TomoCon

User's Manual

TatraMed

TomoCon Workstation
TomoCon Viewer
TomoCon Lite

User's Manual

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TomoCon PACS

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1 General note

1.1 Intended use

TomoCon PACS is a PACS system designed to be used for patient image data storage, handling, transfer, visualization and diagnostics. The system enables DICOM data import and export and the visualization of stored images for diagnostic purposes.

1.2 TomoCon PACS client applications

The TomoCon Workstation, TomoCon Viewer and TomoCon Lite (hereinafter referred to as TomoCon) are the client applications of the TomoCon PACS system. All three client applications provide the same basic functionality (as outlined in the section above). The applications also provide advanced functionality that varies depending on the license. Where appropriate, the user is advised of divergence from the basic functionality.

1.3 Medical device class and CE mark

TomoCon PACS has been classified as a Class IIb medical device, according to Directive MDD 93/42/EEC as amended by Directive 2007/47/EC and has been certified as such. Written declaration of conformity is available on request (see 26 Contact).

CE 0434

1.4 Security precautions

The TomoCon user interface is written in English and therefore knowledge of English on an adequate level is required.

The software runs on Microsoft Windows XP, Windows Vista, Windows 7 or 8 and thus good knowledge of the used operation system is recommended.

Solid understanding of the installation instructions in this documentation (see 2.1.2 Installing TomoCon) is mandatory before installing TomoCon for clinical usage. Thorough comprehension of the entire user manual is required prior to the clinical use of TomoCon.

Diagnosing users should be aware that certain views may display interpolated data. Interpolated data, although based on the original data set, may give the appearance of healthy tissue in situations in which pathology, which is smaller than the scanning resolution, may be present. Occasionally, interpolated data may also include image artifacts, which should not be interpreted as actual pathology.

The TomoCon system saves images along with personal patient information (when saving to the local database and when exporting from TomoCon). It is important to protect this data from access by unauthorized persons.

1.4.1 Network security requirements

It is strictly recommended to use TomoCon only within a secured network environment. It is assumed that a secured network environment includes the following, at the very minimum:

- Firewall or router safeguards to ensure that only approved external hosts have network access to TomoCon.
- Firewall or router safeguards to ensure that TomoCon has network access only to approved external hosts.
- Any network communication with external hosts outside the local secured network uses appropriately secure network channels (e.g. Virtual Private Network (VPN)).

2 Getting started

2.1 Installing and uninstalling TomoCon

2.1.1 System installation requirements

TomoCon requires the following hardware and software as minimal configuration (recommendations are in parenthesis):

2.1.1.1 Hardware requirements

- **CPU** Pentium 4, 2.5 GHz
- **Memory** 2 GB
- **CD-ROM**
- **Hard Disk** 250 MB free disk space for software installation (at least 50 GB for patient image data)
- **Display** 19" color monitor (two monitors with dual-head graphics adapter, 3D-accelerated graphics adapter)

The mammography mode in TomoCon assumes the resolution of the monitors connected to the workstation is at least 3Mpx (recommended are two portrait-oriented mammography monitors, both with the same resolution, min. 3Mpx).

2.1.1.2 Additional hardware recommendation

- **USB port** for attaching the hardware protection dongle
- **Network port** for data acquisition, connection to PACS systems
- **Backup system** based on magnetic tape, CD-R or HD media

2.1.1.3 Software requirements

TomoCon Workstation:

- **Operating System** Microsoft Windows XP SP3, Windows Vista SP2, Windows 7, Windows 8
- **Microsoft Internet Explorer** version 6.0 or higher

TomoCon Viewer, TomoCon Lite:

- **Operating System** Microsoft Windows XP SP3, Windows Vista SP2, Windows 7, Windows 8
- **Microsoft Internet Explorer** version 6.0 or higher

2.1.2 Installing TomoCon

To install TomoCon, proceed as follows:

1. Insert the installation CD into the drive. A window should soon be displayed automatically, allowing you to select TomoCon for installation. If the window is displayed, proceed to step 3. If it is not displayed, go to step 2.
2. Run `SETUP.EXE` from the installation CD by double-clicking the '`My Computer`' icon on your desktop, then double-clicking the icon of your CD-ROM drive ('`D`' for example), and finally double-clicking the '`Setup`' or '`Setup.exe`' executable file.
3. Follow the instructions provided by the TomoCon setup program.

2.1.3 Uninstalling TomoCon

To uninstall TomoCon in the Microsoft Windows XP operating system proceed as follows:

1. Click the Microsoft Windows **Start** button.
2. Go to **Settings**, **Control Panel** and launch **Add/Remove Programs**. From the list of currently installed programs, select **TomoCon** and click the **Change/Remove**.

To uninstall TomoCon in the Microsoft Windows Vista or 7 operating systems proceed as follows:

1. Click Microsoft Windows **Start** button.
2. Go to **Control Panel** and launch **Uninstall a program**. From the list of currently installed programs, select **TomoCon** and click the **Uninstall**.

To uninstall TomoCon in the Microsoft Windows 8 operating systems proceed as follows:

1. Go to **Start** screen by pressing Windows key.
2. Right click on **TomoCon** icon and click on the **Uninstall** item in the **Options** part.
3. Follow uninstalling steps and remove application.

