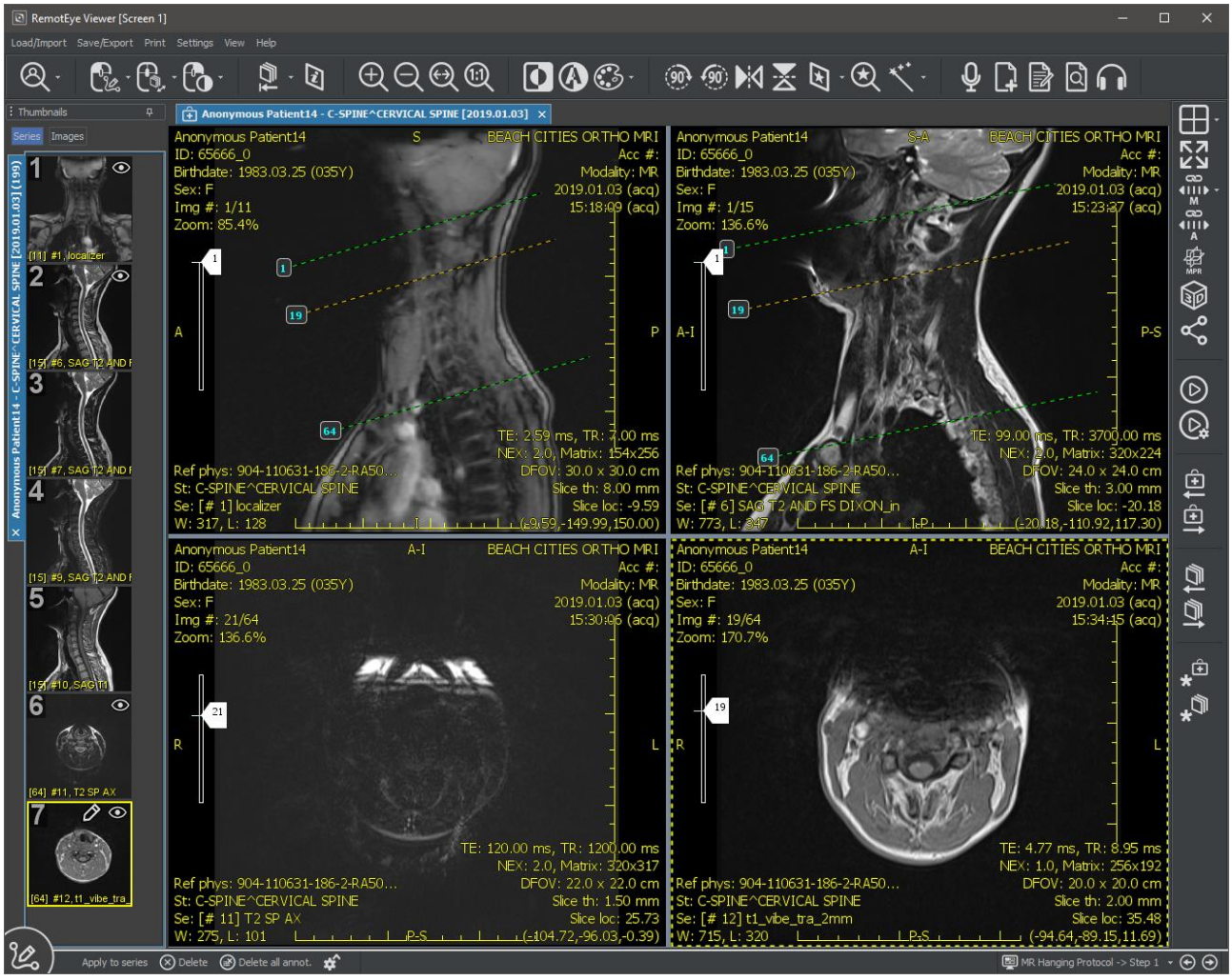
Reference lines show intersections of the currently-selected image plane with all other image planes shown in the non-selected image panels. Reference lines are only available when the DICOM header provides enough information on the positioning, orientation and pixel spacing of each medical image in the 3D patient-related coordinates system. Normally, this happens for CT and MR images.

The *Display current reference line* menu item allows enabling and disabling the display of reference lines related to the currently selected image on all other displayed and intersecting series. A reference line indicates the location of an image slice (the currently selected image) on another image of an intersecting plane.

The *Display first/last reference lines* menu item allows enabling and disabling the display of reference lines related to the first and last image of the currently selected series.

The *Display all reference. lines* menu item allows enabling and disabling the display of reference lines related to all images of the currently selected series.

The following picture shows an example of how reference lines look like on a MR study:

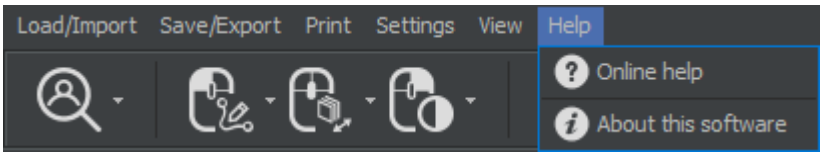


Warning: reference lines are generated by a software algorithm. The correctness of their location and geometry depends on the correctness of several positioning, orientation and spacing data stored in the original DICOM datasets, in addition to the correctness of the implemented algorithm. The viewer itself has no mean to ensure these input data are correct. Hence, reference lines displayed on the images shall be checked and treated in a very “critical” way by the user/radiologist, and any

conclusion coming from reference lines shall be carefully evaluated.

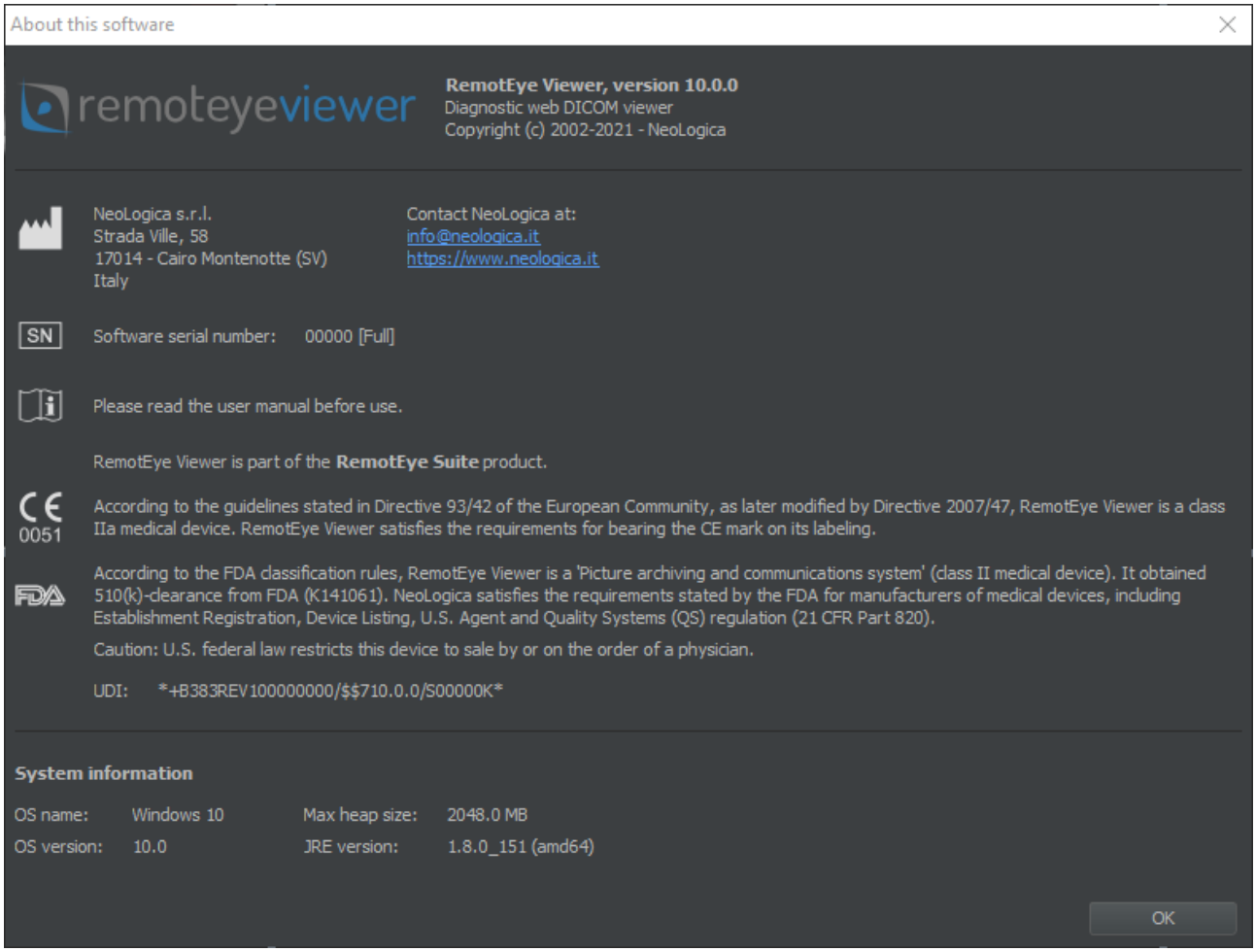
6.6 Help

Here is a screenshot of the *Help* menu:



The *Online help* menu item allows accessing the application's user manual. A suitable PDF reading software will need to be available on the client machine in order to ensure proper functionality of this feature.

Pressing the *About this software* menu item, the "*About this software*" dialog box will appear, showing information about the current software version and the license in use:



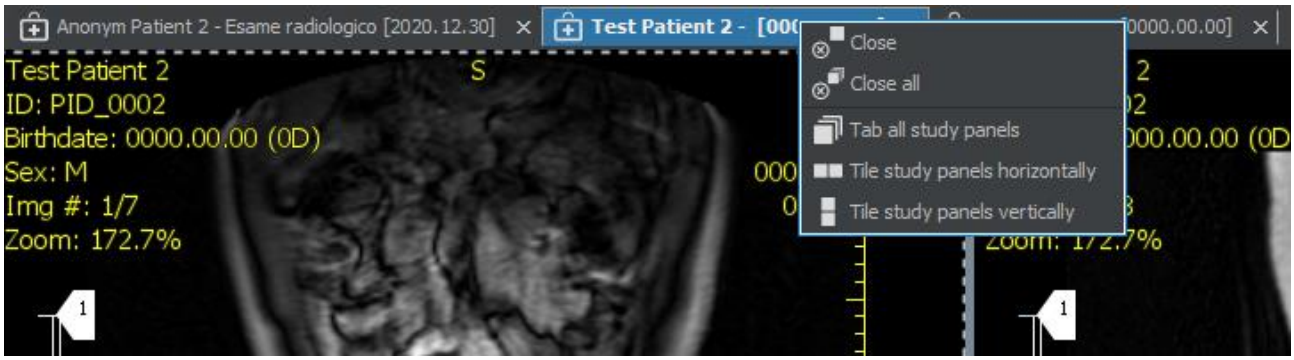
7 Study panels

In RemotEye Viewer, each loaded study is displayed in its own dedicated *study panel*, which in turn contains one or more *series panels*. The number and layout of series panels contained in the study panel depends on the *series tiling* setting (i.e., the number of series columns and series rows), which can be set by acting on the appropriate toolbar button, as detailed in the following chapter.

Once the study is open, and several series are displayed on screen, you can maximize a given series (thus switching to 1x1 series tiling and 1x1 image tiling) by double-clicking on it when the *Select/Stack* tool is associated with the double-clicked mouse button. Then, when you are done with this image, you can double-click again on it in order to return to the previous display mode, and all previously displayed images will be restored on screen.

By default, multiple study panels (corresponding to multiple open studies) are arranged in a "tabbed" fashion. However, it is possible to manually drag the tab title of each study panel to arrange and dock the panel according to the user's preference (e.g., in a side-by-side fashion).

In addition, by right-clicking on the tab title related to a study panel, the following drop-down menu will appear:



As can you see, this menu allows user to arrange study panels on screen in some different ways: study panels can be grouped together in a tabbed fashion, they can be tiled horizontally or they can be tiled vertically.

8 Toolbar actions

Toolbars are now entirely configurable in RemotEye Viewer, through the dedicated section of the *Viewer settings*. Hence, toolbars can contain virtually any button associated with any action defined and available within RemotEye Viewer.

Due to this flexibility, your toolbar(s) may differ also substantially from the toolbars shown in the following sections of this manual. However, the following paragraphs will describe all the main actions which may be typically assigned with toolbar buttons, obviously including the actions associated with the default toolbar buttons configuration.

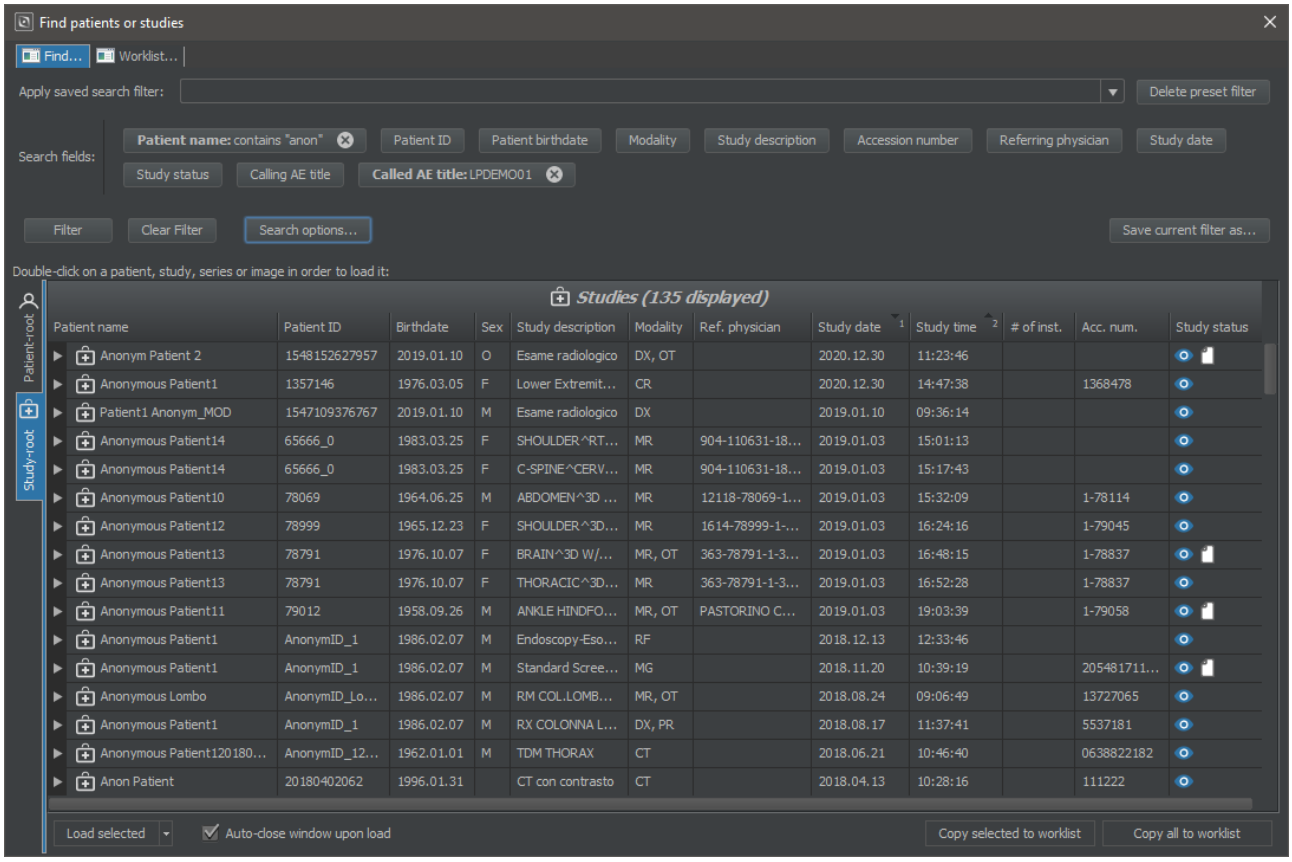
Here is how the top toolbar and the right toolbar appear in a typical default configuration:

The left toolbar is empty, hence hidden, in the default configuration.

8.1 Finding patients / studies

The *Patients* / *Studies* toolbar button () can be used to search for available patients or studies.

If you press the *Patients* / *Studies* button, the *Find Patients or Studies* window will appear, as shown in the following picture:



This window shows all available studies, series and images.

Depending on the current user's selection, the tree view may display a “Patient / Study / Series / Image” hierarchy (*Patient-root* view) or a “Study / Series / Image” hierarchy (*Study-root* view).

You can double-click on a patient, study, series or image node (for each operation a massage asks how you would like to combine the new loaded studies with the existing ones):

- Double-clicking on a patient node (only possible with *Patient-root* view) will cause loading all studies belonging to that patient. A confirmation for such operation is asked by RemotEye Viewer;
- Double-clicking on a study node will cause loading all series belonging to that study;
- Double-clicking on a series node will cause loading all images belonging to that series;
- Double-clicking on an image node will cause loading just that image.

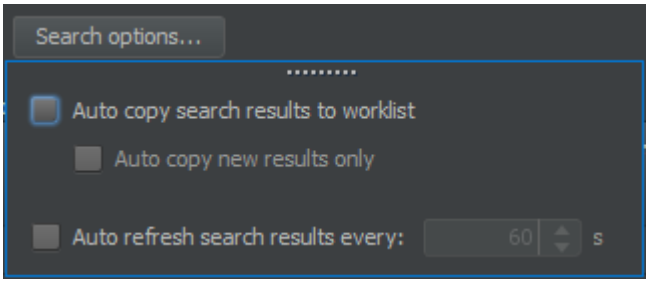
A powerful search filter is also provided to facilitate the search of a particular patient, study or series.

The user may specify a value for a given search parameter, then press the *Filter* button: the “Patient / Study / Series / Image” hierarchy will be filtered and only those nodes matching the search parameter(s) will be displayed. In particular, the following search parameters are supported:

- *Patient Name*
- *Patient ID*

- *Patient birthdate*
- *Modality*
- *Study Description*
- *Accession Number*
- *Referring Physician*
- *Study Date*
- *Study Status* (*Read*, *Dictated*, *Transcribed*, *Report present*, *Report complete*, *Verified* - some study statuses are only available when a specific type of reporting is enabled)
- *Calling AE Title* (only available with the “query” integration model)
- *Called AE Title* (only available with the “query” integration model)

You can apply a previously-saved filter (if any) using the *Apply saved search filter* drop-down list. Also, you can delete the currently-selected filter, with the *Delete preset filter* button.
It is possible to clear/reset all the currently-set search parameters by pressing the *Clear Filter* button. On the other side, you can reset each individual search parameter by pressing the small “X” button ( ) located next to each search field.
Pressing the *Search options…* button, the following panel will appear:



Checking "*Auto copy search results to worklist*" option, all studies appearing as the result of each search will be automatically copied to the *Worklist* (the Worklist concept will be explained later in this paragraph). Checking also the *Auto copy new results only* option, only the new results (i.e., results which haven't appeared before in the *Find...* view) will be added to the worklist.
You can also *auto-refresh search results* (i.e., periodically repeat the query for matching studies), and you can choose the time of refreshing.
With the *Save current filter as...* button you can save the current set of search parameters, and assign an identifying name to this preset. The newly-saved search filter will be added to the drop-down list located at the top of this *Find* panel.
The *Load selected* button allows loading the selected studies; clicking the arrow-shaped drop down button located next to the *Load Selected* button, an additional menu containing a *Load fresh copies of selected items* functionality will appear, allowing to load fresh copies of the selected studies directly from the server, without using files eventually present in the local cache. This functionality is useful for instance when some

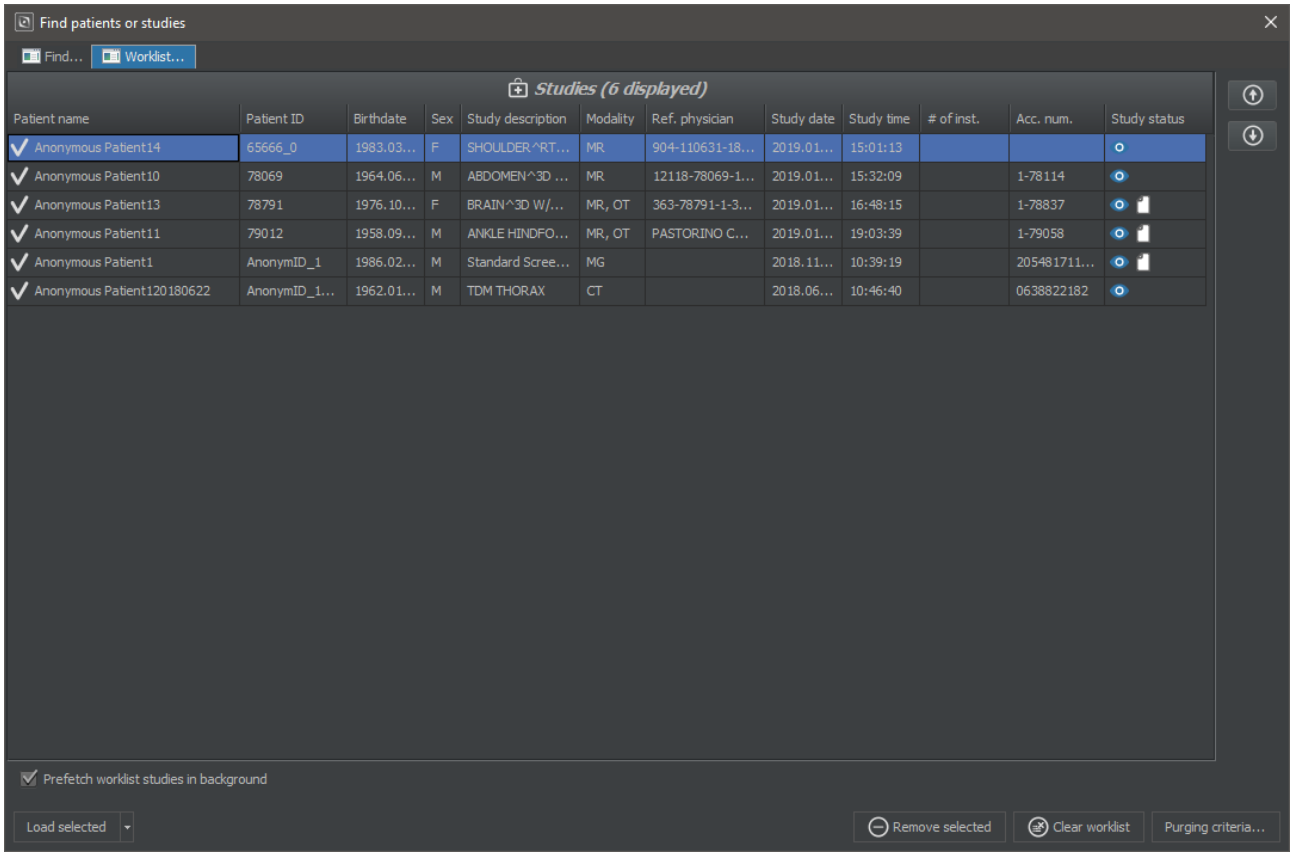
modifications have occurred on the DICOM data stored on the server, and user wants to acquire the up-to-date version of those DICOM files (the fresh copies), even if old copies are already present in the local cache (e.g., due to a previous load operation or background prefetch).

Moreover, the buttons *Copy selected to worklist* and *Copy all to worklist* allow copying studies to the radiologist's worklist (a description of this feature will follow briefly).

Holding down the *Ctrl* button of the keyboard, you can select several studies at the same time.

If the checkbox *Auto-close window upon load* is checked, the *Find Patients or Studies* window will be automatically closed after a load operation is triggered on this view.

By selecting the *Worklist...* tab, the radiologist's worklist view will appear. The *Worklist...* tab is only available when the radiologist's worklist functionality is enabled. The radiologist's worklist is an ordered set of studies which the current user needs to read, report or review. Studies may be manually added by the user to his own worklist, either by drag and drop (from the *Find* tab to the *Worklist* tab), or by the "*Copy...*" buttons available under the "*Find...*" view, or by checking the "*Auto copy search results to worklist*" option under *Search options…* of the "*Find...*" view.