2.1.4 License administration

License administration is an application for managing the licenses for the TomoCon Workstation. It can be launched from the TomoCon Start Menu or from the **Licenses** dialog in the TomoCon Workstation (see Figure 1).

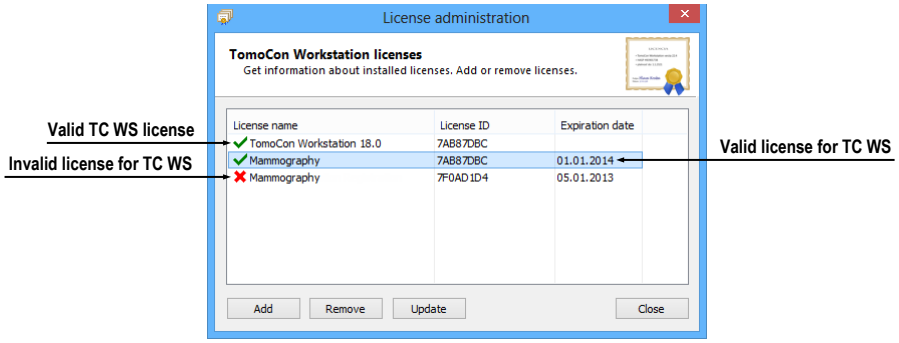


Figure 1 – License administration

The TomoCon Workstation provides the following licenses which can be installed or removed using the License administration application:

- TomoCon Workstation version
- MIR – Mutual Information Registration license (see 16.1.6 MIR)
- License for saving RT structures in the DICOM format (RTSTRUCT Export)

  After installing a license for RT structures, all studies containing RT structures must be resaved (opened in TomoCon and saved again).

- Advanced Contouring license for contouring using advanced Bolus and Margin tools (see 10.8.7 ROI margin drawing tool and 10.8.8 Bolus ROI defining drawing tool). This license includes the license for saving RT structures in the DICOM format.

To install licenses in the TomoCon Workstation, proceed as follows:

1. Start License administration application. In order to start this application launch the **License administration** program from the start menu (MS Windows XP, Vista, 7) or from the Start screen (MS Windows 8) or click the **License administration…** button in the **License** dialog in the running TomoCon application.
2. To install licenses from a file, click the **Add** button and select the license file in the displayed **Open file** dialog. Each license file is generated for a hardware key that has to be inserted into your USB port when the license file is installed. New licenses are installed only if the license file is valid for the connected USB hardware key.

3. A license file can include one or more license types. All licenses are installed automatically. Previously installed licenses which are not included in this file are removed for this hardware key.
4. To update TomoCon licenses for all currently connected hardware keys, click the **Update** button in the License administration tool. The licenses are then downloaded automatically via the Internet (as long as you are connected) and then installed.
5. To remove installed license from the TomoCon Workstation, select the required license from the list and click the **Remove** button in the License administration tool.
6. All changes of the licenses will be applied automatically in the TomoCon Workstation after restart.

2.1.5 TomoCon Workstation licenses

To view all licenses installed in the TomoCon Workstation, proceed as follows:

1. Select the **Licenses...** item in the **Help** menu.
2. The **Licenses** dialog (see Figure 2) listing the installed licenses will be displayed.

To install new licenses, click the **License administration…** button and follow the steps outlined in the previous section.

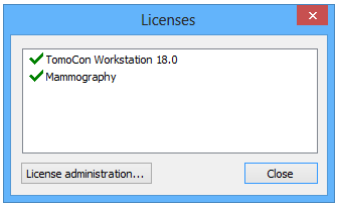


Figure 2 – Licenses dialog

2.1.6 Installation verification

To verify the installation process of the TomoCon Viewer or TomoCon Workstation, proceed as follows:

1. Install the application.
2. Check whether the icon of the application has been placed on the Microsoft Windows desktop.
3. Check whether the application shortcut is included in the Microsoft Windows installed applications.

4. Launch the application and carry out the following steps in TomoCon:
   - If the application is being installed for the first time (it is not an upgrade), the **Select TomoCon Language** dialog will be displayed. Select the language and click the **OK** button.
   - If the DICOM receiver is not properly configured, the warning message "Could not start DICOM receiver" will be displayed. The reason could be that the TomoCon DICOM receive port is being used by another application. Click the **OK** button.
   - Check whether the main application window is displayed.
   - Select the **About...** item in the **Help** menu. The TomoCon **About box** will be displayed.
   - Check whether the version number in the displayed **About box** is 18.

2.2 Starting TomoCon

To start TomoCon, locate application icon and click on it.

- MS Windows 8: Open Start screen, type *'tomocon'* and find the application tile on the left.
- MS Windows 7 and Vista: Open Start menu, type *'tomocon'* and find application item in 'Programs' group in search results.
- MS Windows XP: Open Start menu, select *'All Programs'*, '*TomoCon Workstation'* folder and finally '*TomoCon Workstation*' application item.

The optional start-up parameters are as follows:

- /**t** - to start TomoCon in the touch screen mode (see 19 Touch screen mode).
- **/m** or **–m** to start the TomoCon mammography mode (see 24 Mammography mode).

In order to start the TomoCon Workstation, it is necessary to plug the valid hardware key HASP into your USB drive (the TomoCon Workstation cannot be started without the valid HASP key). If a problem occurs with HASP in TomoCon, you will be informed through one of the following error messages:

- **TomoCon workstation license is not valid** – The HASP is not compatible with the version of TomoCon and it is necessary to update it using License administration application (see 2.1.4 License administration).

- **HASP not found** – Make sure that you actually inserted the HASP hardware key into the USB drive. If you have, it is necessary to contact TatraMed customer support (see 26 Contact); the problem could be one of the following:
    - The HASP is probably mechanically damaged.
    - The battery in your time HASP is low and the key must be changed.

2.3 Logging into TomoCon

The TomoCon application provides you with following access authorization possibilities:

- Non-authorized access; TomoCon can be launched on any logged-on computer.
- Authorized access with user name and password; the user needs to enter his/her user name and password into the **Log On to TomoCon** dialog (see Figure 3). Next, click the **OK** button in order to start the application.

Figure 3 – Log On to TomoCon dialog

3 Using TomoCon

The TomoCon application consists of the following main parts (see Figure 4):

- Working area (see 3.1 Working area)
- Tools panel (see 3.2 Tools panel)
- Thumbnail palette (see 3.3 Thumbnails palette)
- Main menu (see 3.4 Main menu)
- Toolbars (see 3.5 Main toolbar)
- Status bar (see 3.6 Status bar)

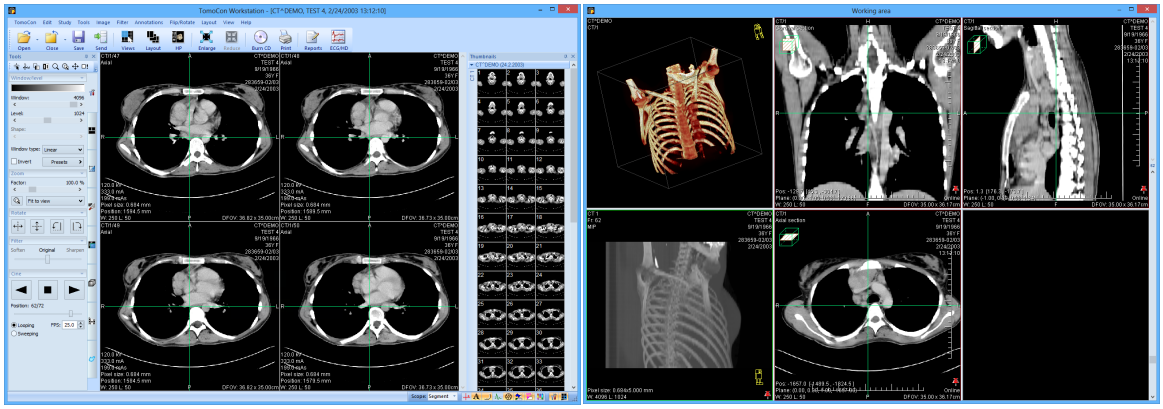


Figure 4 – TomoCon application

3.1 Working area

The working area is the space designed for the visualization and diagnostics of patient data (the displaying of examination, MPR, 3D and other images). The main working area is bound to the main application window. It is possible, in the case of need, to create a new independent working area with variable dimensions and place it anywhere on another screen. You can create a new working area by clicking the **Create new working area** item in the **View** menu. A new empty working area is automatically created and placed on the first free monitor.

3.1.1 Working area layout

A newly created working area consists of one segment that covers the entire workspace and can be divided into multiple views (see Figure 5). A segment is a defined part of the working area with adjustable borders that can be divided into other smaller segments. After having created a new working area, you can divide it into a

desired layout by dividing the segments and defining the views of each of them (a segment contains one view by default). You can also change an existing layout at any time by resizing, deleting or adding segments. This allows you to effectively create all kinds of layouts necessary for viewing and diagnosis.

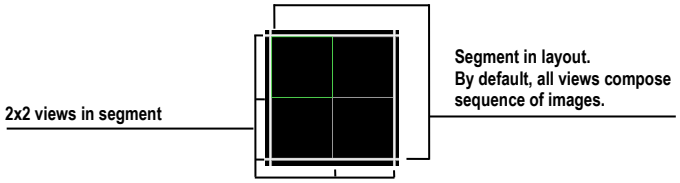


Figure 5 – Four views in a segment

The TomoCon application allows you to quickly and easily define a desired layout using the tools docked in the **Define layout** tool in the tools panel. The **Define layout** tool (see Figure 6) is initially docked in the tools panel (on the third tab). You can access it at any time by clicking the tab with the icon. All of these functions are also accessible in the **Layout** system menu.