For each study, this list shows: *Patient name*, *Patient ID*, *Patient birthdate*, *Study description*, *Modality*, *Referring physician*, *Study date*, *Study time*, *# of inst.* (i.e., number of instances), *Accession number*, *Study status*.

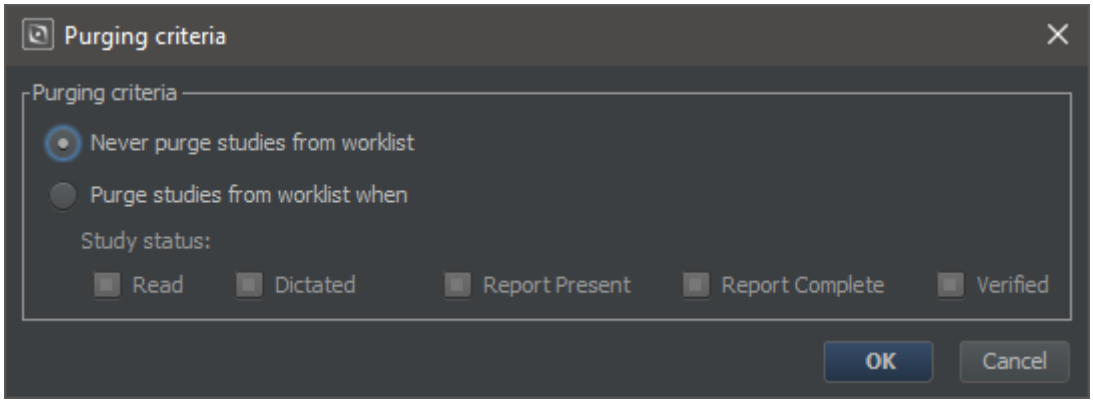
Selecting a row and then pressing the “arrow up / arrow down” buttons () available on the top-right of this view, you can move a selected study through the list. The same result can be obtained with the mouse, through a drag&drop operation within the list.

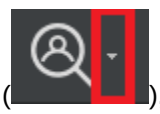
Studies appearing in the worklist may be loaded and displayed by double-clicking on the appropriate row of the list.

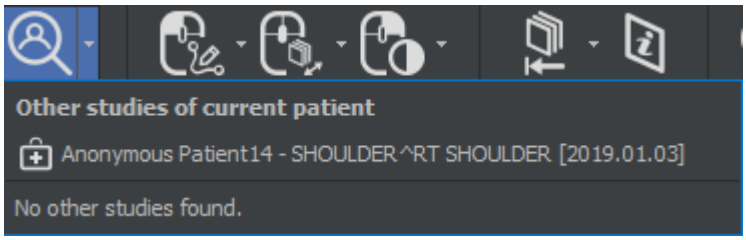
Also, if the checkbox *Prefetch worklist studies in background* is checked, RemotEye Viewer is able to pre-fetch in background the studies belonging to the current radiologist’s worklist. Each study is denoted by a “folder” icon () if it hasn’t been pre-fetched yet, or a “checkmark” icon () if it has already been pre-fetched. Pre-fetched studies are much faster to load, since they reside on the local hard drive of the client station.

With the *Load selected* button you can load the selected study(s); clicking the arrow-shaped drop down button located next to the *Load Selected* button, a drop down menu containing a *Load fresh copies of selected items* and *Clear selected items from cache and prefetch history* functionalities will appear. The former allows loading fresh copies of items directly from the server and the latter clears local and back-end caches from the selected items.

Finally, with the *Remove selected* button you can remove the selected study(s) from the worklist. With the *Clear worklist* button you can remove all studies from the worklist. With the *Purging criteria... button* you can choose when to automatically purge studies from worklist:



Clicking on the arrow-shaped drop down button located next to the *Patients / Studies* toolbar button (), a drop down menu containing the other studies (both older and newer) related to the current patient will appear, allowing to speed up the patient's studies search. See the following picture:



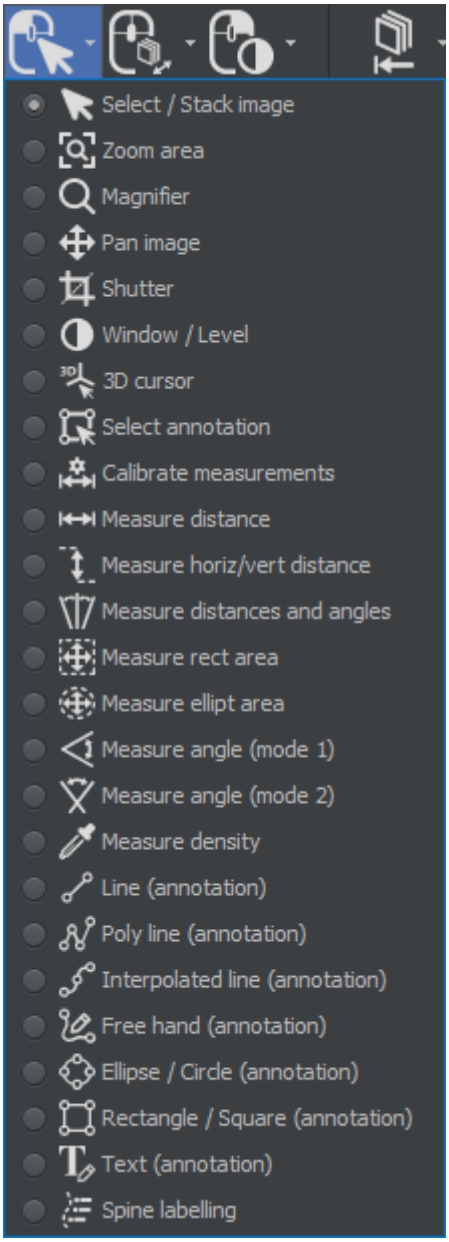
8.2 Association of tools with mouse buttons

RemotEye Viewer supports a completely flexible association between mouse buttons and image manipulation tools.

In particular, the following toolbar buttons may be used to associate a tool with the left mouse button, the mouse wheel and the right mouse button:

When moving the mouse pointer over each one of the above toolbar buttons, a tooltip text will appear, providing additional information about the function of the button.

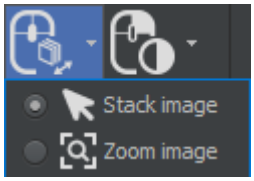
The *Associate tool with LEFT mouse button* toolbar button () can be used to associate an image manipulation tool with the left mouse button. If you press this toolbar button, the following drop-down menu will appear:



The *Associate tool with RIGHT mouse button* toolbar button () can be used to associate an image manipulation tool with the right mouse button. If you press this toolbar button, the same drop-down menu as above will appear.

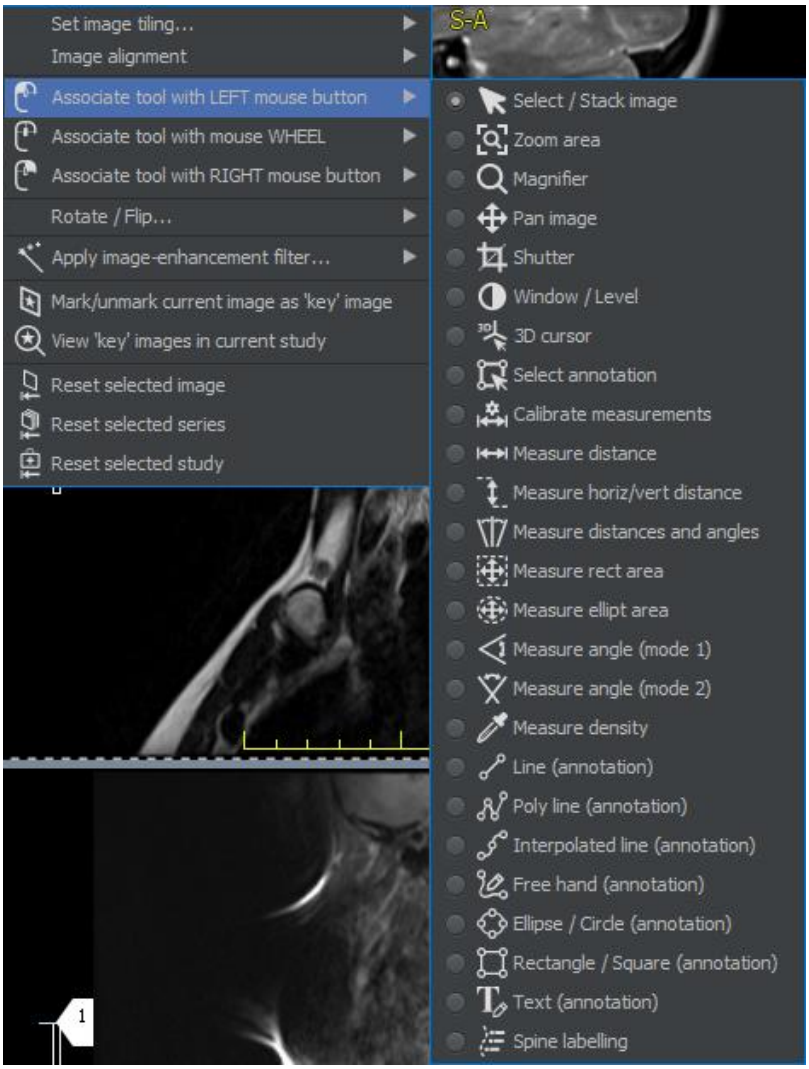
Each available image manipulation tool can be independently associated with the left mouse button and with the right mouse button. All combinations of left / right mouse button tools are supported.

The *Associate tool with mouse WHEEL* toolbar button () can be used to associate *Stack image* or *Zoom image* tools with the mouse wheel. If you press this toolbar button, the following drop-down menu will appear:



This flexible functionality implies that each single image tool is always usable with a single mouse button. For instance, the *Poly line (annotation)* tool allows drawing a poly-line with a single mouse button; double-click of the associated mouse button must be used to conclude the shape.
The icon of the tool currently associated with the left and right mouse buttons will appear in the next to the left, right and wheel mouse button icons.
In addition to using these toolbar buttons, there are also other ways to associate tools to mouse buttons:

- By CTRL + right-clicking over an image panel, the following contextual menu will appear:



Using the Associate tool with LEFT mouse button, Associate tool with mouse WHEEL and Associate tool with RIGHT mouse button menu items, you are able to change the association between mouse buttons and tools.

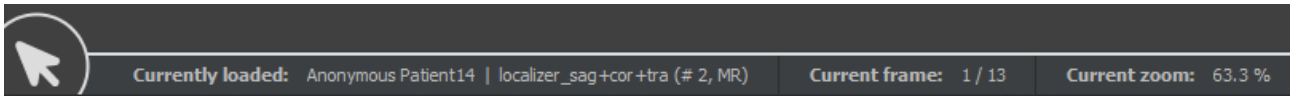
- By SHIFT + left-clicking, the viewer directly shows the popup menu to associate a tool with the left mouse button. By SHIFT + right-clicking, the viewer directly shows the popup menu to associate a tool with the right mouse button. By SHIFT + wheel-clicking, the viewer directly shows the popup menu to associate a tool with the mouse wheel.

Each image manipulation tool has its own associated *Tool options* panel. When the user starts using an image manipulation tool on a medical image, that tool becomes the *active tool*, and the *Tool options* panel related to that tool will be displayed in the viewer's bottom bar. Also, the icon of the active tool is displayed in the bottom left corner of the viewer's window:

The following paragraphs will describe each image manipulation tool, as well as the options and information available in the *Tool options* panel associated with each tool.

8.2.1 Select/Stack image

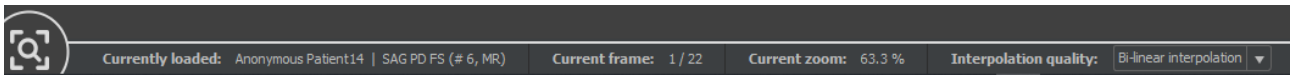
The *Select/Stack image* tool allows selecting an image panel on a screen, by a single click on the image. To unselect the image you have to click on the image while holding the *Ctrl* key pressed. Also, it is possible to scroll through the images of the series by dragging with the associated mouse button over the image ("stack" operation). It is additionally possible to exploit a 'Scroll to frame #' screen action, which can be associated with a keyboard shortcut.
The *Tool options* panel associated with this tool, shown in the picture below, in the viewer's bottom bar, displays basic information about the currently selected image.



8.2.2 Zoom area

The *Zoom area* tool allows zooming a specific rectangular portion of the currently selected image. The rectangular region to be zoomed can be selected by dragging with the associated mouse button over

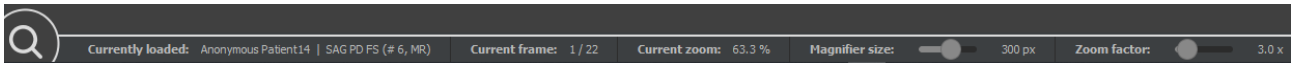
the medical image (single drag operation to define the boundaries of the rectangular area to zoom). If the *SHIFT* key of the keyboard is kept pressed, then the area to zoom will be forced to a square shape.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



The interpolation algorithm used to zoom images can be chosen through the *Interpolation quality* drop-down list on the *Tool options* panel associated with this tool. Three different interpolation types are supported, providing a speed vs quality trade-off.

8.2.3 Magnifier

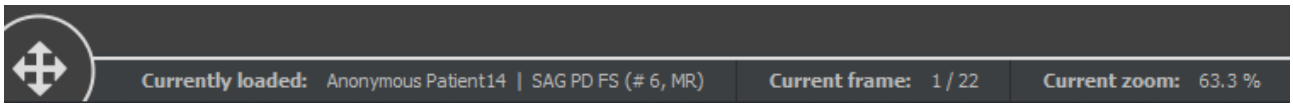
The *Magnifier* tool allows magnifying a moving portion of the image, by dragging with the associated mouse button over the image.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



The magnification factor used by the magnifier, as well as the size of the magnifier itself, can be modified by dragging the *Zoom factor* and the *Magnifier size* sliders on the *Tool options* panel associated with this tool.

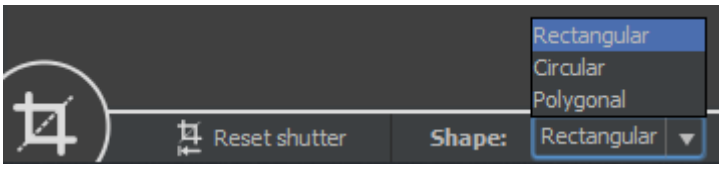
8.2.4 Pan image

The *Pan image* tool allows panning over the currently selected image, by dragging with the associated mouse button over the image.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



8.2.5 Shutter

The *Shutter* tool allows applying a shutter over the image, i.e., hiding a sub-region of the image, which is not interesting for medical purposes. The shutter is always applied to the entire series.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



You can select the shape of the shutter to apply on the series by selecting the appropriate *Shape* option in this panel. In order to draw a Rectangular or Circular shutter, it is sufficient to select the *Shutter* tool, to drag with the associated mouse button over the image, and then to release the mouse button when you are satisfied with the size of the shutter. On the other side, if you want to draw a Polygonal shutter, then you need to click the associated mouse button on every point of the polygon contour that you want to define. When you want to define the last point of the contour, double-click the associated mouse button, and the polygonal shutter will complete (i.e., close the polygon) automatically.

8.2.6 Window / Level

The *Window / Level* tool allows modifying the window width and window level values (also known as "window center") for the gray levels (or colors) of the current image. The Window / Level values are given in Hounsfield Units if the selected image panel contains a CT image.

You may change the Window,Level values by dragging with the associated mouse button over the image.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:

It is possible to change the sensitivity of mouse dragging movements for contrast changes, by dragging the *Sensitity* slider in this panel.

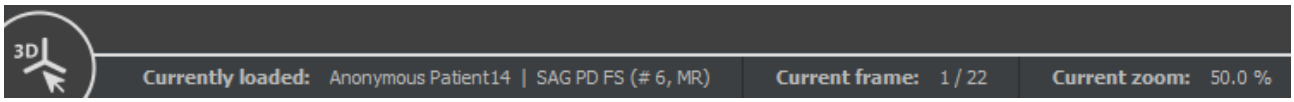
Window width and window level values can also be changed by selecting one of the available contrast presets (from the *Presets* drop-down list). Finally, you can manually enter window/level values in the *W / W* and *W / L* text fields, and press *Enter* on your keyboard to confirm and apply them.

Press the *Auto window* button ( ) in order to apply an automatic "optimal" windowing for the currently selected image. The *Reset W/L to default* button ( ) may be used to restore the original Window / Level setting suggested in the DICOM data set (if present).

8.2.7 3D cursor

The *3D cursor* tool (also known as "*3D localizer*" tool) allows a fast navigation through CT or MR series, and is able to show the location of the point indicated by the mouse cursor (over the current image) also on the other displayed series or, when the MPR view is active, on the different cut planes of the MPR. In particular, when the mouse button associated with this tool is pressed or dragged on a particular point of the current image (the "3D point", from now on), the other series are scrolled up to the slice containing that same point in the 3D patient coordinates space (or the slice that is nearest to that 3D point), and the location of the "3D point" is shown on those images.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:

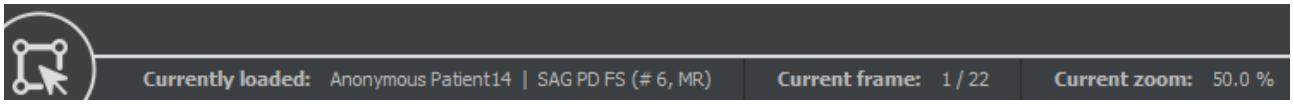


Warning: the navigation allowed by the 3D cursor tool is generated by a software algorithm. As such, the correctness of the location of the point indicated by the mouse cursor on other series depends on the correctness of several orientation and spacing data stored in the original DICOM datasets, in addition to the correctness of the software algorithm. The viewer itself has no mean to ensure these input data are correct. Hence, the location of the 3D cursor shall be checked and treated in a very "critical" way by the user/radiologist, and any conclusion coming from the location of the 3D cursor shall be carefully evaluated.

8.2.8 Select annotation

The *Select annotation* tool allows selecting a measurement or graphical annotation which already exists on the current medical image. Selection of the annotation shape is done by clicking with the associated mouse button over the annotation shape itself. Once the annotation is selected, it is possible to move and modify the shape itself, by dragging with the associated mouse button over specific points of the selected annotation shape. If dragging is started over one of the displayed selection handles (the small red squares), then the shape will be modified, by moving the relevant selection handle point. On the other side, if dragging is started over a generic point of the shape (i.e., not over a selection handle), then the entire annotation is moved, with no modifications to its geometric shape.

The generic *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



Once a measurement or graphical annotation shape is selected, the Tool options panel will reflect the properties of the specific selected shape, and will offer more options. Also, when an annotation is selected, you can delete it by pressing the *Delete* key on the keyboard, or the *Delete* button in the *Tool options* panel. Finally, once an annotation is selected, you can select the previous or next annotation of the current image by pressing the '-' or '+' keys on the numeric keypad of your keyboard.

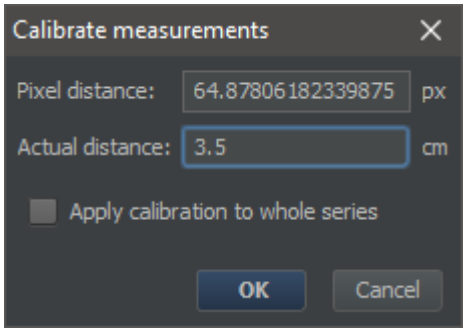
8.2.9 Measurement tools

RemotEye Viewer supports several measurements tools, described in the following sub-paragraphs.

⚠ **Warning:** measurements taken through the RemotEye Viewer software are based on pixel-to-millimetres calibration information which is read from the DICOM dataset. This calibration information is stored by the modality which originally acquired the medical images. RemotEye Viewer has no mean to guarantee that the calibration information is correct and accurate, hence it has no mean to guarantee that the final measurements taken by the software are actually accurate. It is recommended that the user of RemotEye Viewer critically checks the result of each measurement.

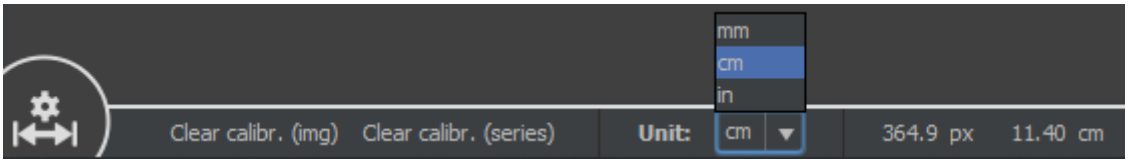
8.2.9.1 Calibrate measurements

The *Calibrate measurements* tool allows calibrating distances, that is, assigning an actual known distance value (in mm, cm or inches) to a given distance measured on-screen, over the image. In order to perform calibration, select the *Calibrate measurements* tool and drag with the associated mouse button over the image, on the distance that you want to calibrate / set. As soon as the drag operation has finished, the *Calibrate measurements* dialog will appear:



User needs to enter the *Actual distance* corresponding to the measured *Pixel distance*. User also has the option of specifying that the following calibration must be applied to the whole series, that is, to all images belonging to the current series. If this option is not checked, then the calibration will only be applied to the DICOM file containing the current image.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:

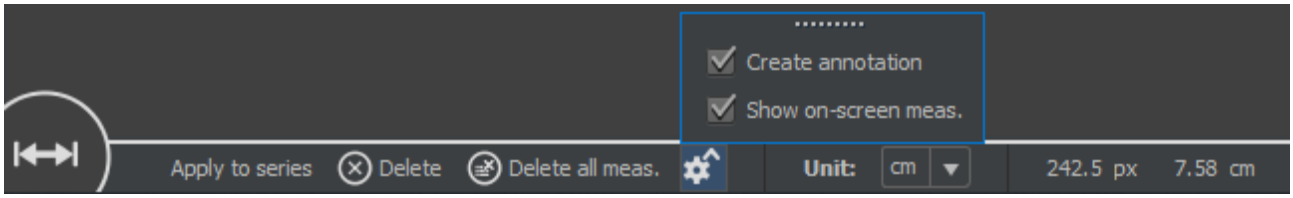


This panel basically allows you to modify the measurement unit used for calibration.

8.2.9.2 Measure distance

The *Measure distance* tool allows measuring linear distances on the selected medical image. The measurement is performed by dragging with the associated mouse button over the image, and releasing the mouse button once you traced the distance that you want to measure.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



The user may choose to create an *annotation* of each measurement, thus leaving a persistent graphic object over the image, by enabling the *Create annotation* checkbox. In addition, the user may choose to add the drawn measurement annotations to all images of the current series, by pressing the *Apply to series* toggle button. If the *Create annotation* option is disabled, the graphic object representing the current measurement over the image will immediately disappear when the measurement is complete (i.e., the mouse button is released).

The user may also choose whether to display an on-screen label of each performed measurement, by checking or unchecking the *Show on-screen meas.* option.

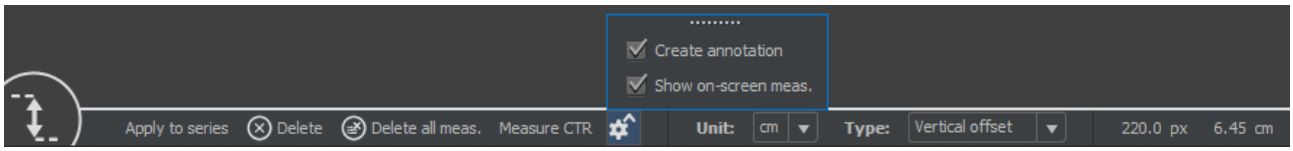
The measurement unit used for measurements may be chosen by selecting the corresponding option (*mm*, *cm*, or *in*) in the *Unit* drop-down list of this *Tool options* panel.