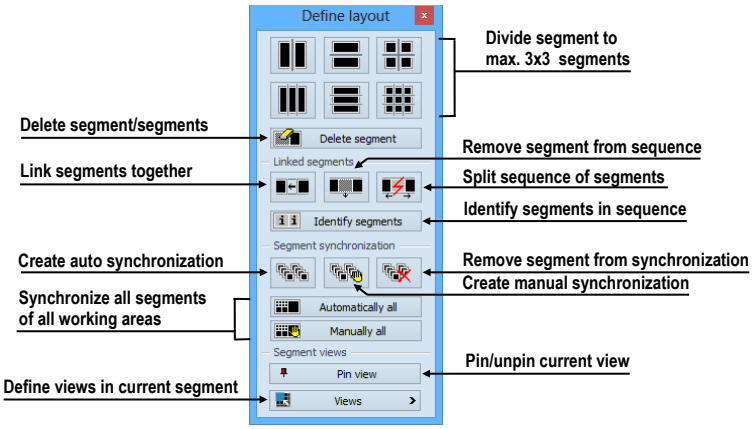


Figure 6 – Define layout tool

To divide an existing segment into other smaller segments (see Figure 7a), proceed as follows:

1. Select the desired type of division in the **Define layout** tool.
2. Click the segment you wish to divide.

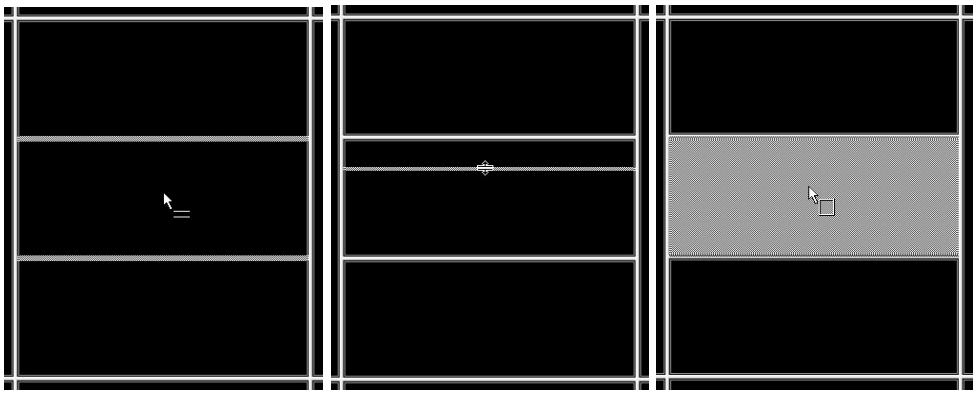
Segments are divided by thick movable separation lines. The size of each segment can be modified simply by dragging and moving them with the cursor.

To adjust adjacent segments (see Figure 7b), proceed as follows:

1. Move the cursor to the boundary (separation) line you wish to move.
2. Press and hold down the left mouse button, move the line to the required location and release the mouse button.

To remove an existing segment or existing segments (see Figure 7c), proceed as follows:

1. Press the **Delete segments** button in the **Define layout** tool.
2. Move the cursor to the segment(s) you wish to delete (the segment(s) will be highlighted in white) and click.



(a) **(b)** **(c)**

Figure 7 – Defining segments in the working area, a) dividing a segment, b) moving a segment border, c) deleting a segment

Once you have defined the layout of the segments in the working area, you can change the layouts of their views. Each new segment has one default view, which covers the entire area of the segment. You can change this at any time and define a new layout of views with up to 8x8 views in one segment.

To define a view layout in a segment (see Figure 8), proceed as follows:

1. Click in the required segment.
2. Press the **Views** button in the **Segment views** section of the **Define layout** tool or press the **Views** button in the main toolbar of the TomoCon application.
3. Select the required view layout in the displayed grid.

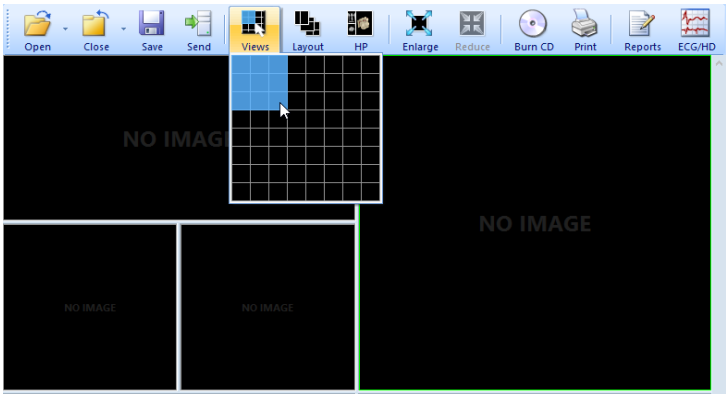


Figure 8 – Defining views for a segment

3.1.2 Organizing Layouts

After creating the working areas and the segment definition for each, you can save the entire layout in the application for the next use. The application allows you to organize your layouts in the following lists:

1. **Recent layouts** – a list of the four most recently used layouts.
2. **Favorite layouts** – a list of favorite layouts (any saved layout can be added to or removed from this list using the Layouts manager).
3. **Other layouts** – a list of the other layouts that are not included in the favorites list. It is possible to move any layout in this list to the **Favorite layouts** list.

3.1.2.1 Saving a Layout

To save a current layout proceed as follows:

1. Press the **Add layout...** item in the **Layout** menu.
2. Enter the name of the new layout in the displayed **Add layout** dialog (see Figure 9).
3. Press the **Add** button.

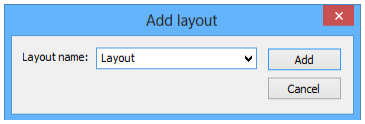


Figure 9 – Add layout dialog

The new layout is automatically added to the appropriate list of layouts (**Other layouts**) under the entered name. If you want to rewrite an existing layout, enter the name of the layout (or select it from the defined layouts list which is displayed after pressing the ▼ button; see Figure 10) and press the **Add** button to confirm.

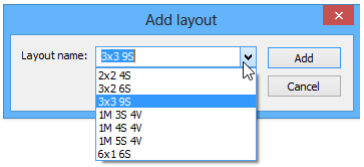


Figure 10 – Overwriting a defined layout

3.1.2.2 Loading a Layout

To load a saved layout proceed as follows:

1. Press the **Layout** item in the main toolbar or the **Favorite**, **Recent** or **Others** button in the **Layouts** tool of the tools panel (see Figure 11).

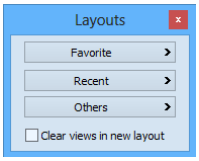


Figure 11 – Layouts tool

2. Click the required layout in the displayed window (see Figure 12). The selected layout is automatically loaded into the application.

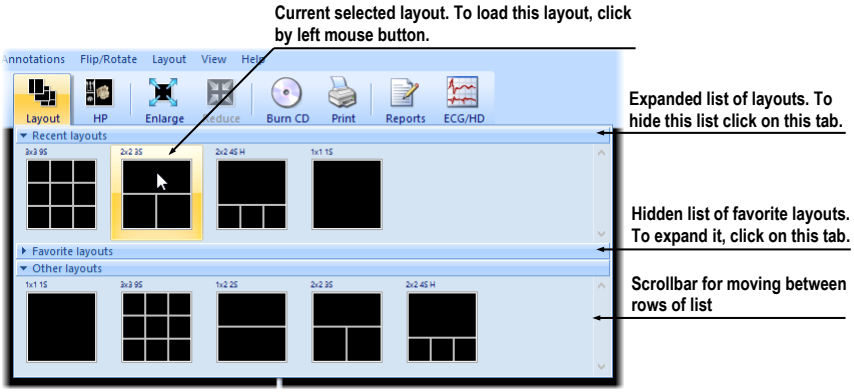


Figure 12 – Layout list

3.1.2.3 Layouts Manager

The layouts manager allows you to change the basic properties of previously saved layouts by means of the **Layouts manager** dialog (see Figure 13). After pressing the **Layouts manager…** item in the **Layout** menu of the dialog, you can delete (the **Delete** button) or rename (the **Rename** button) a selected layout and move it from/to the list of favorite layouts (the **Favorite** check box).

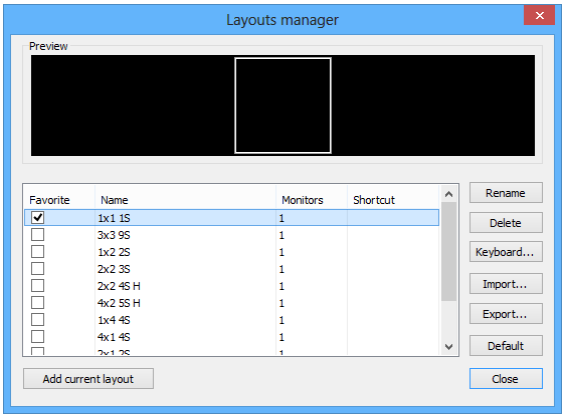


Figure 13 – Layouts manager dialog

3.1.3 Current View

The current view is the most recently selected view of all existing working areas and is labeled by clicking any mouse button. When you select a view and make it the current view, all operations you carry out will apply only to this view.

To change the current view, move the cursor to another view and click any mouse button (see Figure 14). The current view is outlined with a colored frame according to the TomoCon settings (the frame color can be changed; see 4.4 Color options).

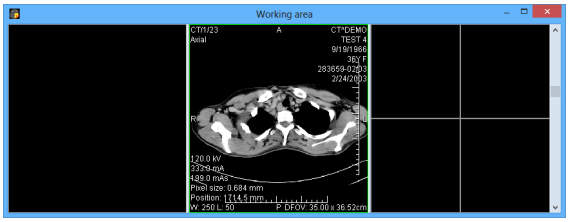


Figure 14 – Working area

3.2 Tools panel

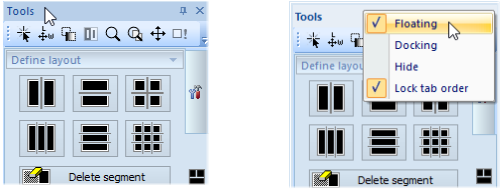
The tools panel contains the main tools for viewing and diagnosing loaded images in the TomoCon application. The panel is highly configurable and you can easily move around its components as well as hide/display them. The panel can be used to maximize the usefulness of your working area.

You can place the panel anywhere on the screen in a floating state or dock it to the left or right side of the main workspace. The panel is docked on the left side by default.

To undock a panel and move it to a floating position using the drag and drop method, drag the panel title bar (see Figure 15a), move the panel to the desired position on the screen and release the mouse button.