Finally, it is possible to delete the currently selected annotation by pressing the *Delete* button, or to delete all measurement annotations by pressing the *Delete all meas.*

8.2.9.3 Measure horiz/vert distance

The *Measure horiz / vert distance* tool allows measuring linear horizontal or vertical distances on the selected medical image. The measurement is performed by dragging with the associated mouse button over the image, starting the dragging operation on the start point and releasing the mouse button on the end point of the vertical or horizontal distance that you want to measure.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



The user may choose whether he wants to compute the horizontal offset (i.e., horizontal distance) or the vertical offset (i.e., vertical distance) between the start and end point which have been identified through the mouse drag operation, by acting on the *Type* drop-down box.

Computation of the Cardio-Thoracic Ratio (CTR)

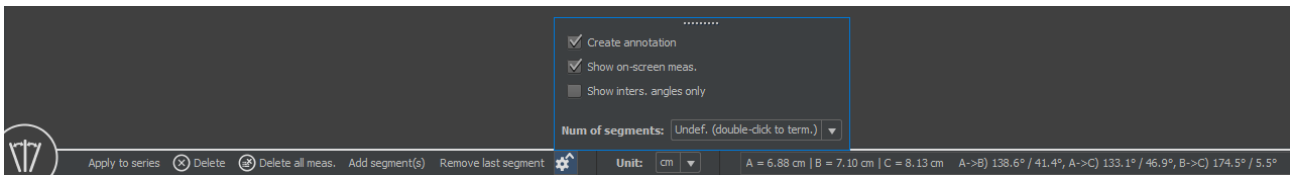
The *Measure horiz / vert distance* tool allows computing the value of the Cardio-Thoracic Ratio. Once the appropriate chest xray image is selected, just select *Horizontal offset* in the *Type* drop-down of the *Tool options* panel. Take a first horizontal distance measurement corresponding with the cardiac size, then a second horizontal distance measurement corresponding with the maximum width of the thoracic cavity. Finally, press the *Measure CTR* button, and you will get the value of CTR. According to literature, a value of CTR above 50% is considered abnormal.

⚠ **Warning:** in order to guarantee maximum accuracy, it is recommended that the *Measure CTR* tool is only used on a PA (Posterior - Anterior) chest xray image.

8.2.9.4 Measure distances and angles

The *Measure distances and angles* tool allows measuring angles among an arbitrary number of segments, which may be intersecting or not. Also, the distances represented by each segment are computed and displayed. The measurement is performed by dragging with the associated mouse button over the image, in order to trace each segment. A double-click with the associated mouse button will terminate the sequence of segments. Once the sequence is terminated, all distances and angles will be computed and shown.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



The user may choose whether he wants only angles among intersecting segments are computed and shown, by checking the *Show inters. angles only* option. Also, it is possible to set the number of segments in a sequence to a fixed value, by acting on the *Num of segments* drop-down box: this will eliminate the need for

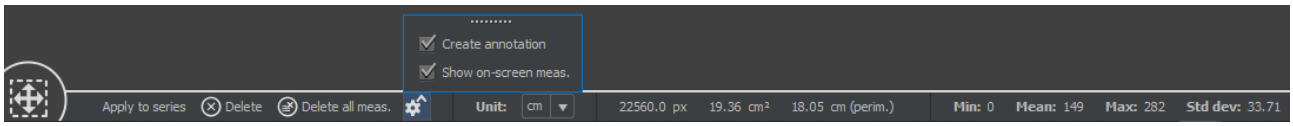
a double-click to terminate the sequence, as the sequence will be automatically terminated once the just-set number of segments will be traced.

Each sequence of segments is independent from other sequences, even on a single image. Once a sequence is terminated, it can still be modified both in terms of position of each single segment and in terms of number of segments: this last aspect can be managed by acting on the *Add segment(s)* and *Remove last segment* buttons (a sequence must be selected first).

8.2.9.5 Measure rect area

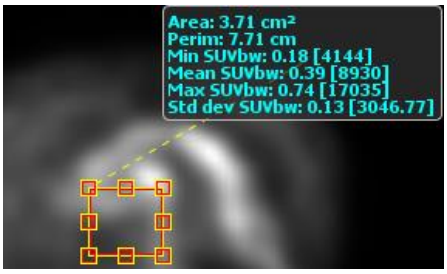
The *Measure rect area* tool allows measuring rectangular areas on the selected medical image. Information about the surface, the perimeter, the minimum/maximum/mean density, and the standard deviation of the densities within the rectangular area is provided. The measurement is performed by dragging with the associated mouse button over the image, and releasing the mouse button once you traced the rectangular area that you want to measure. Keeping the *Shift* key of the keyboard pressed will force the area to be exactly square.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



Please refer to the paragraph about the *Measure distance* tool for an explanation of the options available in this panel.

In addition, as shown in the following screenshots, on PET images containing the appropriate data elements in their DICOM dataset, RemotEye Viewer is able to provide the minimum/maximum/mean SUV, and the standard deviation of the SUV within the selected rectangular area.



SUV (Standardized Uptake Values) is commonly used in PET image analysis. It measures the concentration of a radiotracer in a defined region of interest (ROI), which provides interesting diagnostic information. In particular, RemotEye Viewer computes SUV according to the "SUV Body Weight" algorithm which is based on the following formula:

suvValue[body weight] = (activityConcentration / (radionuclTotalDoseBq * decayFactor)) * patientWeightG

where:

- activityConcentration: the pixel value in the image, after processing of Modality LUT.
- radionuclTotalDoseBq: the radionuclide total dose, expressed in Bequerels.
- decayFactor: the decay factor.
- patientWeightG: the patient's weight, expressed in grams.

⚠ **Warning 1:** computation of SUV in RemotEye Viewer is based on generally accepted methods and equations, and in particular on the Body Weight equation reported above. However, some institutions may use methods and/or equations that differ from those used by RemotEye Viewer and described in this user manual. Prior to use in a clinical environment, it is important that all equations be confirmed and an independent evaluation be conducted of the SUV values reported by RemotEye Viewer with studies from all PET acquisition devices present at your facility, under typical acquisition conditions.

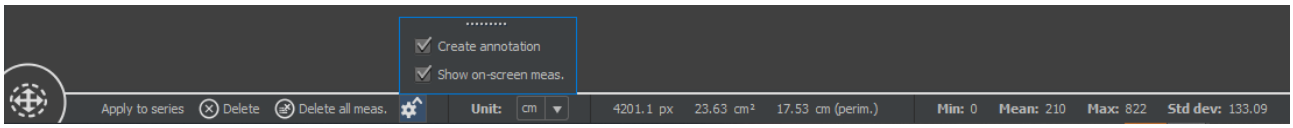
⚠ **Warning 2:** RemotEye Viewer computes SUV only based on the information stored in the image's DICOM dataset. It is the modality technician's responsibility to ensure that all information is correct and accurate. RemotEye Viewer won't compute SUV if some of the data elements which are used to compute SUV are not present or empty in the DICOM dataset.

⚠ **Warning 3:** RemotEye Viewer does not compute SUV on images that have not been decay-corrected by the acquisition device, because the computed SUV value would not be reliable in that case.

8.2.9.6 Measure ellipt area

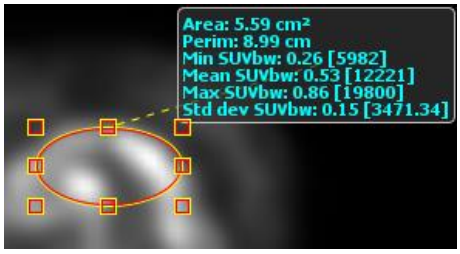
The *Measure ellipt area* tool allows measuring elliptical areas on the selected medical image. Information about the surface, the perimeter, the minimum/maximum/mean density, and the standard deviation of the densities within the elliptical area is provided. The measurement is performed by dragging with the associated mouse button over the image, and releasing the mouse button once you traced the elliptical area that you want to measure. Keeping the *Shift* key of the keyboard pressed will force the area to be exactly circular.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



Please refer to the paragraph of the *Measure distance* tool for an explanation of the options available in this panel.

In addition, as shown in the following screenshots, on PET images containing the appropriate data elements in their DICOM dataset, RemotEye Viewer is able to provide the minimum/maximum/mean SUV, and the standard deviation of the SUV within the selected elliptical area.

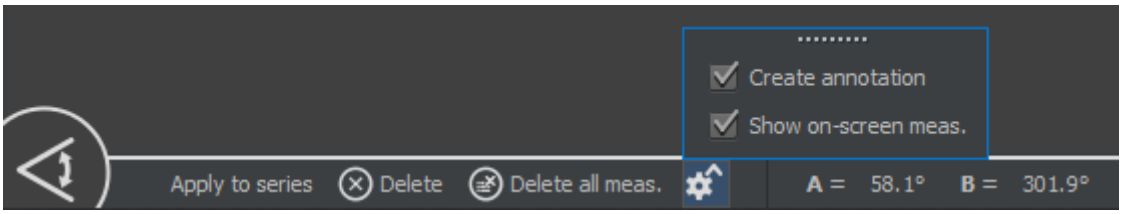


Please refer to the previous paragraph "*Measure rect area*" for details and recommendations about SUV (Standardized Uptake Values).

8.2.9.7 Measure angle (mode 1)

The *Measure angle (mode 1)* tool allows measuring angles on the selected medical image. The measurement is performed by clicking three times with the associated mouse button over the image; each click identifies one of the three points defining the angle to be measured.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



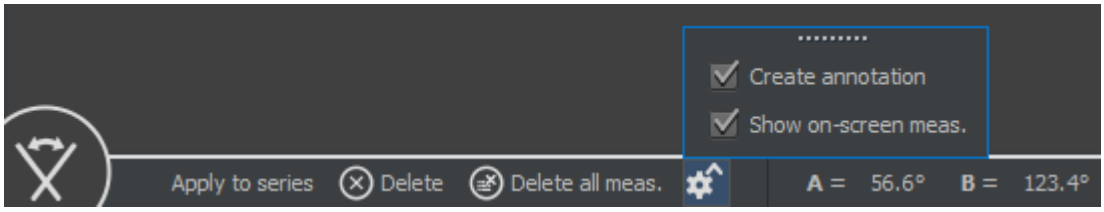
Please refer to the paragraph of the *Measure distance* tool for an explanation of the options available in this panel.

8.2.9.8 Measure angle (mode 2)

The *Measure angle (mode 2)* tool allows measuring angles on the selected medical image. The measurement is performed by drawing two segments over the image; each segment can be drawn by

dragging with the associated mouse button over the image, and releasing it when each segment has the desired properties.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



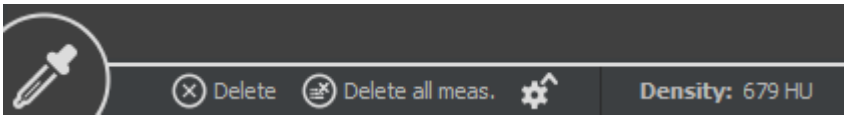
Please refer to the paragraph of the *Measure distance* tool for an explanation of the options available in this panel.

8.2.9.9 Measure density

The *Measure density* tool allows measuring densities on the selected medical image.

The measurement is performed by dragging with the associated mouse button over the image. Once the mouse button is released, the density measurement is eliminated.

The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



Moreover, on PET images containing the appropriate data elements in their DICOM dataset, RemotEye Viewer is able to provide the SUV for each point which is selected on the image. The value provided in square brackets is the actual detected pixel value, after modality LUT transformation.

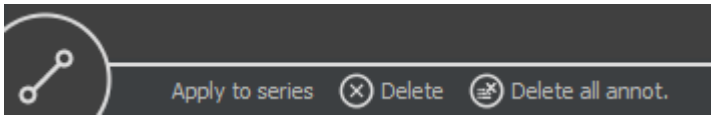
Please refer to the paragraph "*Measure rect area*" for details and recommendations about SUV (Standardized Uptake Values).

8.2.10 Annotation tools

RemotEye Viewer supports several annotation tools, described in the following sub-paragraphs.

8.2.10.1 Line (annotation)

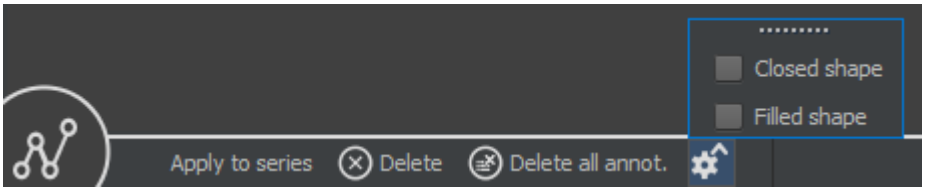
The *Line (annotation)* tool allows drawing straight annotation lines on the selected medical image. The drawing of the annotation is performed by dragging with the associated mouse button over the image, and releasing the mouse button once you traced the desired line.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



The user may choose to add the drawn annotations to all images of the current series, by enabling the *Apply to series* option button.
Finally, it is possible to delete the currently selected annotation by pressing the *Delete* button, or to delete all annotations by pressing the *Delete all annot* button.

8.2.10.2 Poly line (annotation)

The *Poly line (annotation)* tool allows drawing a multiple-segment annotation line (i.e., polyline) on the selected medical image. The drawing of the annotation is performed by clicking multiple times with the associated mouse button over the image, one click for each point which identifies the polyline. In order to draw the last point of the polyline, it is sufficient to double-click with the associated mouse button.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:

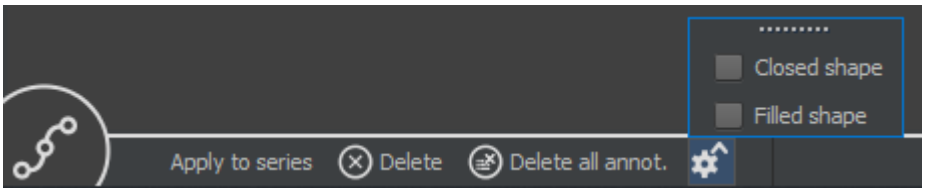


In addition to the options already described for the *Line (annotation)* tool, it is possible to enable the *Filled shape* option to fill the internal area of the polyline with a solid color, and the *Closed shape* option to connect the first and the last points of the polyline, thus creating a closed shape.

8.2.10.3 Interpolated line (annotation)

The *Interpolated line (annotation)* tool allows drawing an interpolated annotation line on the selected medical image. The drawing of the annotation is performed by clicking multiple times with the associated

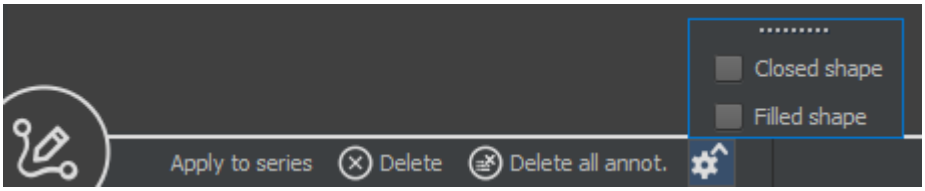
mouse button over the image, one click for each point which identifies the interpolated line. In order to draw the last point of the interpolated line, it is sufficient to double-click with the associated mouse button.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



Please refer to the paragraph of the *Poly line (annotation)* tool for an explanation of the options available in this panel.

8.2.10.4 Free hand (annotation)

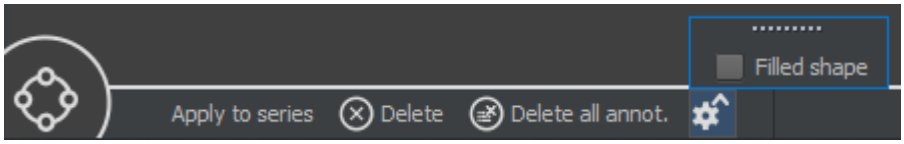
The *Free hand (annotation)* tool allows drawing a free-hand annotation line on the selected medical image. The drawing of the annotation is performed by dragging with the associated mouse button over the image, and releasing it once the drawing of the free-hand line is finished.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



Please refer to the paragraph of the *Poly line (annotation)* tool for an explanation of the options available in this panel.

8.2.10.5 Ellipse / Circle (annotation)

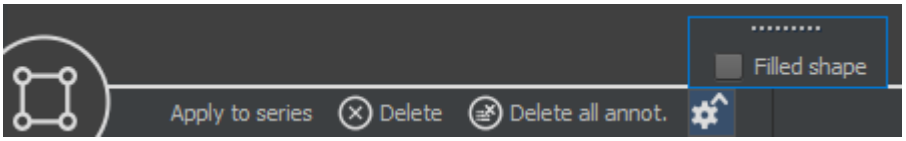
The *Ellipse / Circle (annotation)* tool allows drawing an elliptical annotation shape on the selected medical image. The drawing is performed by dragging with the associated mouse button over the image, and releasing the mouse button once you traced the desired elliptical shape. Keeping the *Shift* key of the keyboard pressed will force the shape to be exactly circular.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



In addition to the options already described for the *Line (annotation)* tool, it is possible to enable the *Filled shape* option to fill the internal area of the ellipse with a solid color.

8.2.10.6 Rectangle / Square (annotation)

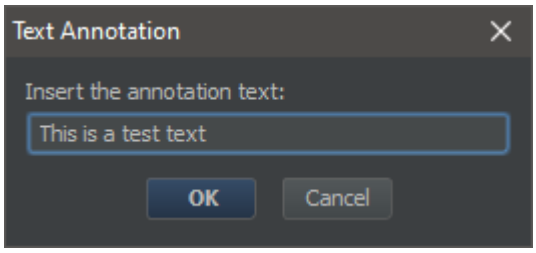
The *Rectangle / Square (annotation)* tool allows drawing a rectangular annotation shape on the selected medical image. The drawing is performed by dragging with the associated mouse button over the image, and releasing the mouse button once you traced the desired rectangular shape. Keeping the *Shift* key of the keyboard pressed will force the shape to be exactly square.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



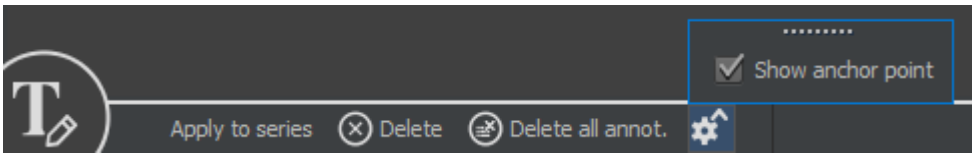
In addition to the options already described for the *Line (annotation)* tool, it is possible to enable the *Filled shape* option to fill the internal area of the rectangle with a solid color.

8.2.10.7 Text (annotation)

The *Text (annotation)* tool allows drawing a textual annotation on the selected medical image. In order to enter the textual annotation, it is necessary to click with the associated mouse button over the image, in the exact point where the text annotation must be applied. The *Text annotation* dialog box will immediately appear:



Please enter the text of your annotation, then press the *OK* button or press *Enter* on your keyboard. The *Text annotation* dialog box will disappear, and the text annotation will start floating on the image as you move your mouse pointer: click again with the associated mouse button in order to fix the position of the label.
The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:



In addition to the options already described for the *Line (annotation)* tool, it is possible to enable the *Show anchor point* option to show the point of application of the textual annotation. If this option is disabled, the textual annotation will still be visible, but the exact application point will not be explicitly shown.

8.2.10.8 Spine labelling

The *Spine labelling* tool is intended to allow labelling of vertebrae on MR or CT spine studies. Spine labels placed by user on a CT or MR slice become 3D points in the patient's coordinates space, and are displayed in all different views / series within the study (sagittal, axial, coronal and even arbitrary views generated through MPR).
In order to properly use this tool, user shall follow these steps:

1) Open a CT or MR study where the patient's spine has been imaged. In particular, user has to make sure a sagittal series is available in the study and visible in the viewer. If no sagittal series is present in the study, user may use RemotEye Viewer's Multi-Planar Reconstruction (MPR) feature to artificially generate the sagittal view.
2) Select the *Spine labelling* tool from the *Image manipulation toolbar*, and associate it with left or right mouse button.
3) Stack the sagittal series to an image that is approximately in the middle of the patient's spine.
4) Click repeatedly, with the assigned mouse button, in the center of each vertebra the user wishes to label. Each click will put a marker (i.e., a spine label) on a vertebra. The user has to take care of clicking in the center of each vertebra, in order to ensure the accurate display of spine labels in the other views. The spine labelling tool, indeed, doesn't perform any automatic segmentation. Initially, the spine is labelled by numeric identifiers (from 1 up to 24).
5) To terminate the current spine labels sequence, user has to set the last marker by double-clicking on the last vertebra he wishes to label. At this time, a pop-up menu containing all possible ascending or descending ranges of vertebrae (depending on the number of drawn spine labels) will appear: the user has the opportunity to choose the desired range. Here are all the possible vertebrae IDs supported and proposed by RemotEye Viewer: C1, ..., C7 (Cervical section), T1, ..., T12 (Thoracic section), L1, ..., L5 (Lumbar section).
6) User is able to repeat this process if he wishes to create a new spine labels sequence, for instance to label different parts of the spine separately.
7) User will always be able to change the vertebrae identifiers of a spine labels sequence, by double-clicking on a spine label of that sequence, and by editing the range from the pop-up menu which will appear. He can also delete a spine labels sequence by selecting it and pressing the *Delete* key on

the keyboard, or using the *Delete selected sequence* button in the *Tool options* panel. From the *Tool options* panel, user can also choose to delete all sequences, by pressing the *Delete all sequences* button, or to delete the last label of the selected sequence, by pressing the *Delete last label* button. The *Tool options* panel associated with this tool is shown in the picture below, in the viewer's bottom bar:

Once the spine labels have been set:

- Spine label markers will appear on all series / views of that study (sagittal, coronal, axial), as long as the acquisition is the same (i.e., same "frame of reference", in DICOM).
- Each marker (small ellipse) can be moved independently in all planes, in order to accurately label the spine in 3 dimensions. Those changes are reflected everywhere that marker is visible. To move a marker, ensure the *Spine labelling* tool is selected, then drag a given marker with the mouse button associated with the *Spine labelling* tool.
- Only markers that are within 2.5 cm from the current image plane (in the patient space) will be shown. So, user will notice that some (or all) markers will disappear as he navigates through images in a given series.
- Frequently, in the "non-upright" views (e.g., axial views), markers would be overlapping. In these cases, a single marker will be shown by the viewer, but the related text label will show the identifiers of both markers (e.g., C4/C5); the first identifier will indicate the marker that is closest. If user will move such a marker on that view, it will be the closest marker (C4) that he will see moving in the other images. However, if one of the markers is very close to the current image plane (< 2 mm), the text label will only show its identifier, even though there is a second marker within 2.5 cm.
  On the other side, in "upright" views (e.g., sagittal views) all markers will always be shown separately, even when they are very close.

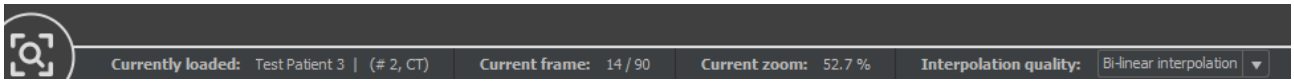
⚠ **Warning**: the locations of spine labels resulting from this functionality are partially generated by a software algorithm. As such, the correctness of these locations depends on the correctness of several orientation and spacing data stored in the original DICOM datasets, in addition to the correctness of the implemented algorithm. The viewer itself has no mean to ensure these input data are correct. Hence, labels coming from spine-labelling tool shall be checked and treated in a very "critical" way by the user/radiologist, and any conclusion shall be carefully evaluated.

8.2.11 Stack image (mouse wheel)

If the *Stack Image* tool is associated with the mouse wheel, scrolling the mouse wheel will cause scrolling the images of the current series (equivalent to *Previous frame* and *Next frame* buttons optionally available in the Series toolbar, depending on the viewer configuration). If the *Alt* key on the keyboard is kept pressed while scrolling the mouse wheel, a scrolling of the current scene (i.e., page of images) will happen (equivalent to *Previous scene* and *Next scene* buttons optionally available in the Series toolbar, depending on the viewer configuration).