To undock a panel and move it to the most recent floating position, right-click the panel title bar and select the **Floating** item in the displayed context menu (see Figure 15b).

To dock the tools panel to the most recent docked position, move the cursor over the panel title bar and right-click. Then select the **Docking** item in the displayed context menu (see Figure 15b).



(a) **(b)**

Figure 15 – Tools panel undocking, by dragging and dropping (a), using the context menu (b)

To dock the tools panel to a new docking position, drag the panel title bar and move the panel. When the tools panel is being moved, the docking navigators are displayed in the application window. Each navigator shows the available docking position for the panel. When the cursor is placed over a docking navigator, a new docking position for the tools panel will be displayed (see Figure 16). To dock the panel at the displayed location, release the mouse button when the cursor is placed over the navigator.

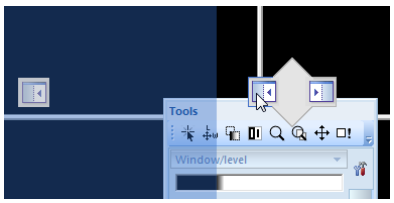
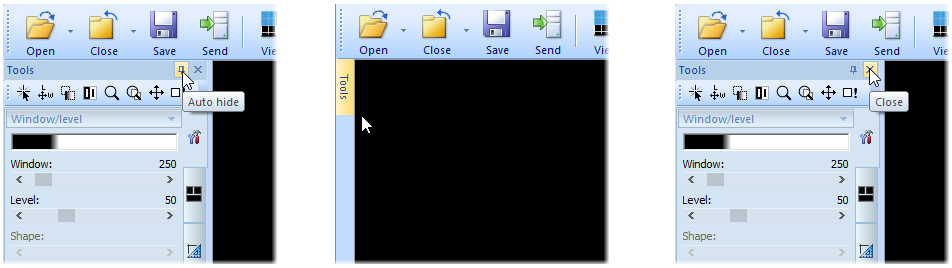


Figure 16 – Docking the tools panel to the left side of the TomoCon application

In addition, to maximize your workspace, you can switch on the auto hide mode of the docked tools panel. The tools panel will then be represented by a thin bar on the respective side of the main TomoCon application window.



(a) **(b)** **(c)**

Figure 17 – Turn on auto hide mode of the Tools panel (a), display hidden panel (b), close the Tools panel (c)

To activate the auto hide mode, click the icon located in the upper right-hand corner of the panel title bar (see Figure 17a). When the cursor is placed over the bar (see Figure 17b), the tools panel is automatically displayed and you can then use any docked tool in the panel. When the cursor is moved outside the displayed tools panel, it is automatically hidden.

To hide tools panel click on icon placed in the right corner of tools panel title bar (see Figure 17c). The tools panel will be whole hidden and it can be displayed by clicking the **Tools panel** item in the **View** main menu.

3.2.1 Navigating through the Tools Panel

The tools panel (see Figure 18) is a simple topmost dialog consisting of three parts. The first part is the quick access toolbar and the second is the title bar. The third and main part is made up of a selected group of tools for viewing images and using them

for diagnosis. The main part is divided into clearly labeled sections – one for easy tool selection and the other for the thumbnail palette. Each section is organized as a separate tab page with docked tools in a specified arrangement.

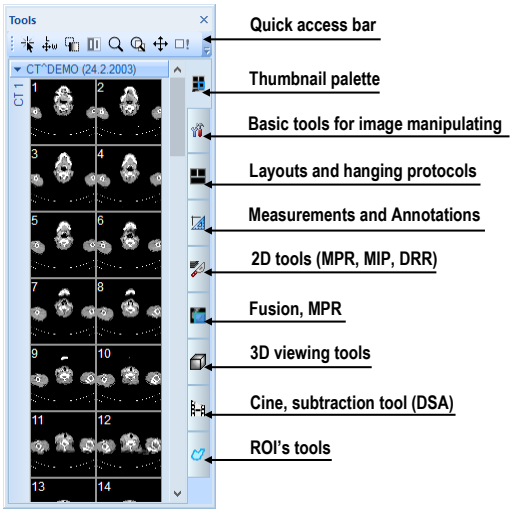
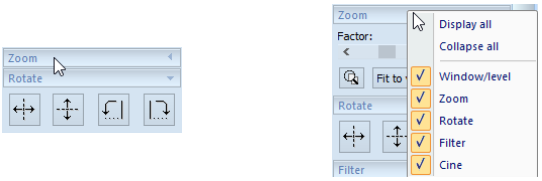


Figure 18 – Tools panel

The tools panel can be customized so that it displays the tools you use most often. The order of the docked tools can be rearranged on each page and each tool can be individually hidden or undocked from the tools panel. The tools are separated by title bars with the names of the tools appearing in the upper left-hand corner.

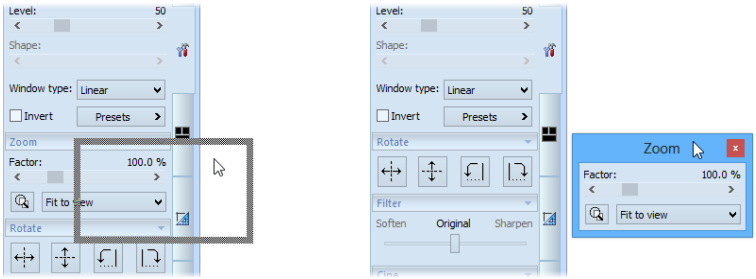
To collapse or display a selected docked tool in the tools panel, click its title bar (see Figure 19a) or use the context menu of the tools panel (see Figure 19b). The context menu is displayed by right-clicking the tab page in the tools panel.