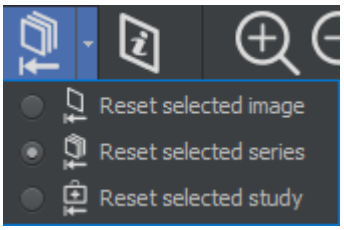
8.2.12 Zoom image (mouse wheel)

If the *Zoom Image* tool is associated with the mouse wheel, scrolling the mouse wheel will cause a zoom in or zoom out operation (depending on the direction of wheel rotation) on the current image.



8.3 Resetting operations on images

The following toolbar button may be used to reset all changes done on the current image, on all images of the current series, or on all images of the current study:



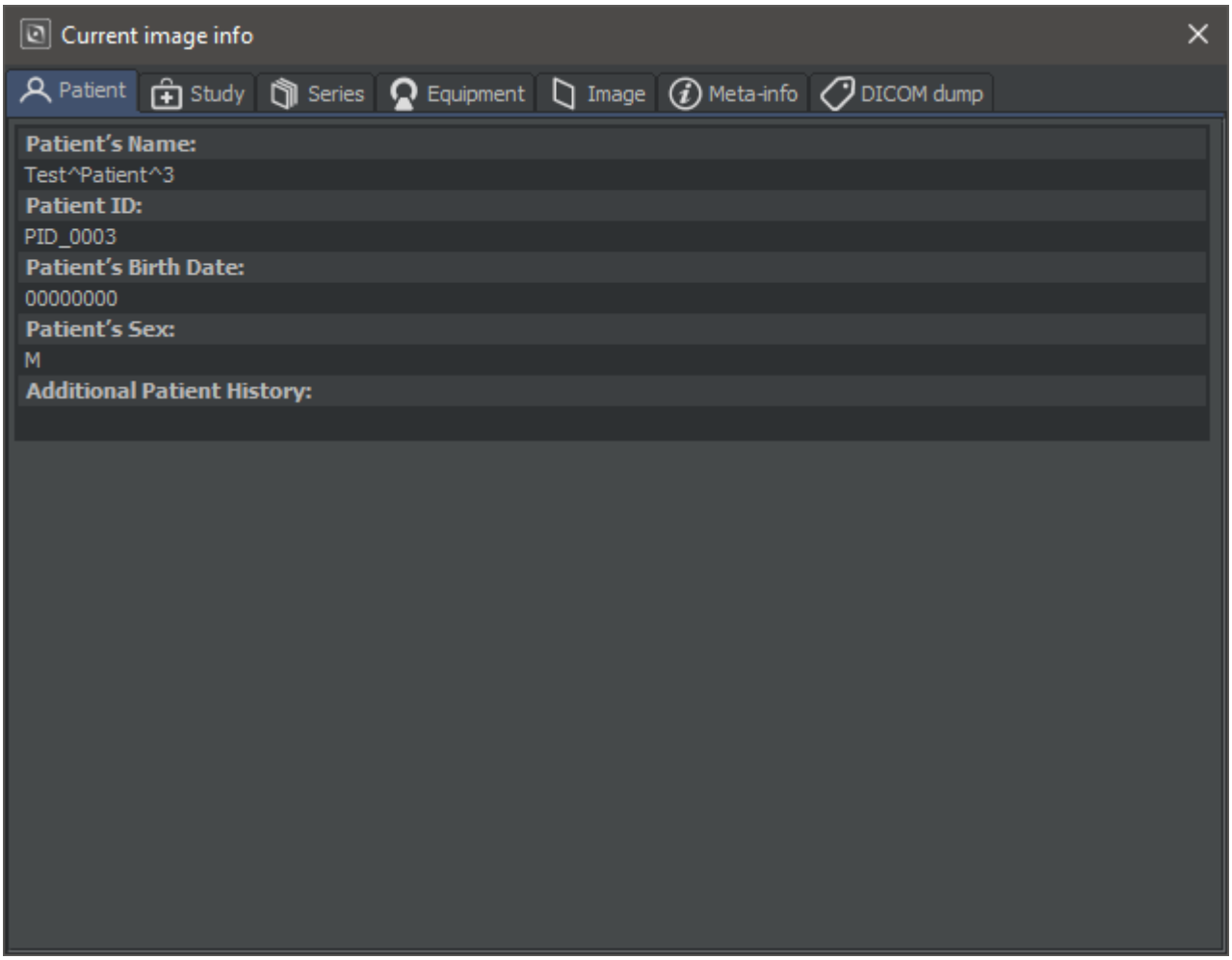
More specifically, the "reset" toolbar button above may correspond with the Reset selected image, or with the Reset selected series, or with the Reset selected study action, depending on which item is selected in the related drop-down menu, which can be shown by pressing the down arrow next to the "reset" toolbar button, as visible in the screenshot above.

Here is a short description of each Reset operation available:

- *Reset selected image*: all changes and operations performed on the currently selected image will be reset.
- *Reset selected series*: all changes and operations performed on the current series will be reset.
- *Reset selected study*: all changes and operations performed on the current study will be reset.

8.4 Showing image information

The *Show image information* toolbar button ( ) allows viewing information about the currently selected image. If you press this toolbar button, the *Current Image Info* dialog box will appear:



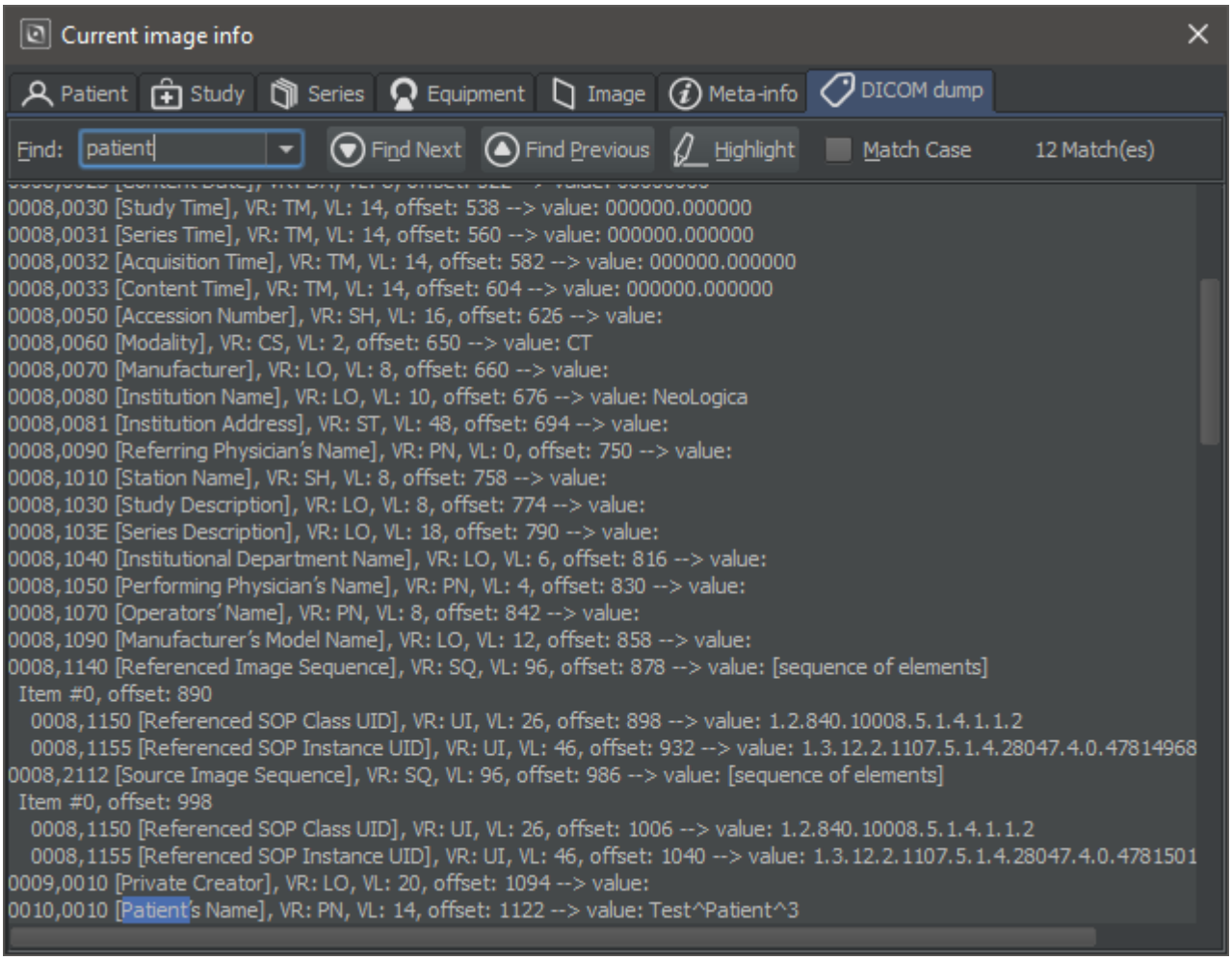
This dialog box is composed of several tabs:

- *Patient tab*
- *Study tab*
- *Series tab*

- *Equipment tab*
- *Image tab*
- *Clinical Trial tab* (if enabled)
- *Meta-Info tab*
- *DICOM dump tab*

These tabs display information extracted from the current DICOM file, i.e., the DICOM file related to the currently selected image.

In particular, the *DICOM dump* tab allows performing the DICOM dump of the selected image or of a file not open in RemotEye Viewer, dragging it in the "dump area". In this second instance, the DICOM dump could be a useful diagnostic tool, when, for some reason, is impossible opening the file.
The DICOM dump, indeed, shows all the DICOM data elements related to the selected file/image.



A search box is also supported, allowing to easily find information in the DICOM dataset dump.

8.5 Zooming images

Several zoom-related operations are available as toolbar buttons, as shown in the screenshot below:

When moving the mouse pointer over each single zoom button, a tooltip text will appear, providing additional information about the function of the underlying button.
The following paragraphs will describe each zoom operation tool.

8.5.1 Zoom in

Pressing the *Zoom in* toolbar button () the image displayed in the current panel will be zoomed in.

8.5.2 Zoom out

Pressing the *Zoom out* toolbar button () the image displayed in the current panel will be zoomed out.

8.5.3 Zoom to fit

Pressing the *Zoom to fit* toolbar button () the image displayed in the current panel will be zoomed to fit the size of the panel itself.

8.5.4 Zoom reset

Pressing the *Zoom reset* toolbar button () the image displayed in the current panel will be set at zoom 100%, i.e., at its original pixel size.

8.6 Managing image contrast

Several contrast management operations are available as toolbar buttons, as shown in the screenshot below:

When moving the mouse pointer over each single contrast management button, a tooltip text will appear, providing additional information about the function of the underlying button.
The following paragraphs will describe each contrast management operation, corresponding with each button.

8.6.1 Invert

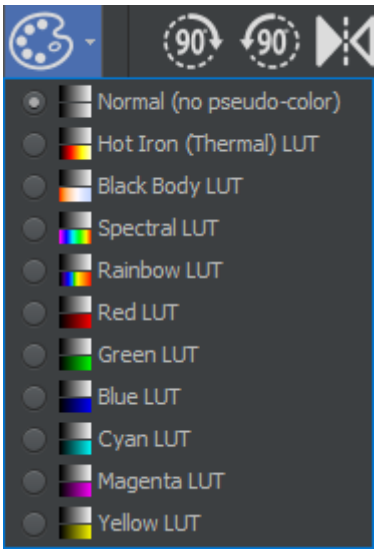
Pressing the *Invert* toolbar button () all images of the current series will be contrast-inverted. In other words, the images are transformed into their “negative” images.

8.6.2 Auto window

Pressing the *Auto window* toolbar button () all images of the current series will be auto-windowed. In other words, an automatic “optimal” contrast windowing will be applied to images.

8.6.3 Apply pseudo-coloring...

Pressing the *Apply pseudo-coloring...* toolbar button () a pseudo-coloring scheme will be applied to all images of the current series. Pseudo-coloring may only be applied to greyscale images. The particular pseudo-coloring lookup table to be applied may be chosen from the drop-down menu which appears when the *Apply pseudo-coloring...* toolbar button is pressed, as shown in the following picture:



8.7 Rotating and flipping images

Several geometric transformation operations (i.e., rotation and flipping) are available as toolbar buttons, as shown in the screenshot below:

When moving the mouse pointer over each single geometric transformation button, a tooltip text will appear, providing additional information about the function of the underlying button.
The following paragraphs will describe each geometric transformation operation, corresponding with each button.

8.7.1 Rotate +90°

Pressing the *Rotate +90°* toolbar button () all images of the current series will be rotated clockwise of 90 degrees.

8.7.2 Rotate -90°

Pressing the *Rotate -90°* toolbar button () all images of the current series will be rotated counter-clockwise of 90 degrees.

8.7.3 Flip horizontally

Pressing the *Flip horizontally* toolbar button () all images of the current series will be flipped horizontally.

8.7.4 Flip vertically

Pressing the *Flip vertically* toolbar button () all images of the current series will be flipped vertically.

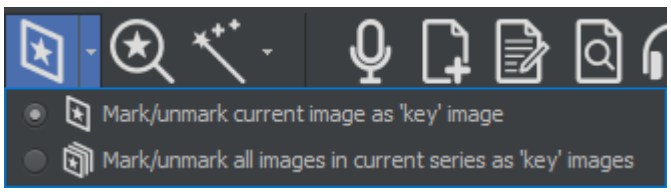
8.8 Managing key images

RemotEye Viewer supports marking specific images as *key* images, and offers functionalities to display all images marked as key images within the current study. All these functions are available as toolbar buttons, as shown in the screenshot below:

When moving the mouse pointer over each single key images button, a tooltip text will appear, providing additional information about the function of the underlying button.
The following paragraphs will describe each key images operation, corresponding with each button.

8.8.1 Mark/unmark current image as 'key' image

The first toolbar button in the "key images" group may correspond either to the *Mark/unmark current image as 'key' image* action or to the *Mark/unmark all images in current series as 'key' images* action, depending on which item is selected in the related drop down menu, which can be shown by pressing the down arrow located next to this first toolbar button:



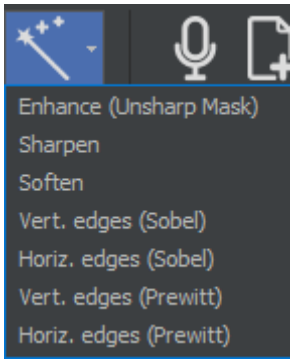
8.8.2 View 'key' images in current study

Pressing the *View 'key' images in current study* toolbar button () all images previously marked as “Key Images” will be displayed in the current study panel, each key image in a dedicated image panel.

8.9 Enhancing images

Image enhancement operations (i.e., image filters) are available through the following toolbar button:

The particular image enhancement filter to be applied may be chosen from the drop-down menu which appears when the *Apply image enhancement filter...* tool button is pressed, as shown in the following picture:



Here is a short description of each supported filter:

- *Enhance (Unsharp Mask)*: enhance details and edges in the images, by applying the “Unsharp Mask” image processing operation.
- *Sharpen*: enhance little details in the images. Warning: on noisy images, this filter may amplify noise.
- *Soften*: blurs the images. On noisy images, this filter may help in removing high-frequency noise.
- *Vert. Edges (Sobel)*: highlights vertical edges in the images, by applying the Sobel filter.
- *Horiz. Edges (Sobel)*: highlights horizontal edges in the images, by applying the Sobel filter.
- *Vert. Edges (Prewitt)*: highlights vertical edges in the images, by applying the Prewitt filter.
- *Horiz. Edges (Prewitt)*: highlights horizontal edges in the images, by applying the Prewitt filter.

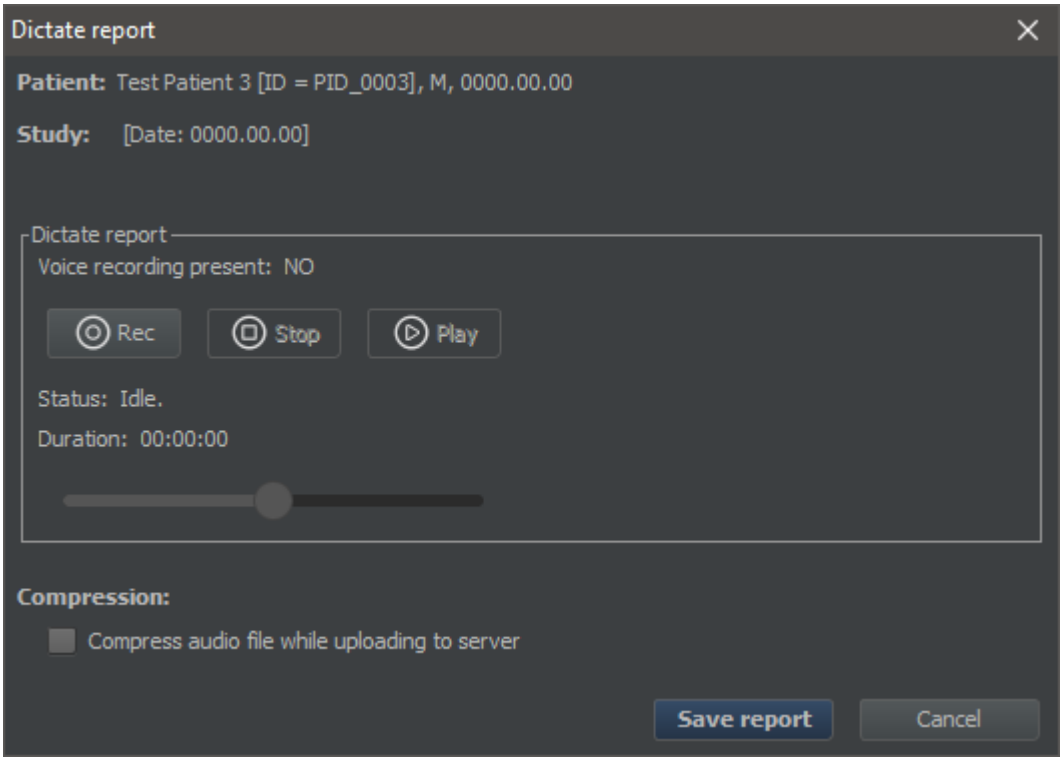
8.10 Reporting

RemotEye Viewer supports several reporting features, which allow associating text and voice reports with the displayed studies. These features are available as toolbar buttons, as shown in the screenshot below:

The following paragraphs will describe each reporting operation, corresponding with each button.

8.10.1 Dictate...

If the *Dictate...* button () is pressed, the *Dictate report* dialog box will appear. The same effect can be obtained by pressing *CTRL+D* on the keyboard (if using the default key bindings configuration).



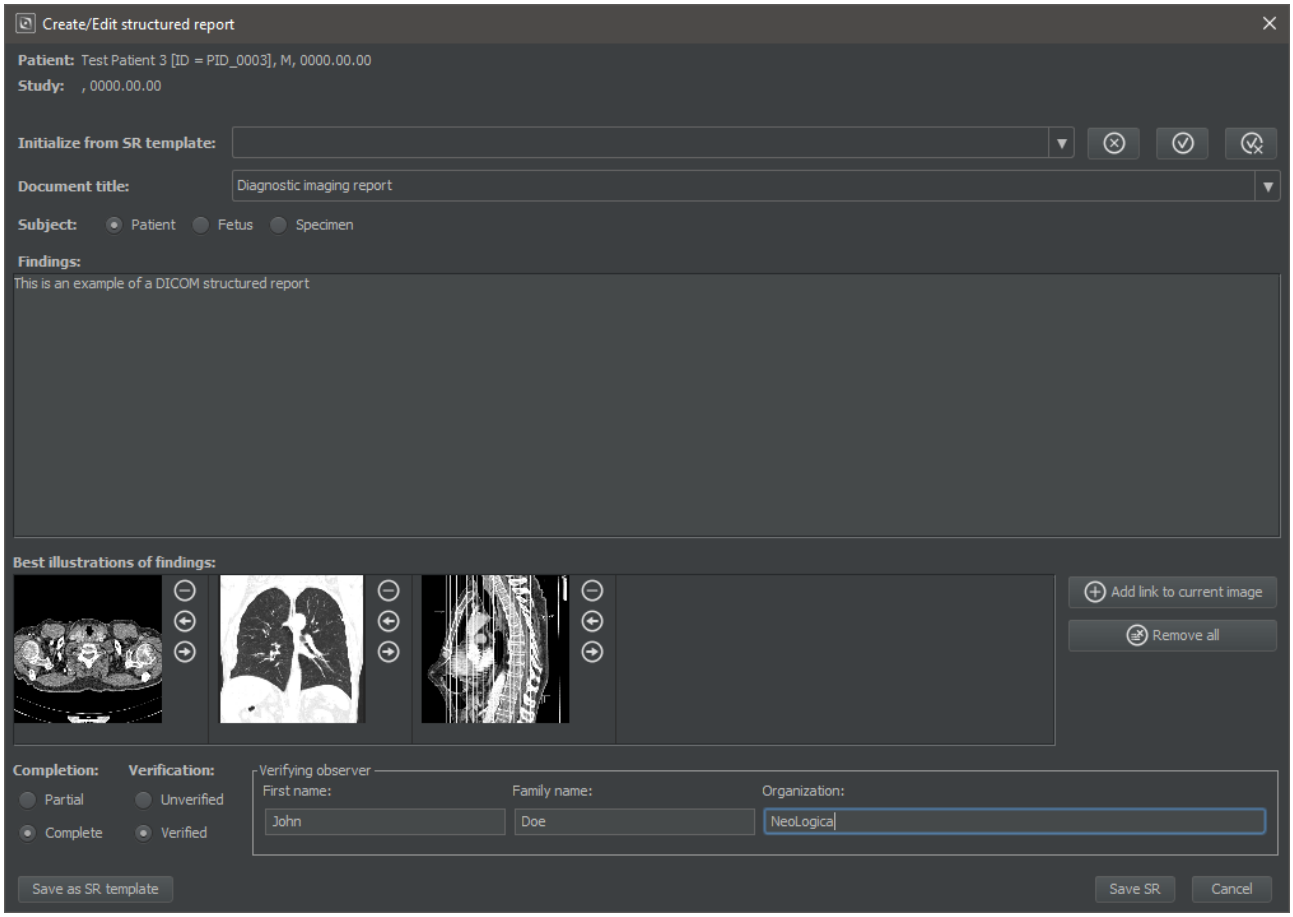
This window allows associating a vocal report with the currently displayed and selected study. In order to record a new vocal report, it is sufficient to press the *Rec* button: the audio acquisition will begin and will continue until the *Stop* button is pressed. RemotEye Viewer will record the voice of the user through an

appropriate microphone, which must be connected to the audio adapter of the client PC. The enabling of the microphone input and the settings of the audio levels must be performed through the software mixer provided with the driver of the audio adapter or with the Operating System.
The recorded vocal report can be saved to the server, by pressing the *Save report* button.
Also, the recorded vocal report can be played back by pressing the *Play* button. The slider located on the bottom of the *Dictate Report* panel can be used to skip to a particular position in the recorded audio clip. If the dedicated checkbox is marked the the audio file is compressed while uploading it to server.
The following keyboard shortcuts are supported when the *Dictate Report* dialog box is visible (if using the default key bindings configuration):

- *Ctrl+O* = start recording, overwriting the eventually existing report. Pause recording when audio recording is already active.
- *Ctrl+I* = start recording, inserting the new recording into the current position of the eventually existing audio report. Pause recording when audio recording is already active.
- *Ctrl+A* = start recording, appending the new recording to the existing report. Pause recording when audio recording is already active.
- *Ctrl+S* = stop playing or recording.
- *Ctrl+P* = play or pause the current playback.
- *Ctrl+R* = rewind; the current playback position will be moved back of 5 seconds.
- *Ctrl+F* = fast forward; the current playback position will be moved forward of 5 seconds.
- *Ctrl+B* = seek to beginning of current audio file.
- *Ctrl+E* = seek to end of current audio file.
- *Ctrl+V* = save current voice report to server.
- *Ctrl+L* = cancel.