(a) **(b)**

Figure 19 – Collapsed Zoom tool (a), displayed context menu of the tools panel (b)

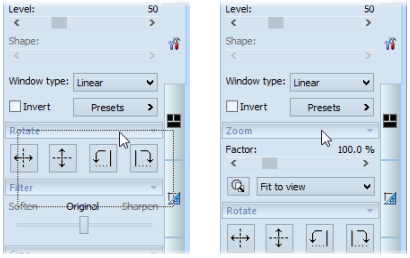
To undock a selected tool from the tools panel, use the drag and drop method. Press and hold down the left mouse button on the tool title bar – the tool will be displayed as an empty frame (see Figure 20a) – drag it to the preferred position and release the mouse button. The undocked tool automatically changes to a floating tool dialog and the contents of the tools panel are automatically rearranged (see Figure 20b).



(a) **(b)**

Figure 20 – Undocking the Zoom tool (a), undocked Zoom tool (b)

To dock a tool to the tools panel, press and hold down the left mouse button on the tool dialog title bar, drag it to the tools panel to the preferred position (see Figure 21a) and release the mouse button. The tool window is automatically docked to the tab page to which it belongs (see Figure 21b).



(a) **(b)**

Figure 21 – Docking the Zoom tool in the tools panel (a), docked Zoom tool (b)

3.2.2 Quick access toolbar

The Quick access toolbar is a customizable toolbar initially docked in the upper part of the tools panel and contains a set of commands that are independent of the tool or the menu that is currently being displayed. You can move the Quick access toolbar from the initially docked location in the tools panel to any floating position or you can dock it to any side of the main TomoCon application window. If you do not want the Quick access toolbar to be displayed in its current location, you can move it at any time to another location by dragging and dropping.

(a) **(b)** **(c)**

Figure 22 – Undocking the toolbar (a), moving the toolbar to a floating position (b), docking toolbar to the upper part of the main TomoCon application window (c)

To undock the Quick access toolbar from the tools panel, press and hold down the left mouse button on the icon in the Quick access toolbar (see Figure 22a), drag it to the preferred location on the screen (see Figure 22b,c) and release the mouse button.

The Quick access toolbar is a fully configurable toolbar that allows you to add or remove buttons representing the commands in the TomoCon application. You can add or remove a command in the Quick access toolbar using the **TomoCon options** dialog that is displayed by pressing the icon in the toolbar and selecting the **Add or remove commands...** item in the displayed context menu (see Figure 23).

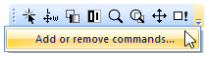


Figure 23 – Displaying the TomoCon options dialog for adding/removing commands

To add or remove a command to/from the **Quick access toolbar** using the **TomoCon options** dialog, see 4.6 Quick access toolbar.

3.3 *Thumbnails palette*

The thumbnails palette is a powerful navigation tool (see Figure 27) that enables you to select images to be displayed in the working area. It always contains the images of all opened studies displayed as thumbnail previews. The thumbnails palette may be resized and docked inside the application border although it can also float and be placed anywhere on the screen. When starting the application, the thumbnails palette is docked in the tools panel by default.

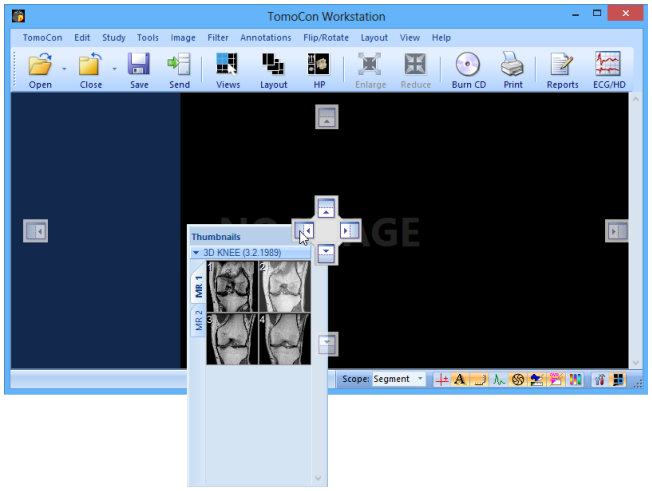


Figure 24 – Docking thumbnails palette to the left side of TomoCon

To dock a thumbnails palette to the left side of the application window, proceed as follows:

1. Drag the title bar of the thumbnails panel, moving the panel over the displayed docking navigators. Each navigator represents a possible docking position.