8.10.2 Create/edit DICOM structured report

If the *Create DICOM structured report...* button () is pressed (only available when DICOM structured reporting is active), the *Create/Edit structured report* dialog box will appear:



This window allows creating a new DICOM structured report (SR) for the current study. DICOM structured report files are 100% DICOM-compliant files, hence they may be stored in a standard DICOM server or PACS. This is a great advantage w.r.t. non-DICOM text reports, since the report will become an integral part of the DICOM study on the PACS server.

In addition, DICOM structured reports can store a lot of structured information regarding the diagnostic report, including optional links to the most relevant images within the study.

The *Create/Edit structured report* window allows manual entering of several data which are typical of a DICOM structured report. In addition, the user may take advantage of the new *SR templates* functionalities. Basically, the user may save the content of a typical structured report as a "*SR template*", by pressing the *Save as SR template* button. He will then be able to re-use that typical content in successively-created structured reports, by selecting the appropriate item from the *Initialize from SR template* drop-down list. This will avoid time-consuming re-entering of typical content, and will speed-up the entire reporting phase.

When a SR template is selected in the *Initialize from SR template* drop-down list, it may be set as the default template by pressing the *Set selected SR template as default* button () and saving the user settings through the *Save user setting* functionality as explained in paragraph 5.4.3. The *Clear default SR template*

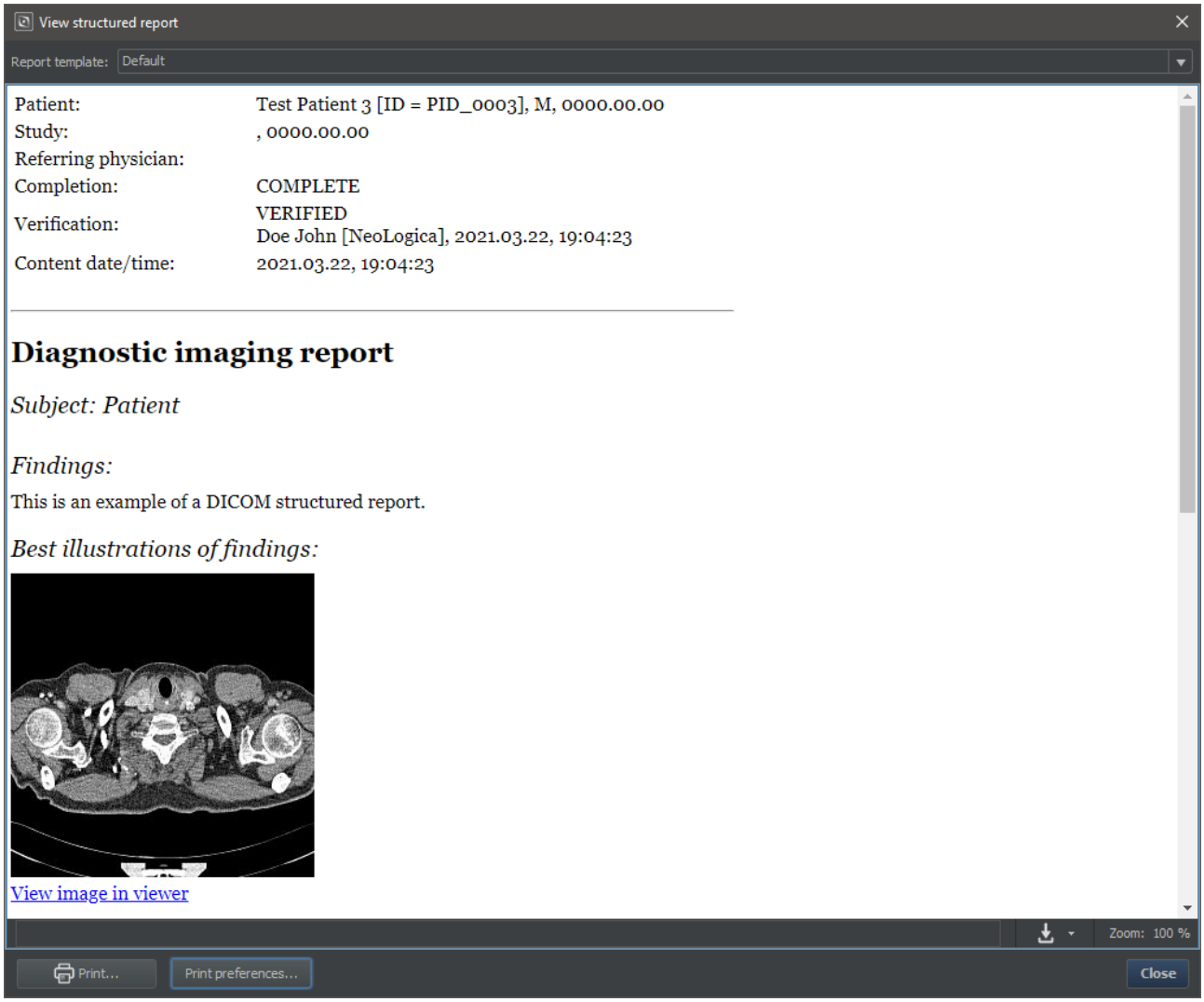
button () allows to delete this preference. Moreover, a SR template can be deleted by means of the *Delete selected SR template* button ().

Once the DICOM Structured Report has been fully created, you can use the *Save SR* button to store it to the server.

Existing DICOM structured reports previously created by RemotEye Viewer can be later edited pressing the *Edit existing DICOM structured Report(s)…* button () (also this item is only available when DICOM reporting is used).

8.10.3 View DICOM structured report(s)...

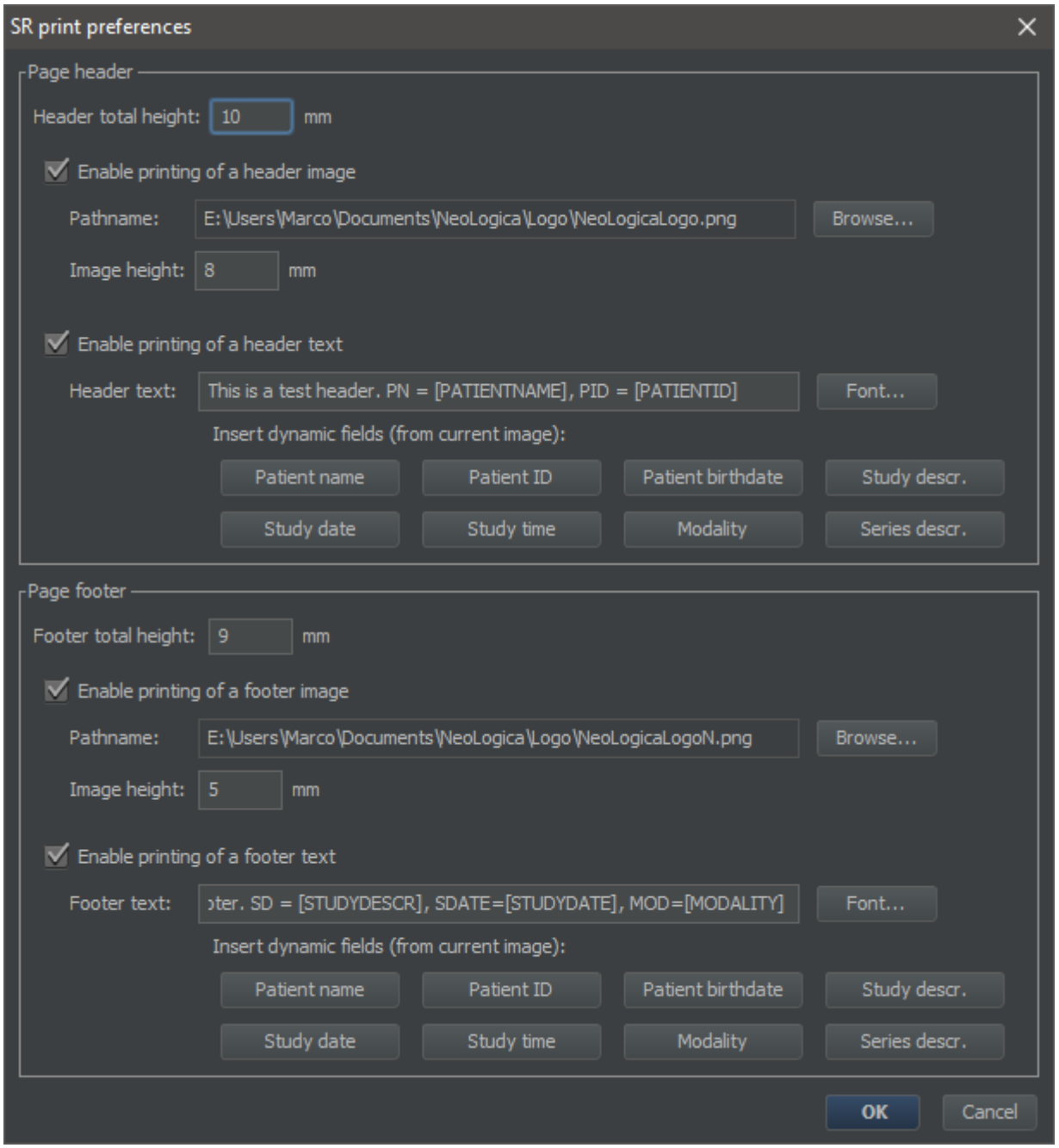
If the *View DICOM structured report(s)...* button () is pressed, the *View structured report* dialog-box will be show and it will be possible to view the existing DICOM structured reports for the current study (i.e., the study of the currently-selected image).



Depending on the viewer's configuration, one or more *Report templates* may be available. Selecting a given report template will affect the way the DICOM structured report is presented to screen and printed to an output sheet (which information is included in the report, how the text will look like, how each data is laid out to screen / sheet, etc.).

In case multiple DICOM structured reports are available, a selection window will appear, allowing to choose the desired SR. The displayed DICOM structured report may also be printed, through the *Print…* button.

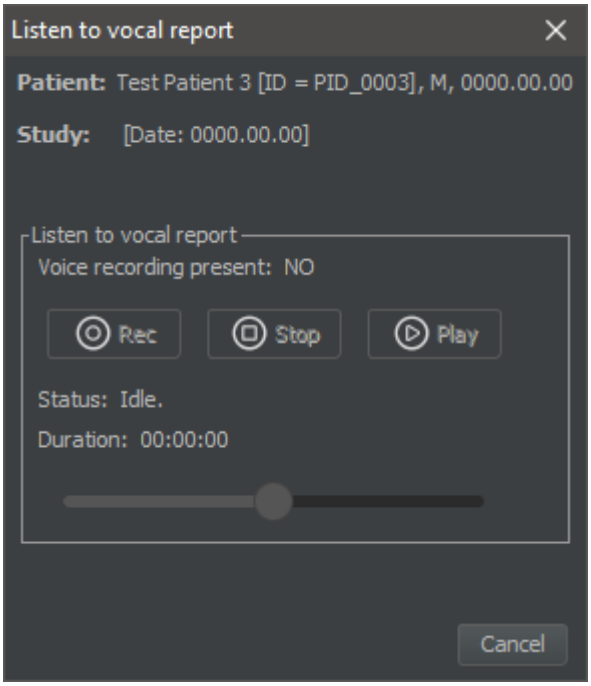
By pressing the *Print preferences...* button, the SR print preferences dialog box will be shown, allowing to define a custom header and footer for the printed structured report, including both images and texts:



Also, eventual preferences (e.g., custom margins, paper format, etc.) set on the final *Print* dialog will be saved in the current user's settings, and will be automatically loaded and applied upon future print attempts.

8.10.4 Listen to voice report...

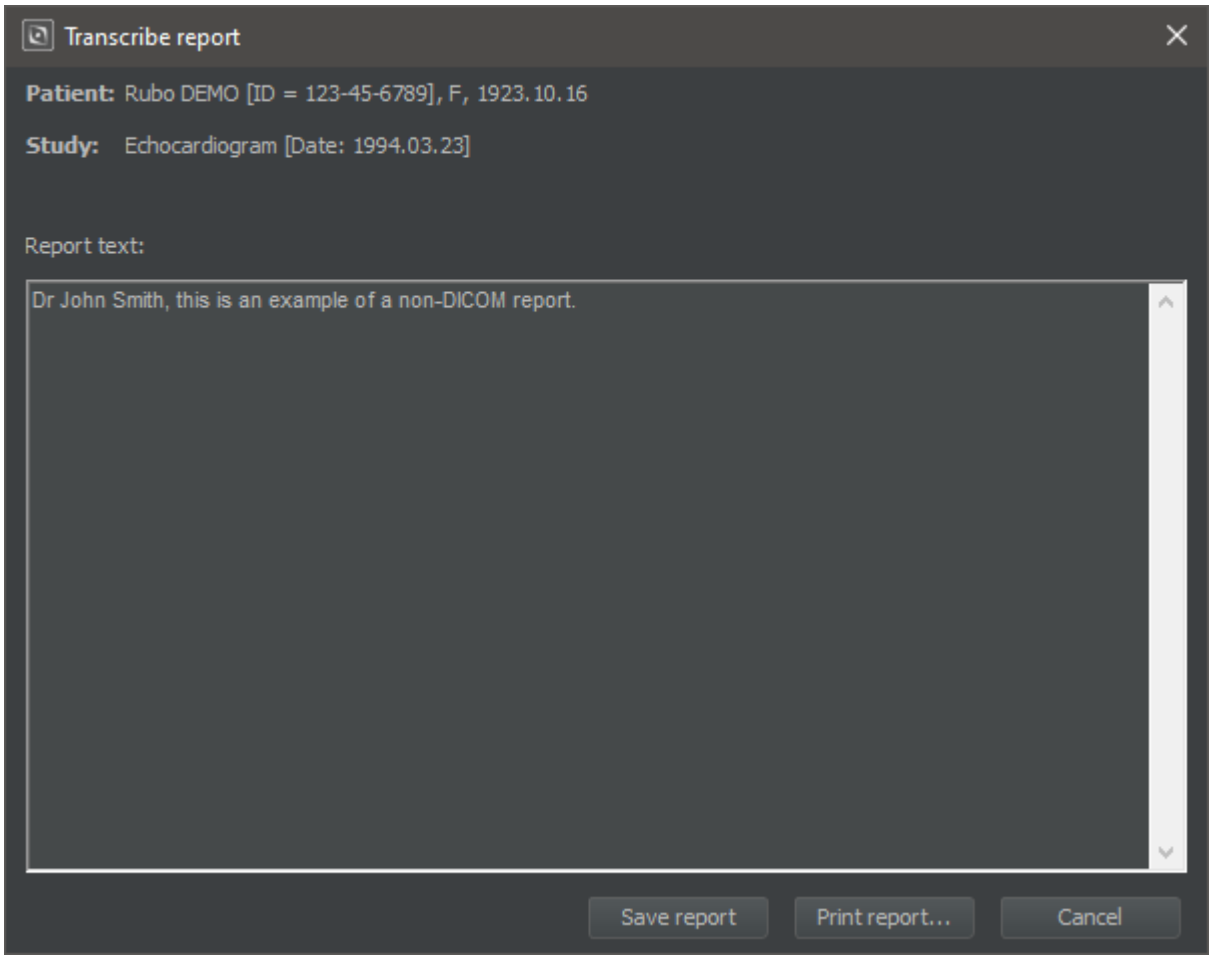
If the *Listen to voice report...* button () is pressed, the *Listen to vocal report* dialog box will appear:



The voice report associated with the current study will be opened and eventually played back. Even in this case, no modifications to the voice report can be performed. If the format of the voice report cannot be directly managed by RemotEye Viewer, an external player application may be launched to play the report audio file.

8.10.5 Plain-text reporting

Pressing the *Transcribe* toolbar button ( , when available), the *Transcribe report* dialog box will appear:



This window allows associating a plain text report with the currently displayed and selected study. The entered text report can be saved to the server, by pressing the *Save report* button, or it can be printed, by pressing the *Print report…* button. Also, the corresponding vocal report can be called, by pressing the *Vocal report…* button placed on top of the dialog box.

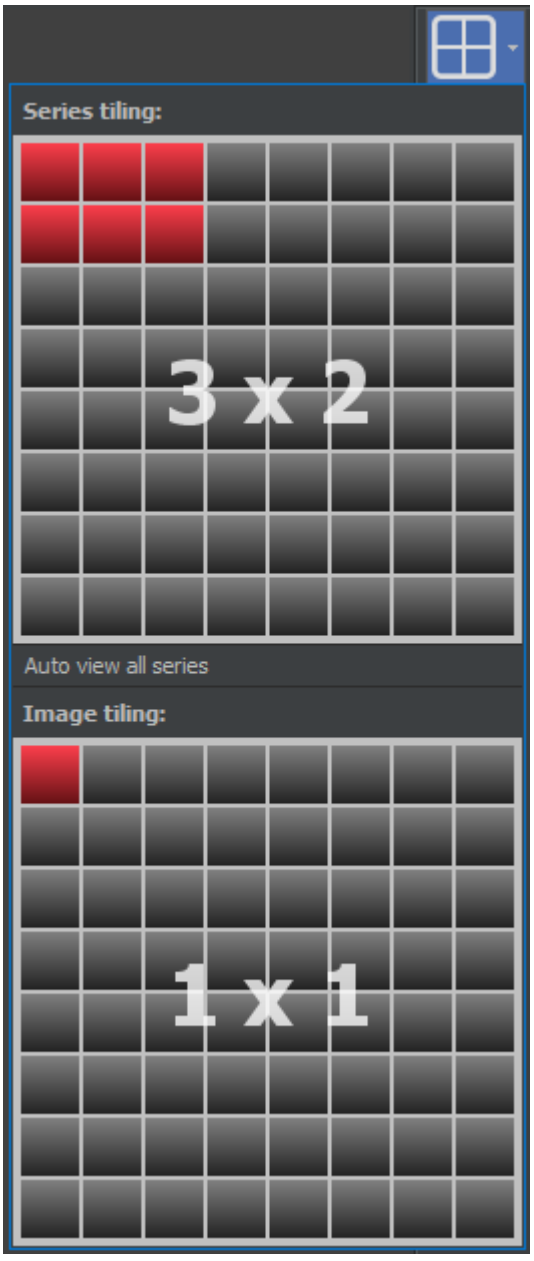
Pressing the *View report* toolbar button (when available), the text report associated with the current study will be displayed, if available. No modifications to the report text can be made in this case. If the format of the text report cannot be directly managed by RemotEye Viewer, an external viewer application may be launched to display the report document.

8.10.6 Custom reporting

Depending on the kind of system RemotEye Viewer is integrated with, reporting toolbar buttons may point to an external web-based reporting interface. This external reporting interface will in any case be shown in viewer-owned windows, which will honor all settings made in the viewer as far as reporting windows are concerned.

8.11 Customizing series and image layout

Pressing the *Set display mode...* toolbar button () is pressed, the following drop-down menu will appear:



This section allows defining exactly how series and images are presented within this study panel.

Series Tiling allows specifying the series tiling for the current study. The series tiling determines how many series will be concurrently visible, and their layout on screen.

If *Auto view all series* item is chosen, then all series are automatically shown and an auto-selected layout will be applied.

Image tiling allows specifying the image tiling for the series panel. The image tiling determines how many images of each series will be concurrently visible, and the layout of images inside the series panel.

If the *View study in full-screen mode* toolbar button () is pressed, the selected study is viewed in full screen. You can the exit from the full-screen mode by pressing the *ESC* button on the keyboard: normal-screen mode will then be restored.

8.12 Managing synchronized scrolling of series

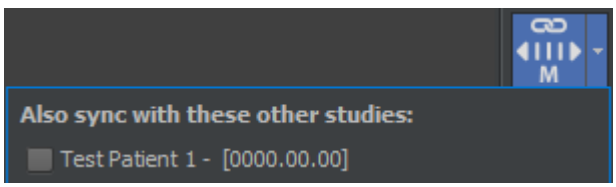
The *Toggle automatic series synchronization...* toolbar button (

) allows synchronizing different CT or MR series whose images (slices) were acquired moving in the same direction (acquisition planes with the same orientation). The synchronization causes a scrolling through the images of these series, in such a way all panels show images related to the same patient coordinates (where available). The reference coordinates, at which all other panels are synchronized, are the ones of the currently selected image panel / series. In order to support synchronization of all series, the image tiling of all series panels is automatically set to 1x1. Once the *Toggle automatic series synchronization...* function is enabled, all scrolling operations will be synchronized across the displayed series. In order to disable the *Toggle automatic series synchronization...* function and the related locked scrolling among series, it is sufficient to click once again on the same toolbar button.

The *Toggle manual series synchronization...* toolbar button (

) allows manually synchronizing different CT or MR series whose images (slices) were acquired moving in the same direction (acquisition planes with the same orientation). This manual function is useful when it is necessary to manually set the initial "aligned" state among several different series, and/or to synchronize scrolling among series belonging to different studies, even acquired by different modalities: under these conditions, the *Toggle automatic series synchronization...* function won't work. In order to use the manual series synchronization, the user must scroll all relevant series in such a way they all show images related to the same patient coordinates. When synchronized scrolling among several studies is necessary, the user shall select a given study, then click on the arrow-shaped drop down button, placed next to the *Toggle manual series synchronization...* toolbar button (

). A drop-down menu will appear, allowing user to choose the other studies (in addition to the current one) to synchronize with.



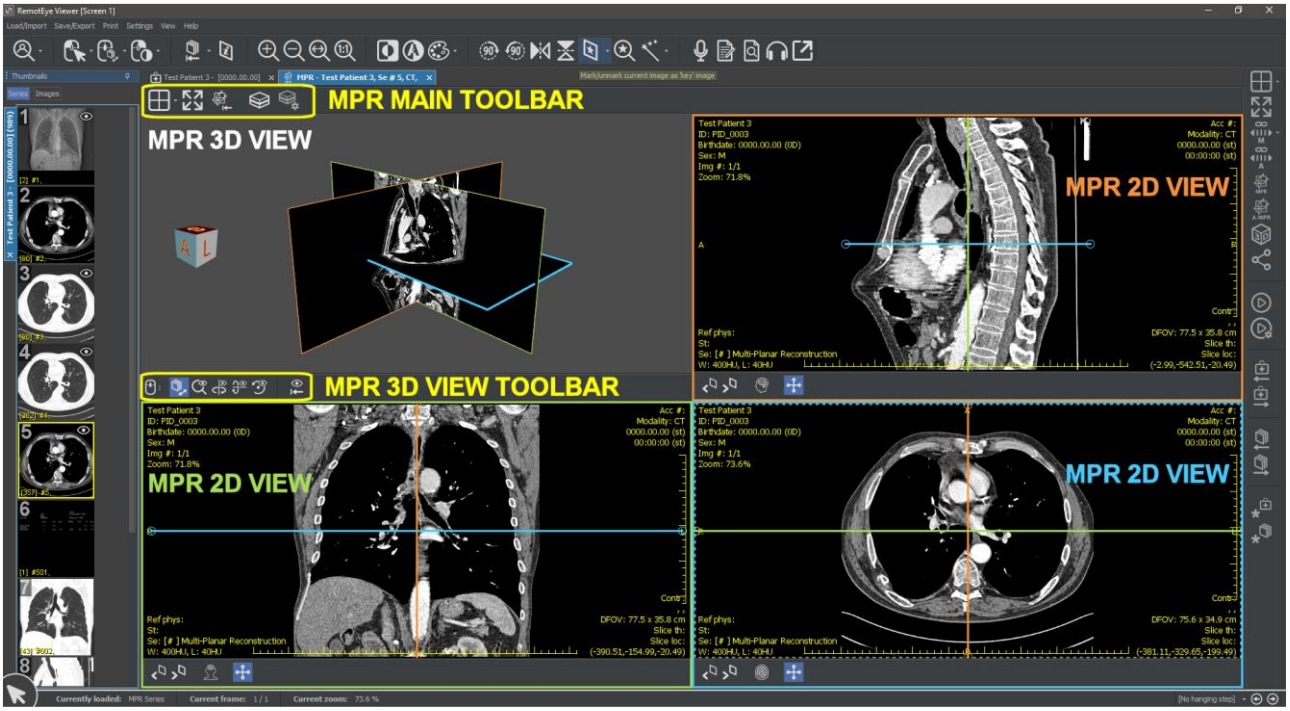
In case of cross-study manual synchronized scrolling, before activating the synchronization, the user must scroll all relevant series of each study, in such a way they all show images related to the same patient coordinates.
Once all relevant series have been scrolled in such a way to represent an initial "aligned" situation, it is possible to press the *Toggle manual series synchronization...* button in order to lock scrolling of all those series in a synchronized way. The scrolling position of each series in the moment when the *Toggle manual series synchronization...* button is pressed is considered to be the initial reference point. In order to disable the *Toggle manual series synchronization...* function and the related locked scrolling among series, it is sufficient to click once again on the same toolbar button.

⚠ **Warning:** synchronized scrolling functionalities are based on a software algorithm. As such, the proper functioning of sync scrolling depends on the correctness of several orientation and spacing data stored in the original DICOM datasets, in addition to the correctness of the implemented scrolling algorithm. The viewer itself has no mean to ensure these input data are correct. Hence, the proper synchronization of the series shall be checked in a very “critical” way by the user/radiologist, and any conclusion coming from these functionalities shall be carefully evaluated.

8.13 MPR (Multi-Planar-Reconstruction)

MPR (Multi-Planar Reconstruction) toolbar button (

) allows performing a 3D volume reconstruction and reslicing, when this operation is possible. The volume is built by stacking the slices of a single series, which may have any acquisition orientation. The MPR function will then allow to "cut" the volume by arbitrary planes, thus obtaining arbitrary slices out of the volume generated from the original series. For instance, you will be able to obtain scrollable axial, sagittal, coronal or oblique views starting from a single axial series.
In order to perform a MPR, it's necessary to start from a series having enough images to build a volume with sufficient resolution. In addition, images must be correctly sorted by image position.
Moreover, if spacing between slices varies across images of the source viewing series or if source volume is 'skewed', then RemotEye Viewer will display a warning message, as the generated MPR volume would be distorted.
The figure below shows the four panels composing the *Main MPR* panel and the MPR toolbars:



As you can see, the default MPR view includes a 3D view (the top left panel in the figure above), and three 2D views, which contain the 2D slices extracted from the volume along the three defined cut planes.

⚠ **Warning**: the images resulting from Multi-Planar Reconstruction (MPR) are synthetic images generated by a software algorithm. They are NOT images acquired directly by a medical device. As such, their geometric and morphologic correctness, as well as the correctness of the measurements taken on these MPR images, depend on the correctness of several orientation and spacing data stored in the original DICOM datasets, in addition to on the correctness of the implemented reconstruction algorithm. The viewer itself has no mean to ensure these input data are correct. Hence, images coming from MPR shall be checked and treated in a very "critical" way by the user/radiologist, and any conclusion coming from MPR images shall be carefully evaluated against the original non-MPR images.

8.13.1 MPR 3D view

The *MPR 3D view* is the panel where the 3 cut planes within the volume are shown in a 3D scene. Left-dragging with the mouse outside of the volume itself allows rotating the camera (i.e., the point of view) around the volume. The toolbar located at the bottom of this 3D view allows associating several functions to the mouse wheel (the association is only valid on this 3D panel), which are useful to move cut planes along their perpendicular direction, as well as to rotate the camera (i.e., the point of view) of the 3D scene around the volume. Finally, it is possible to reset the default view in this 3D scene.

8.13.2 MPR 2D views

Three different 2D views are present in the MPR window, corresponding to the three cut planes which are working on the volume. Each 2D view has a border with a specific color, which allows associating each 2D view with each cut plane displayed in the 3D view. Also, each 2D view shows the cut lines representing the intersections between this cut plane and the other two cut planes. Also the cut lines respect the color convention for cut planes. By left-dragging the end points of the cut lines, it is possible to rotate the related cut plane, thus producing arbitrary oblique slices out of the volume. Clicking on the intersection point between the cut lines, the "*3D cursor* effect" will be obtained (*see paragraph 6.1.7*), regardless the tool associated, at the time, to the left mouse button. Whereas, clicking on any cut line's point, different from the end point and the intersection point with the other cut line, it is possible to move the plane related to that line, allowing user to easily find intersections with any point of the 3D volume. Finally, placing the mouse cursor on a cut line (without clicking), and turning the mouse wheel, holding the *Ctrl* button down, that cut line will be reduced or extended, depending on the rotation's direction, so the plane corresponding to it will be zoomed in/out.

Moving the mouse pointer in the lower portion of a MPR 2D view, a specific toolbar appears, allowing to show/hide cut planes on the 2D view, as well as to restore the view to the original cut orientation (i.e., axial, sagittal or coronal).

Green and blue lines represent, respectively, coronal and axial planes which intersect the sagittal plane.

8.13.3 MPR display layouts and modes

The *MPR main toolbar* contains buttons which allow setting display mode for the MPR window, viewing MPR in full-screen mode, resetting all cut planes, enabling *Thick slab* mode, and setting *Thick slab* mode properties.

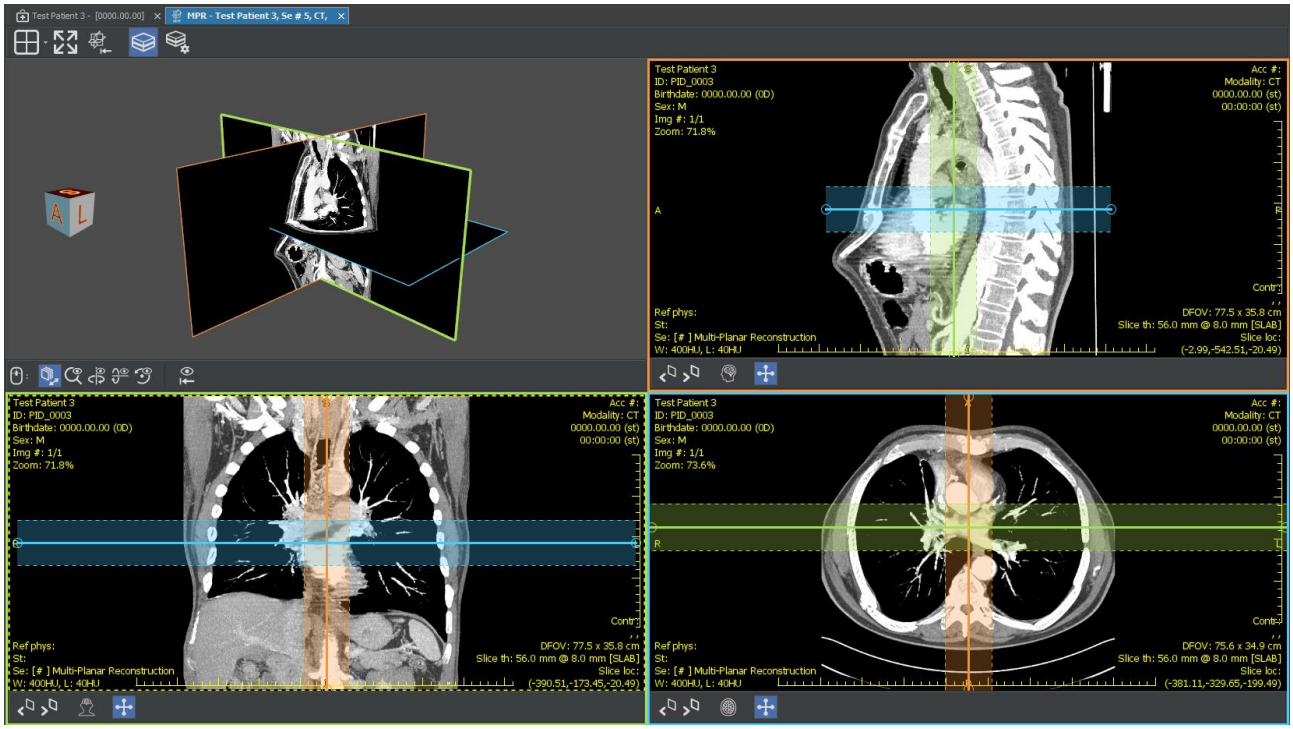
If you press the *Set display mode...* toolbar button, the following drop down menu will appear:

User can choose the desired display mode of the MPR window among several available options.

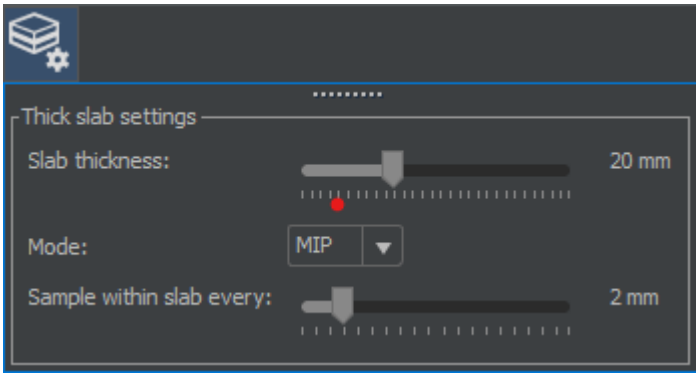
You can also view the MPR reconstruction panel in full-screen mode, using the  toolbar button.

8.13.4 Thick slab mode

RemotEye Viewer, through the button  located on the MPR main toolbar, allows enabling the *Thick slab* mode. Thanks to this feature, it is possible to obtain projection images built from thick sections of the original volume, instead of simply sampling thin slices from the volume as with standard MPR.



In addition, clicking on the  button located on the MPR main toolbar, the following dialog box will appear, containing some options related to the thick slab mode:

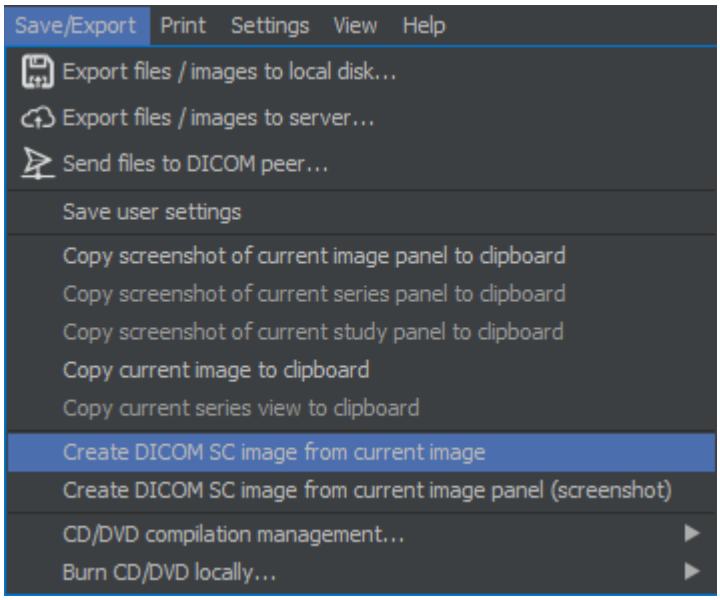


From here, it is possible to choose:

- the *Slab thickness* (in mm), which is the thickness of the section from which the 2D projection is built;
- the sampling frequency within the thick slab (in mm), which basically determines how many thin slices within the thick slab are combined and used to compute the output 2D projection (*Sample within slab every*);
- the algorithm (*Mode*) to be used to compute the output 2D slab. 2D parallel slices, sampled within the thick section, are combined according to the following algorithms: MIP (Maximum Intensity Projection), MinIP (Minimum Intensity Projection), and AvgIP (Average Intensity Projection).

8.13.5 DICOMizing synthetic MPR images

The 2D images generated by the MPR function and visible in the MPR 2D views can be saved as DICOM Secondary Capture images, using the dedicated menu items available in the *Save/Export* menu:



Please ensure that you select the appropriate MPR 2D view's panel before invoking the *Create DICOM SC image from current image* or *Create DICOM SC image from current image panel (screenshot)* actions.

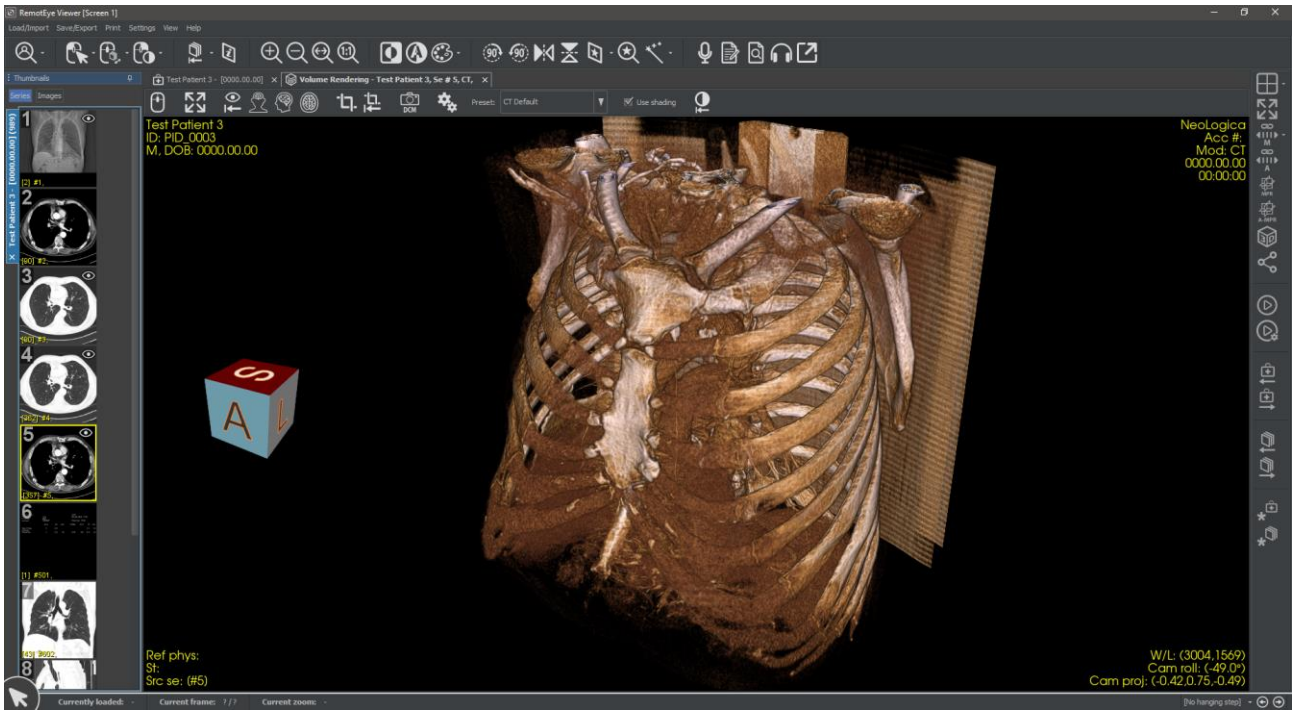
8.14 Volume Rendering

The Volume rendering toolbar button () allows performing a 3D volume reconstruction and presentation, with an interactive manipulation of the view and of the rendering attributes. The volume is built by the software by stacking the slices of a single series (normally, a CR or a MR series), which may have any acquisition orientation.

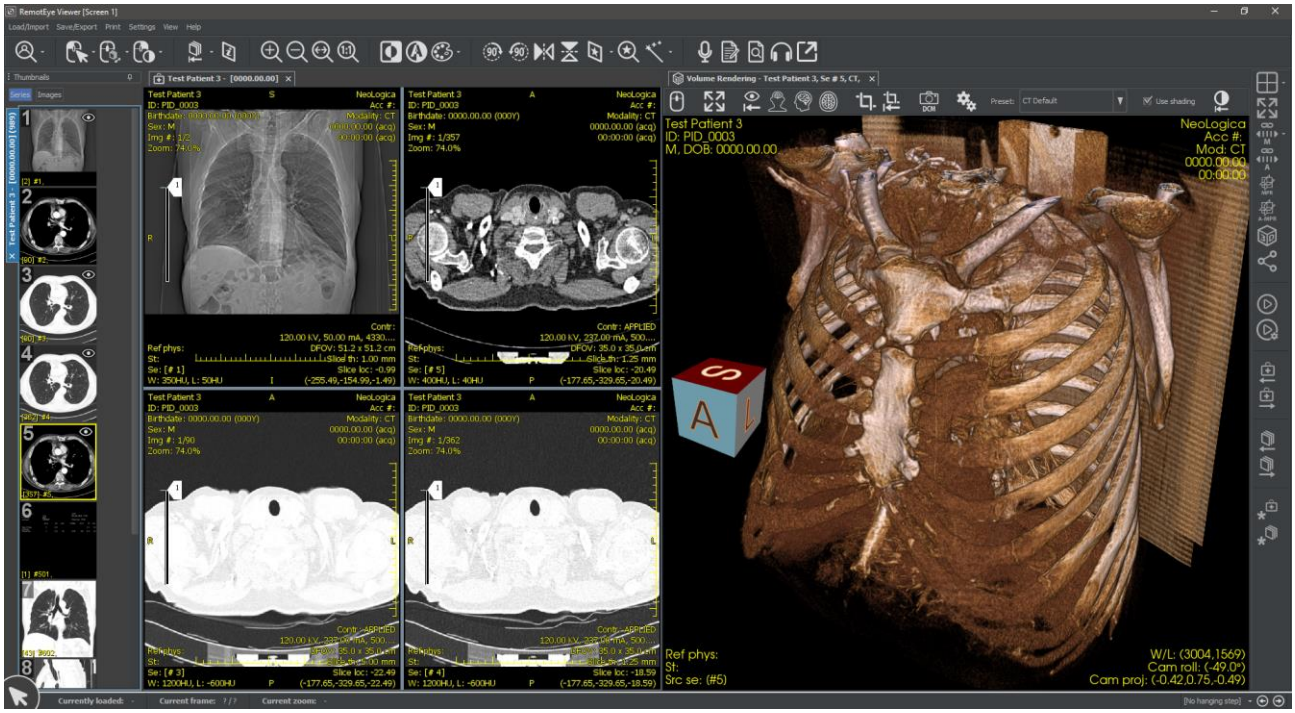
In order to perform a 3D volume rendering, it's necessary to start from a series having enough images to build a volume with sufficient resolution. In addition, images must be correctly sorted by image position.

Moreover, if spacing between slices varies across images of the source viewing series or if source volume is 'skewed', then RemotEye Viewer will display a warning message, as the generated 3D volume would be distorted or may at least require a software interpolation.

Once the source series has been selected, and the *Volume rendering* toolbar button has been pressed, the volume generation process will begin. A new top-level panel will be opened by the viewer, titled "*Volume Rendering*", and containing a single panel showing the 3D representation of the volume:



This top-level panel will be draggable and dockable as any other top-level panel: for instance, it will be possible to drag the 3D volume rendering panel (starting to drag from the tab title label) in such a way the 3D view it will be docked side-by-side with the original series of the source DICOM study:

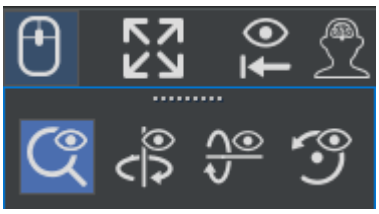


⚠ **Warning**: the images resulting from 3D Volume Rendering (3DVR) are synthetic images generated by a software algorithm. They are NOT images acquired directly by a medical device. As such, their geometric and morphologic correctness depends on the correctness of several orientation and spacing data stored in the original DICOM datasets, in addition to on the correctness of the implemented reconstruction algorithm. The viewer itself has no mean to ensure these input data are correct. Hence, images coming from 3DVR shall be checked and treated in a very "critical" way by the user/radiologist, and any conclusion coming from 3DVR images shall be carefully evaluated against the original non-3DVR images.

8.14.1 Viewing the 3D volume

Once the 3D volume rendering view is displayed on screen, it is possible to start interacting with the volume:

- Left-dragging with the mouse, it is possible to rotate the volume (actually, to rotate the point of view of the camera around the volume)
- Right-dragging with the mouse, it is possible to perform a “pseudo-window/levelling” operation on the 3D volume, in such a way different tissues and body structures are made visible. The actual effect of right-dragging is to shift and expand/shrink the color transfer function and opacity functions used to translate the values of voxels into a visible color 3D volume; the effect for the user will indeed be similar to the window/level operation made on 2D views with grayscale images.
- Scrolling the mouse wheel will correspond with an operation which can be configured though the dedicated button located in the toolbar sitting at the top of the 3D view:



Possible options are:

- Zoom-in / zoom-out
- Rotate the 3D view (or better, the camera’s point of view) around the X axis
- Rotate the 3D view (or better, the camera’s point of view) around the Y axis
- Rotate the 3D view (or better, the camera’s point of view) around the Z axis

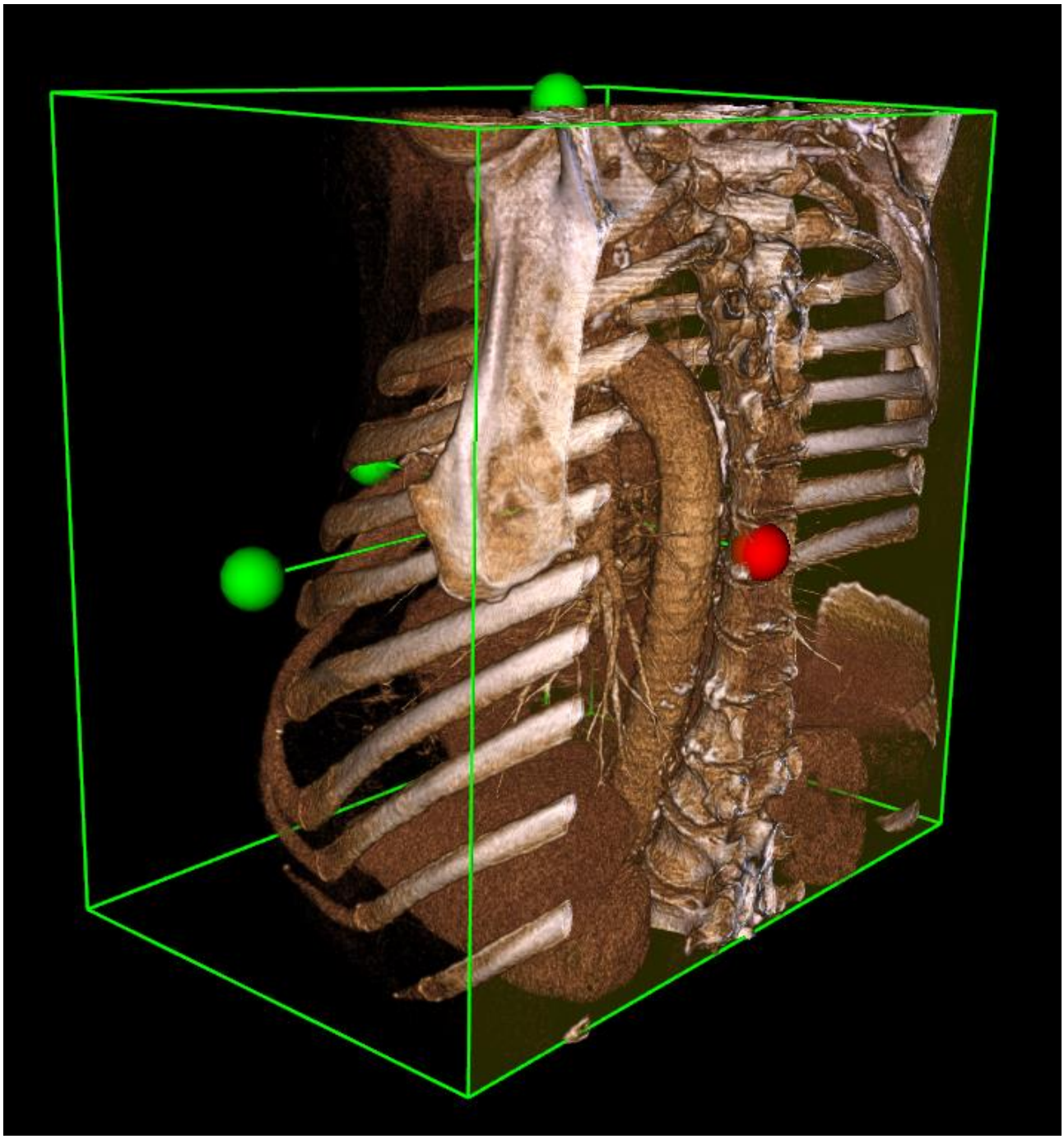
Several other operations can be done on the volume thanks to the 3D view’s top toolbar:

The () button allows you to view the whole 3D volume rendering panel in full screen mode.

The following set of buttons allows you to reset the view at its initial setting, as well as to reset the view to “Front view”, “Side view”, or “Bottom view”:

8.14.2 Cropping the 3D volume

The viewer supports cropping the volume through a “crop box” which can be interactively resized and which act as the visible volume’s bounding box. In order to enable and display the crop box, you can press the *Show crop box* toolbar button (). At this point, you can drag the spherical handles on the crop box faces in order to resize the crop box itself:

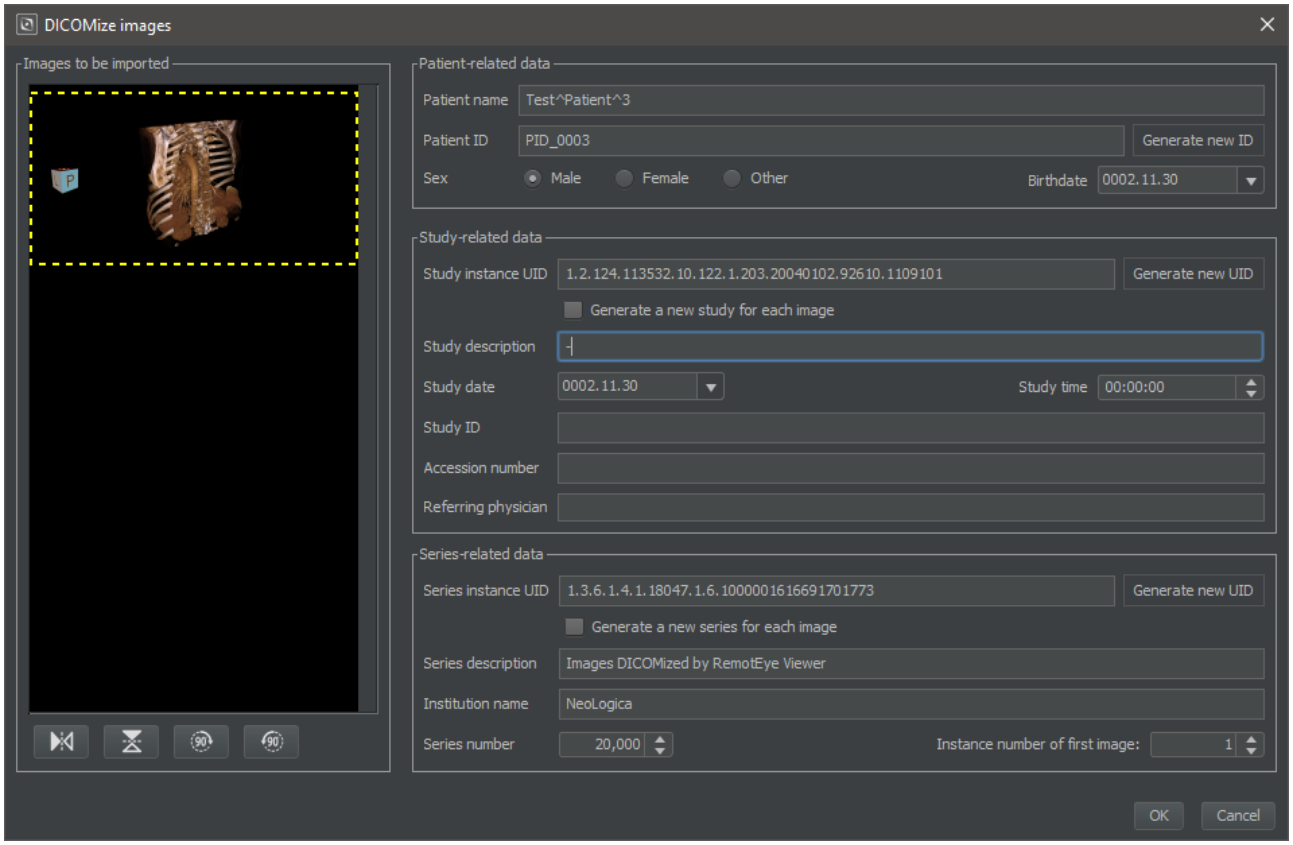


You can drag any face of the crop box. Once you are satisfied with your cropping, you can hide the crop box by pressing the *Show crop box* toolbar button () again. You can also reset the cropping through the *Reset crop* toolbar button ().

8.14.3 DICOMizing the 3D rendering

Pressing the *Create DICOM SC image from current 3D view (screenshot)* toolbar button (

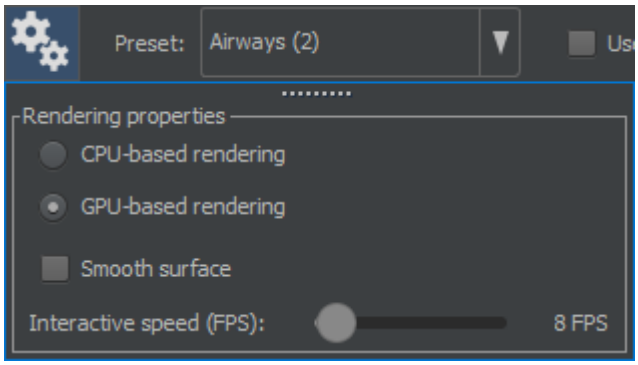
), you can take a screeshot of the current 3D rendering and convert it into a DICOM Secondary Capture image, exploiting RemotEye Viewer's DICOMization functionality:



The generated DICOM SC image will become part of the study and its series will be shown in the thumbnails panel of the viewer. At that point, it will eventually be possible to export that new series to the server, through the *Save/Export → Export files / images to server…* menu item.

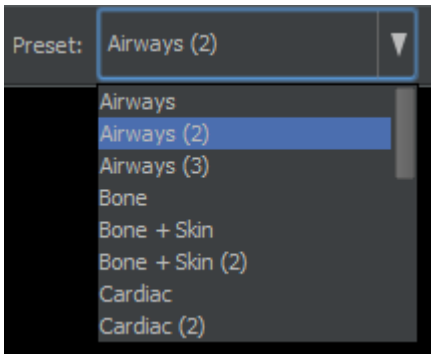
8.14.4 3D rendering properties

Some properties of the 3D rendering process can be customized by pressing the *Rendering properties…* toolbar button:



8.14.5 3D volume rendering presets

RemotEye Viewer allows selecting the “Volume rendering preset” to be used, through a dedicated drop-down box:

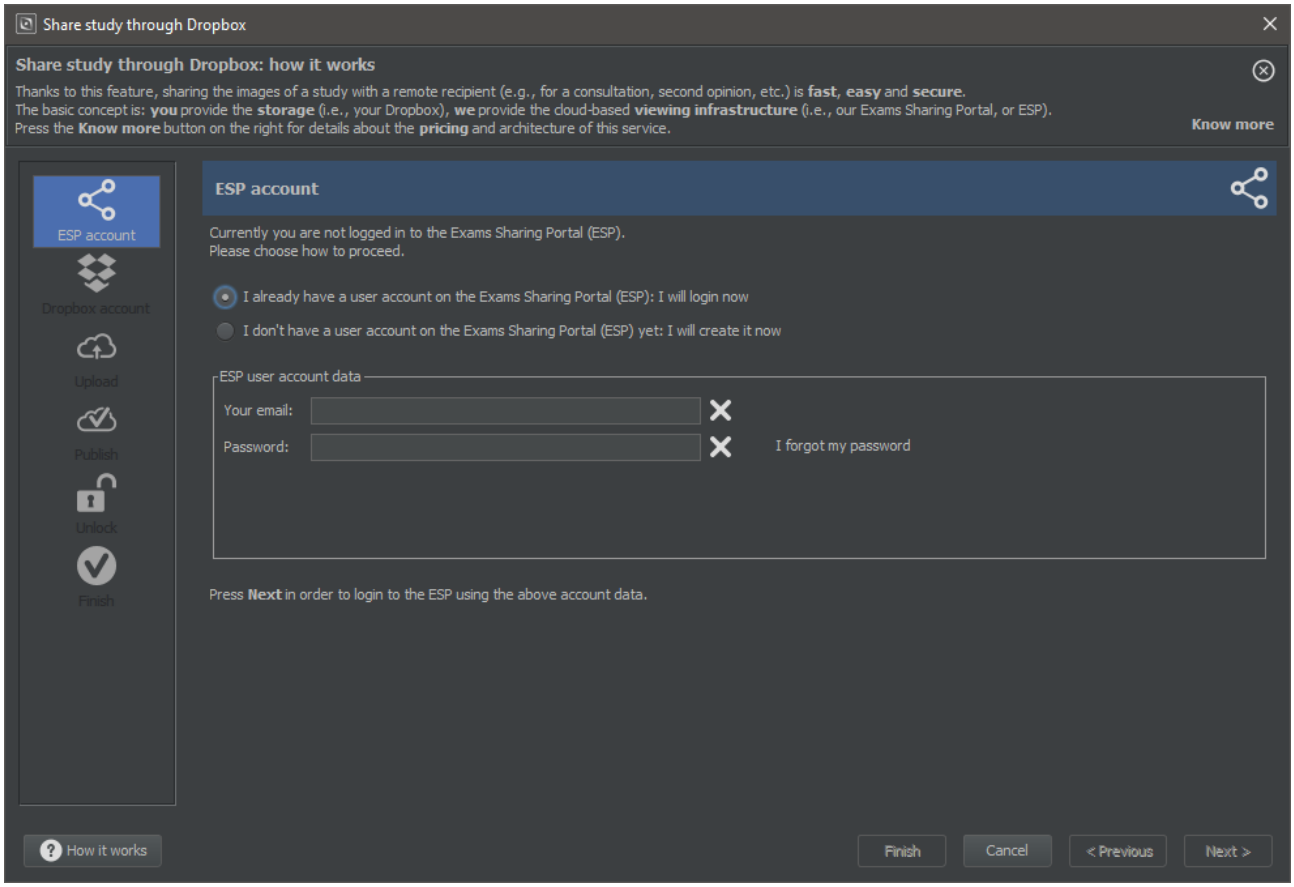


Several presets for CT and MR images are provided “out-of-the-box”. These standard presets correspond to appropriately-calibrated color transfer functions and opacity functions, which are suitable to show particular tissues and body structures with realistic colors.

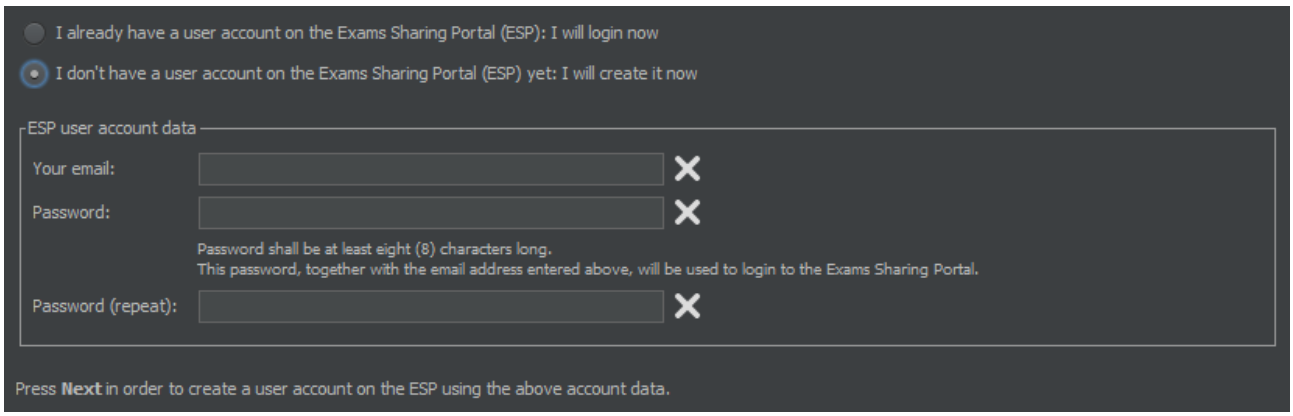
8.15 Sharing a study with a remote recipient

The *Share study through Dropbox* ( ) toolbar button allows sharing the current DICOM study with a remote recipient (e.g., for a consultation, second opinion, etc.) by exploiting the sending user's Dropbox and a cloud viewing infrastructure based on RemotEye Viewer itself. This cloud-based viewing infrastructure has been called "Exams Sharing Portal (ESP)".

Clicking on this button, a step-by-step Share through Dropbox wizard is started, as shown in the following picture:

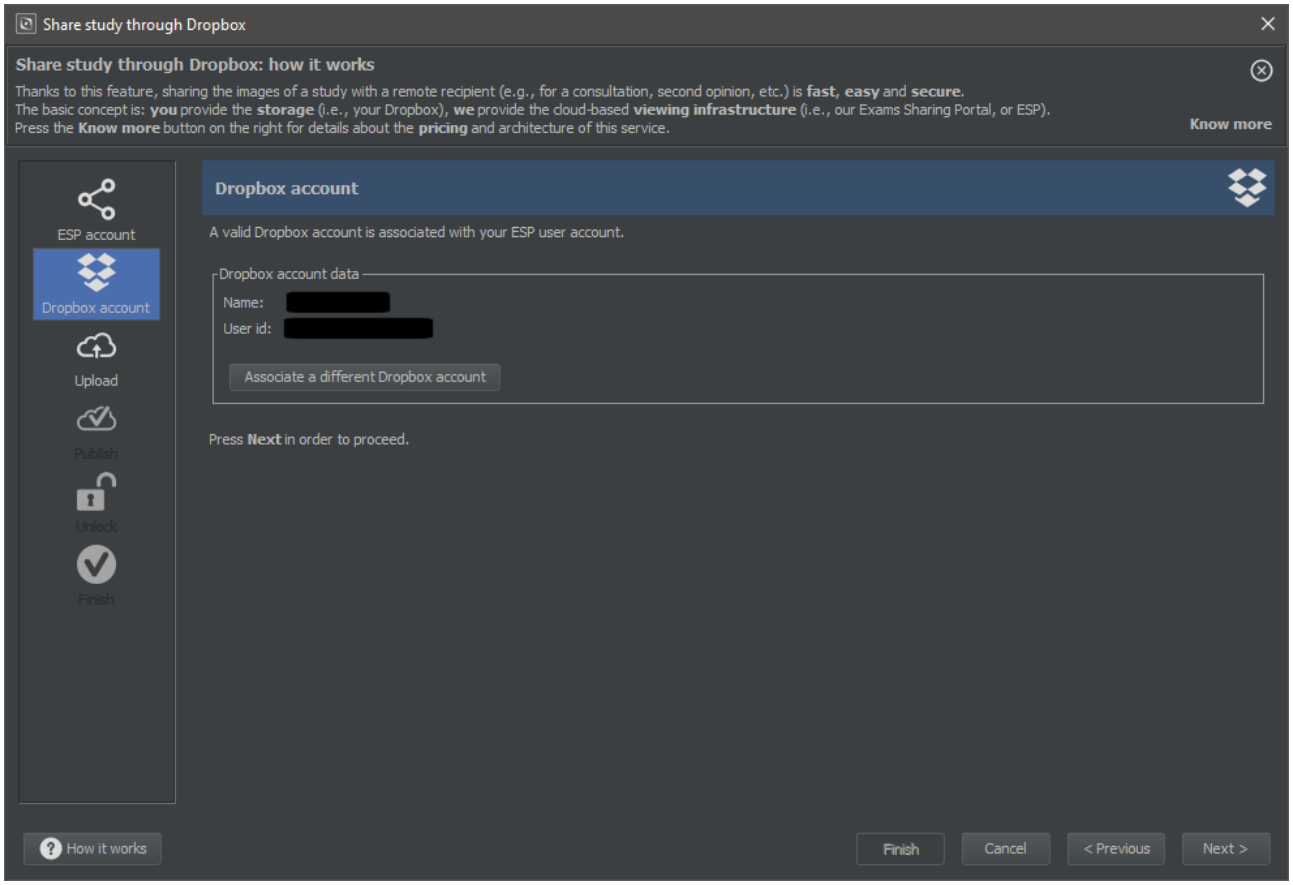


The first step of this wizard allows user to authenticate on the Exams Sharing Portal by entering email and password related to his ESP account. If the user does not have a user account on the ESP yet, he can create a new one selecting the appropriate option, as shown in the following screenshot:

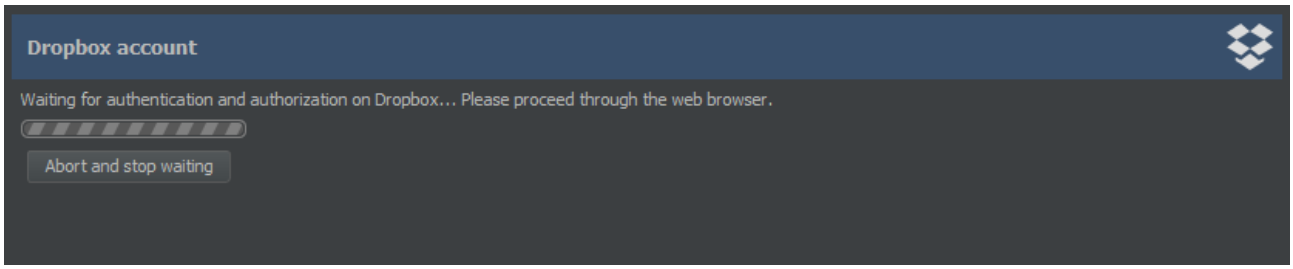


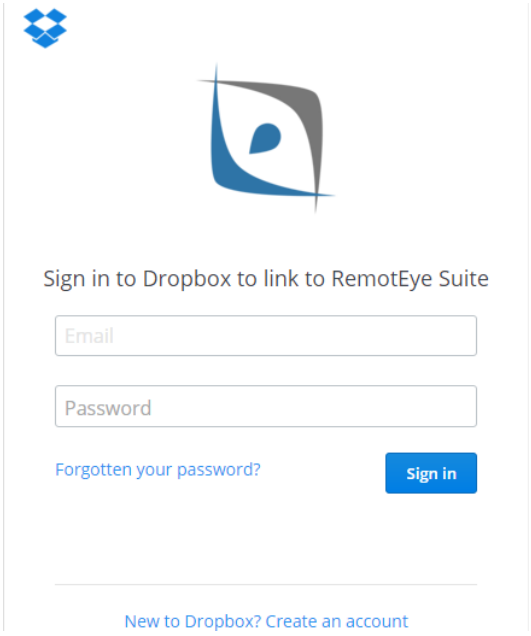
Once user has successfully logged in to the ESP, RemotEye Viewer stores his login data, so that he will be able to auto-login upon later usages of the *Share through Dropbox* functionality.

Clicking on the *Next* button, the page related to the second step of the wizard will appear:

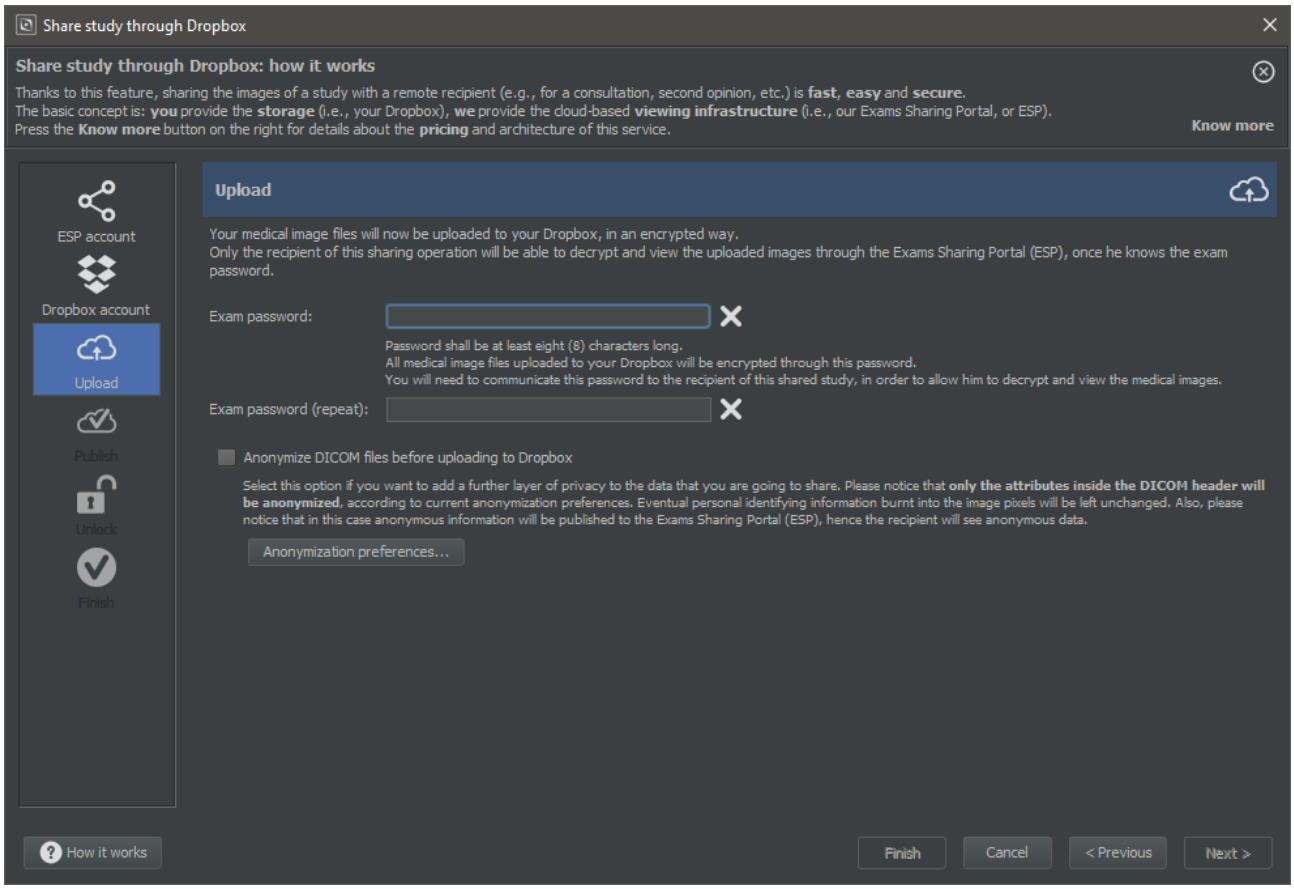


Once user has authenticated on ESP, an attempt will be made to authenticate on Dropbox. If automatic authentication succeeds, user can choose to proceed with that Dropbox account, as shown in the image above. Otherwise, if automatic authentication on the user's Dropbox is impossible or fails, or user just wants to associate a different Dropbox account, an authentication and authorization step takes place on Dropbox, as you can see in the images below:





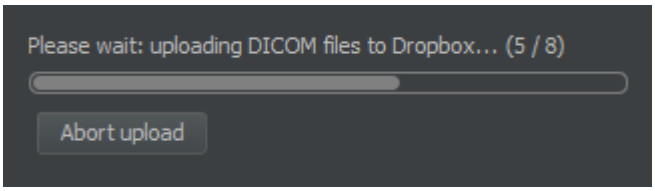
Once user has logged in to the ESP, and access to user's Dropbox is granted, RemotEye Viewer is ready to upload current study's DICOM files to Dropbox.



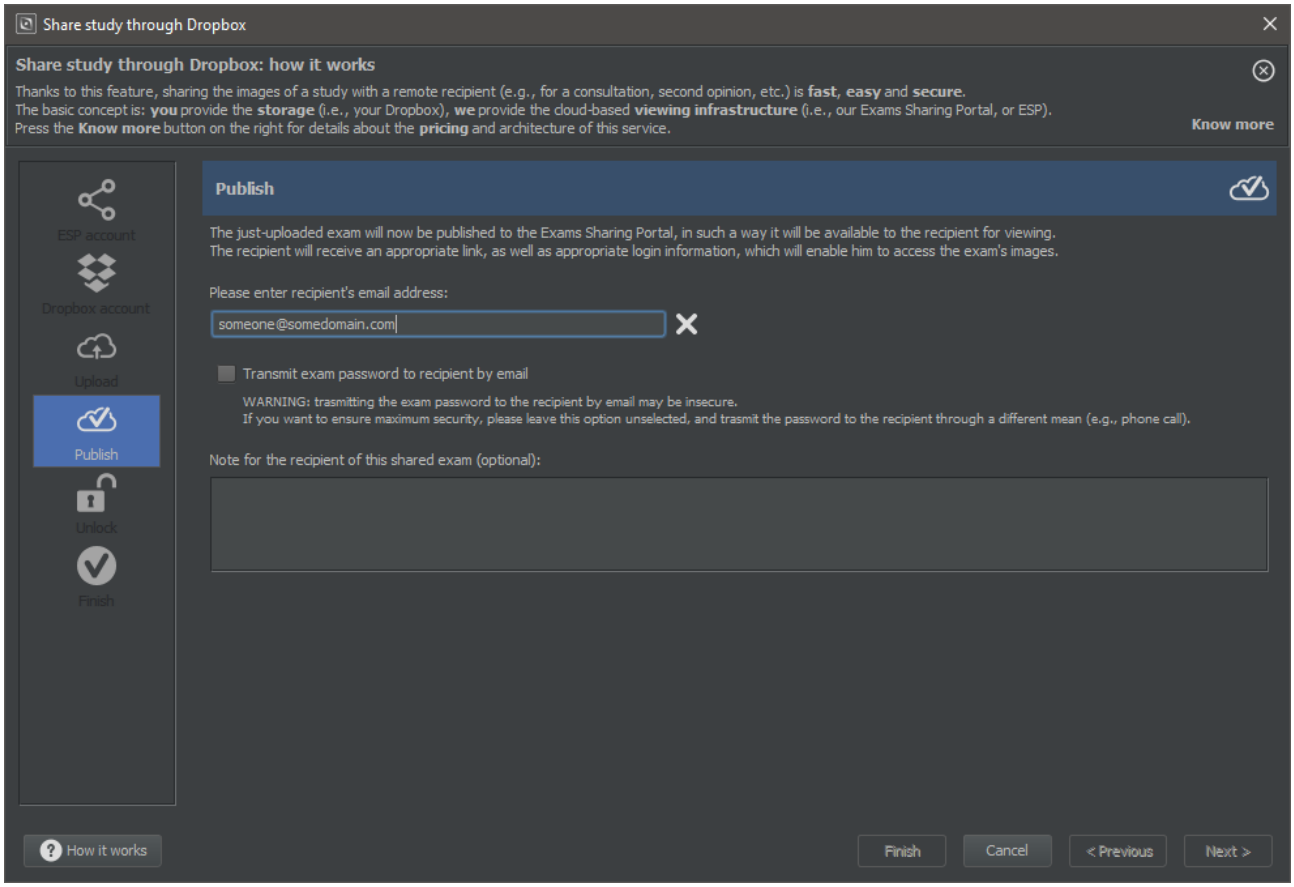
In this step, user is prompted to choose a password needed to encrypt all DICOM files which will be uploaded to his Dropbox. This password must be at least 8 characters long, and user will need to communicate it to the recipient of the shared study. Through this password, indeed, the recipient will be able to decrypt and view the medical images.
In addition, selecting the option *Anonymize DICOM files before uploading to Dropbox*, a further layer of privacy will be added to the data that user is going to share.

⚠ **Important note:** please consider that only the attributes inside the DICOM header will be anonymized, according to the anonymization preferences. Eventual personal identifying information burnt into the image pixels will be left unchanged. Also, please notice that in this case anonymous information will be published to the Exams Sharing Portal (ESP), hence the recipient will see anonymous data.

At this point, RemotEye Viewer is ready to encrypt and upload all DICOM files related to the current study to user's Dropbox. During the upload of DICOM files to Dropbox, a progress bar shows the current progress of the whole upload procedure, which may be very lengthy. User can choose to abort and stop the upload operation.



Once the upload to Dropbox of all DICOM files of the study has successfully completed, the "Publish to Exam Sharing Portal" step takes place:



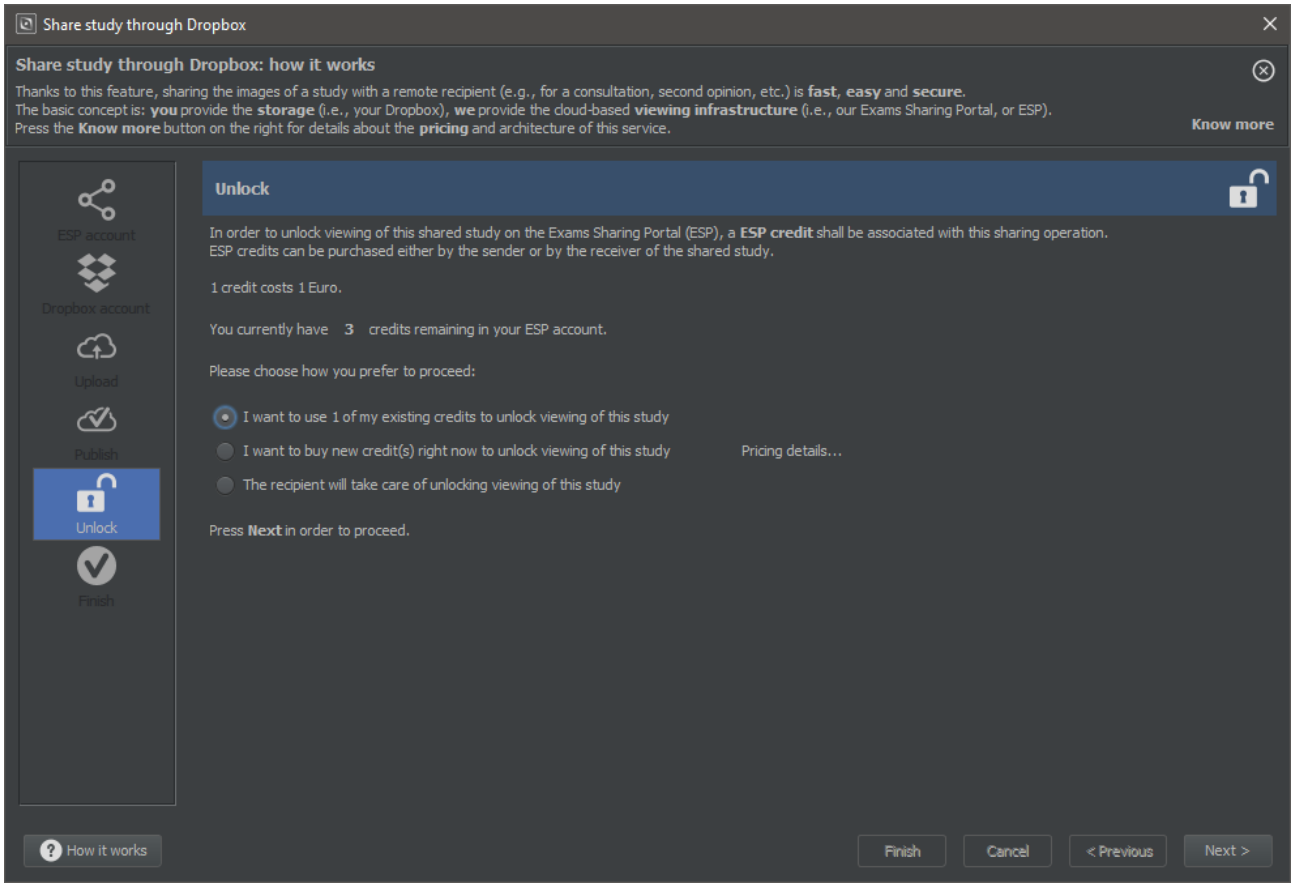
Here, it is necessary to enter the email address of the recipient, which will be used to send him a notification email, informing him about the availability of a shared study for him on the ESP. This email will provide the recipient with an appropriate link, as well as login information, which will enable him to access the exam's images. Also, this email address will be used to create the recipient's user account on ESP, if not already existing. It is possible to send the exam password to the recipient directly by email, by selecting the *Transmit exam password to recipient by email* option.

⚠ **Warning**: transmitting the exam password to the recipient by email may be insecure. If you want to ensure maximum security, please leave this option unselected, and transmit the password to the recipient through a different mean (e.g., phone call).

Finally, user can type a note for the recipient of the shared exam through the appropriate box.

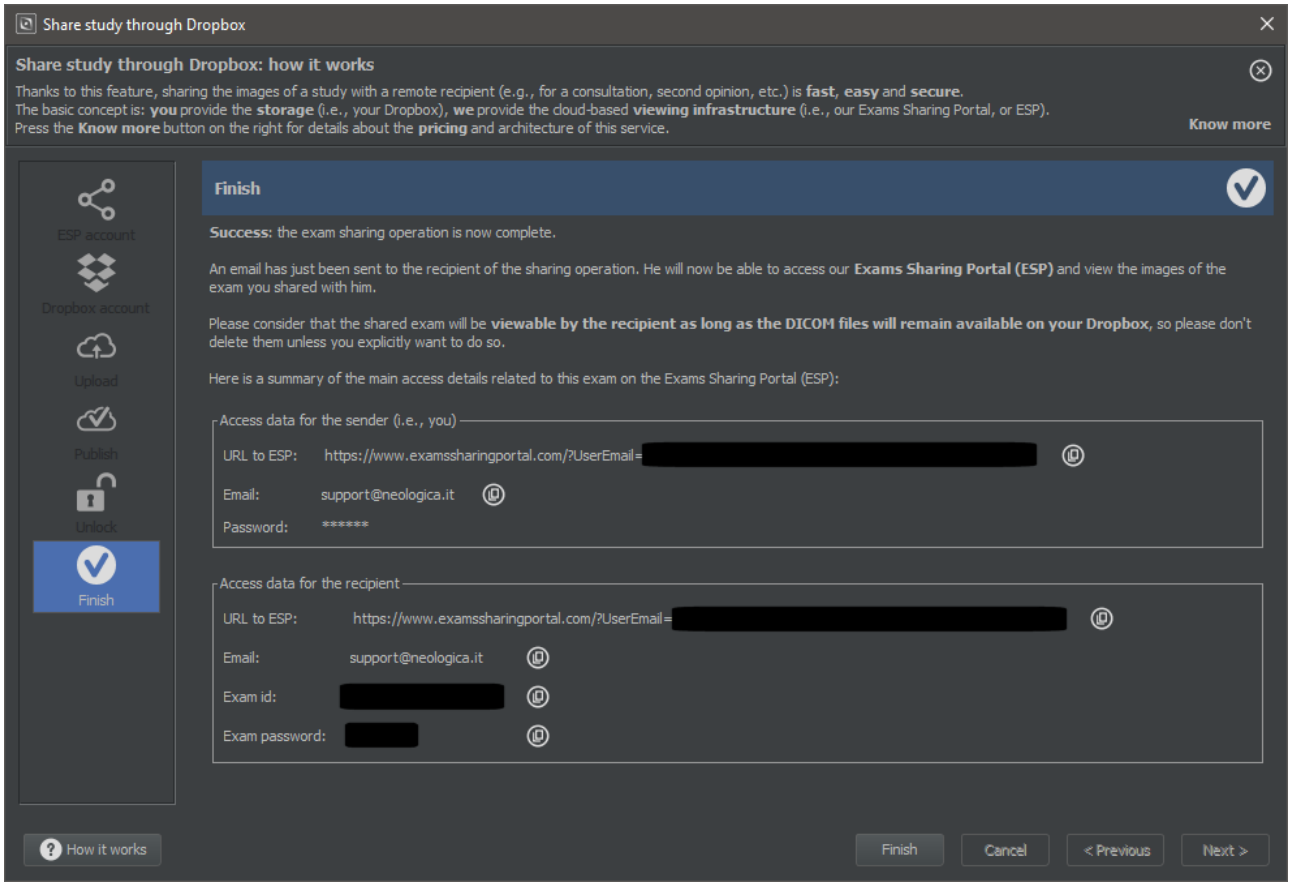
At this point, clicking on the *Next* button RemotEye Viewer will publish the current study to the Exams Sharing Portal (ESP).

Once the study has been successfully published to ESP, user can choose whether to use one of his existing credits (if available) to unlock viewing of the study, or to purchase new credits to unlock the study on behalf of the recipient, or rather to leave the recipient the task of unlocking the study at a later stage.



Once a user has unlocked a shared exam, that exam will be online and viewable (by both the sender and the recipient) as long as the sender will keep it in his own Dropbox, for an unlimited number of times.

Once the unlock step has been done or skipped, the exam sharing operation is complete, and RemotEye Viewer provides a final summary:

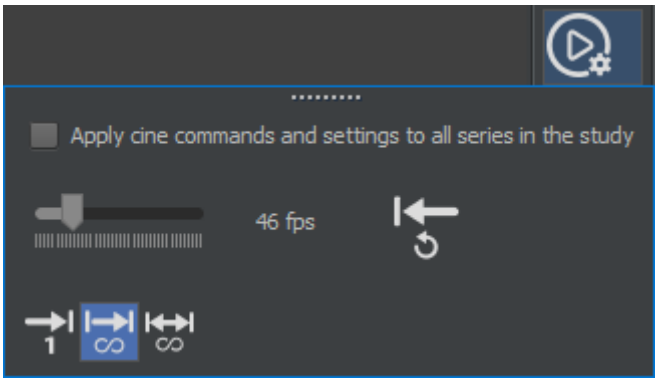


8.16 Cine playback of dynamic sequences

Cine movie toolbar buttons allow obtaining a dynamic playback of the cine sequences belonging to the current study.

The *Play/Stop cine movie* toolbar button (toggling between  and ) allows you to start or stop the cine-playback of cine-sequences currently displayed within the current study panel.

Pressing the *Playback preferences…* toolbar button (), the following options panel will appear:



The *Apply cine commands and settings to all series in the study* option let you decide whether the play and stop commands will have effect just on the currently-selected cine sequence, or rather to all series within the study.

It's possible to modify the speed of the playback (in terms of frames per second, or FPS) by dragging the dedicated slider. The Apply *default FPS (movie speed)* button ( ) allows setting the predefined playback speed for a given cine-sequence (according to the information coming from the DICOM dataset, if available).

The buttons on the bottom of this cine preferences panel allow controlling the loop mode of the playback, which can be *Play once*, *Looping* (default) or *Sweeping* (i.e., back and forth).

Pressing the *Play once* button ( ) the frames 1 to N (where N is the total number of frames in the current series) are displayed in rapid sequence, then the playback is stopped.

Pressing the *Looping* button ( ) the frames 1 to N are displayed in rapid sequence, then the playback begins again from frame 1 and so on (frame sequence: 1,2,…,N,1,2,…,N,1,2,…).

Pressing the Sweeping button ( ) the playback sequence is as follows: 1,2,…,N,N-1,N-2,…,2,1,2,…,N… (forward and backward).

8.17 Navigating among available studies and series

The following toolbar buttons allow you to navigate among the available studies and series:

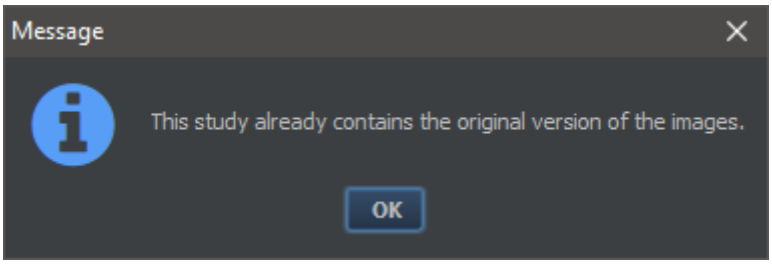
In particular, the *Load previous study in Worklist...* () and *Load next study in Worklist...* () toolbar buttons are used to load the previous or next study present in the Worklist window. The “previous” and “next” terms refer to the order of studies as shown by the *Worklist* window, and are intended with reference to the currently-selected study. In order to allow this function to work properly, it is necessary that the currently-selected study is indeed present in the radiologist’s worklist.

The *Previous series* toolbar button () and *Next series* toolbar button () are used switch the currently-selected series panel to the next or previous series (if multiple series are available in the current study).

8.18 Loading the original version of a study or series

The *Load original version of this study* toolbar button () allows loading the original version of the current study if the study currently contains a lossy version of the images.

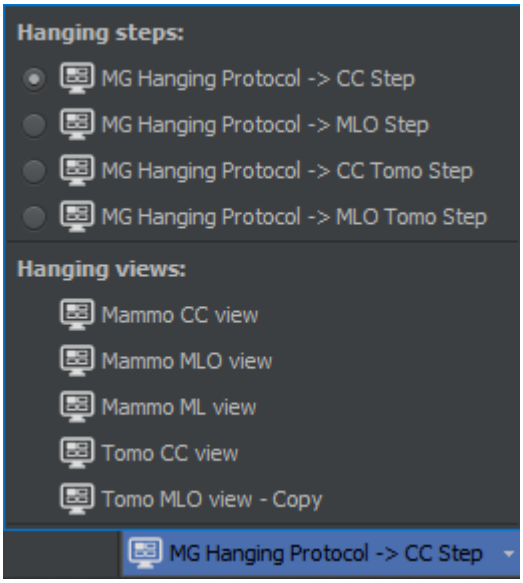
The *Load original version of this series* toolbar button () allows loading the original version of the current series if the series currently contains a lossy version of the images. If, when pressing this button, the series already contains the original version of the images, then the following message is shown by RemotEye Viewer:



Please consider that these toolbar buttons (and the associated features) are only available when the back-end provides adequate support for it, and the *Load a lossy version of the images first* option is enabled in the *Settings --> Loading preferences*.

9 Hanging steps and study view presets

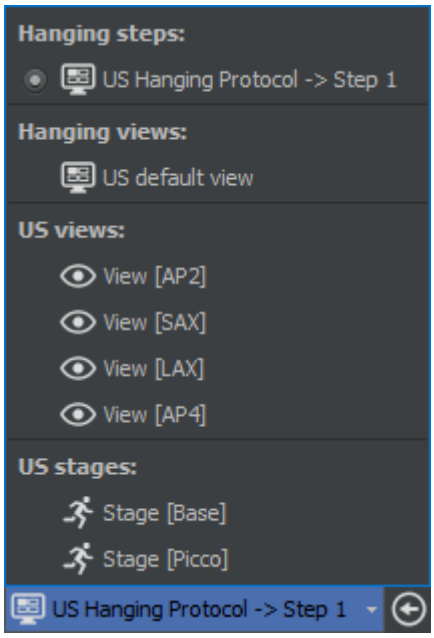
The picture below shows the "*Hanging steps* / Hanging views" dropdown box, which is located at the bottom-right corner of the viewer's window(s):



In case "*hanging steps*" are defined within a hanging protocol, it will be possible for the user to easily iterate through all "hanging steps" which are present within the hanging protocol, also in a next/previous fashion, through the arrow buttons available next to this dropdown box (). Switching to a different hanging step is a viewer-wide operation, which may have an effect on what is hung on all available monitors. It is possible to open several studies, belonging to different modalities or even different patients, and to hang them all together according to their hanging steps.

Each individual hanging view defined in the matching hanging protocol(s) can be directly applied to the single study panel through the same dropdown box.

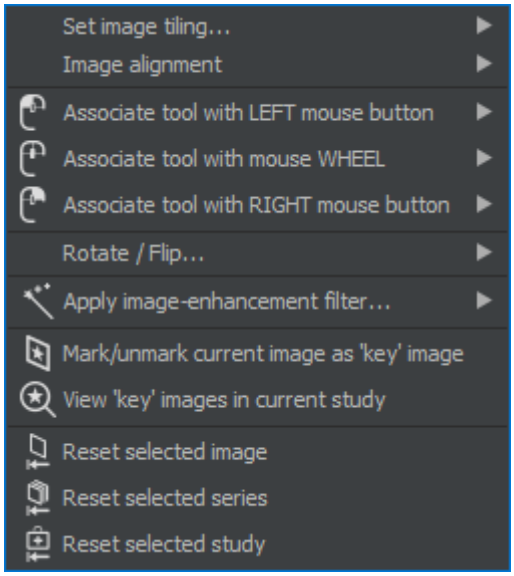
For some particular kinds of studies, special hanging functions are available in the view presets drop-down menu. For instance, in case of ultrasound "echo stress" studies, user will be able to select hanging of series "by view" or "by stage". When selecting a given "view" from the drop-down menu, RemotEye Viewer will display all series related to that view, and will arrange the series tiling automatically in order to contain all series related to that view. In the same way, selecting a given "stage" from the drop-down menu, RemotEye Viewer will display all series related to that stage, and will arrange the series tiling automatically in order to contain all series related to that stage.



10 On-image popup menu

RemotEye Viewer features a pop-up menu on images, which allows a fast selection of common tools, functionalities and options.

In order to show the pop-up menu it is necessary to right-click on a non-empty image panel while keeping the *Ctrl* key of the keyboard pressed. Since RemotEye Viewer allows a flexible association of image tools to both left and right mouse buttons, pressing *Ctrl* on the keyboard is necessary, in addition to right-clicking, to display this pop-up menu.



RemotEye Viewer also supports a faster association of the tools with the left, right and wheel mouse buttons. In order to change the tool associated with the left mouse button, press the left mouse button while keeping the *Shift* key pressed on the keyboard. In order to change the tool associated with the right mouse button, press the right mouse button while keeping the *Shift* key pressed on the keyboard. Finally, in order to change the tool associated with the wheel mouse button, press the wheel mouse button while keeping the *Shift* key pressed on the keyboard.

The pop-up menus are particularly useful when operating in full-screen mode, since most functions may be accessed without the need for the main toolbars.

11 Thumbnails panel

The *Thumbnails* panel displays thumbnail images:

If the *Series* option button is selected on the *Thumbnails* panel, then each thumbnail image will represent a series currently loaded in RemotEye Viewer, and the number of displayed thumbnail images for each study

will be equal to the number of series currently loaded in RemotEye Viewer for that specific study. The thumbnails are grouped by study.

On the other hand, if the *Images* option button is selected on the *Thumbnails* panel, then each thumbnail image will represent a single image currently loaded in RemotEye Viewer, and the number of displayed thumbnail images for each study will be equal to the total number of images currently loaded in RemotEye Viewer for that specific study. Also in this case the thumbnails will be grouped by study and series.

Drag&drop of images or series from the *Thumbnails* panel to the study panel(s) is supported. You can also select multiple thumbnails in the *Thumbnails* panel, by the Windows-usual *Shift-click* or *Ctrl-click*, and then dragging & dropping all selected images or series (depending on the active mode) to the Study panel.

Double-clicking on a thumbnail will load the double-clicked series or image into the currently selected image panel. Double-clicking on a series thumbnail while pressing the *Alt* key on the keyboard will load the study panel with the scene starting at the double-clicked series. Double-clicking on the tab related to a particular study, will hang the study, following the rules of the first matching hanging protocol.

When the proper option is enabled in the *Settings* section (under *Display preferences*) , the thumbnails will be marked by symbols to identify the series or images displayed on the main study panel(s): while the  symbols identify the series or images currently displayed (i.e., hung on screen) in RemotEye Viewer, the  symbol indicates the currently-selected series.

The thumbnail panel may be hidden or shown by clicking on the pin icon appearing at the top right of the panel itself.

12 How to report issues

In case you encounter issues or you detect a malfunctioning while using the RemotEye Viewer software, please report the problem to the NeoLogica Support Staff.

NeoLogica uses a ticket-based online support system. In order to report a problem, please browse to the following web address:

https://www.neologica.it/Support

You will then be able to open a new "support ticket", and specify the details of the issue you have detected. The NeoLogica Support Staff will analyze the reported issue and will reply promptly, then making every effort to solve the issue in the shortest possible time.

13 Acknowledgments

RemotEye Viewer relies on the CharLS library in order to decode JPEG-LS-compressed images.