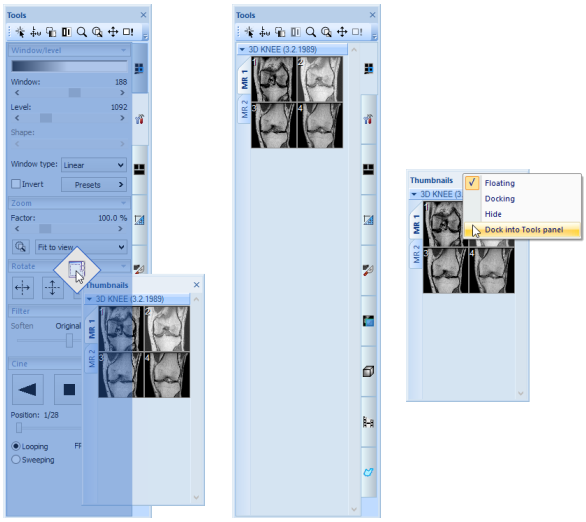
2. Move the panel over the left docking navigator  . A new docking position for the thumbnails palette will be displayed in translucent blue (see Figure 24).
3. Release the mouse button.

To dock a thumbnails palette to the tools panel using the drag and drop method, proceed as follows:

1. Press and hold down the left mouse button on the title bar of the thumbnails panel and drag the panel over the tools panel.
2. A special docking navigator  will be displayed over the tools panel (see Figure 25a).
3. Move the thumbnails palette over the navigator  . A new docking position for the thumbnails palette will be displayed in translucent blue (see Figure 25a).
4. Release the mouse button to dock the thumbnail palette (see Figure 25b).

Alternatively, the thumbnail context menu can be used as follows:

1. Right-click the title bar of the thumbnails panel.
2. Select the **Dock into Tools panel** item in the displayed context menu of the thumbnails bar (see Figure 25c).



(a) **(b)** **(c)**

Figure 25 – Docking the thumbnails palette to the tools panel (a), docked thumbnails palette (b), context menu of the thumbnails bar (c)

To undock a thumbnails palette from the tools panel using the drag and drop method, proceed as follows:

1. Press and hold down the left mouse button on the thumbnails panel tab with the  icon (see Figure 25b) and drag the panel outside the tools panel.

2. The thumbnails palette will be immediately undocked from the tools panel and you can place it in any desired position. To complete the undocking process, release the mouse button.

Alternatively, the context menu of the Tools panel can be used as follows:

1. Right-click the active thumbnail tab in the Tools panel.
2. Select the **Undock thumbnail** item in the displayed context menu (see Figure 26).
3. The thumbnail bar will be undocked from the Tools panel and immediately moved to the last undocked position.

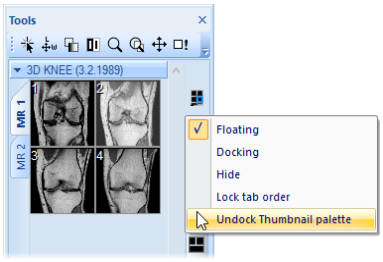


Figure 26 – Undocking the thumbnail bar from the Tools panel using the context menu

3.3.1 Working with thumbnails palette

Each study is displayed in the thumbnails palette (see Figure 27a) as a tab with the patient name and examination date (the date of study creation), as long as the date is available. Under the tabs are reduced images (see Figure 27b) of the series displayed according to the selected series representation type for the study in the thumbnails palette (see 3.3.2 Displaying options). The selection of the representation type is possible using the thumbnails palette context menu (which opens by right-clicking the selected study in the thumbnails palette and selecting the **Show series** item).

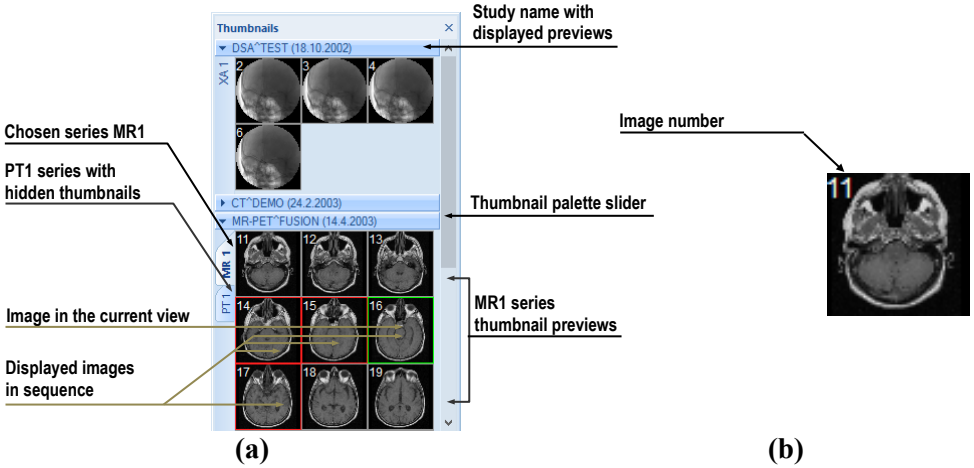


Figure 27 – Thumbnails palette in Tabbed mode (a), image thumbnail (b)

The tabs with opened patient studies can be displayed/hidden by moving the mouse cursor over the patient's name and clicking the selected study. When the triangle arrow in front of the patient name points to the name, the thumbnails are displayed; when the triangle arrow points downward, the thumbnails are hidden although the reduced thumbnail images can be seen (see Figure 27).

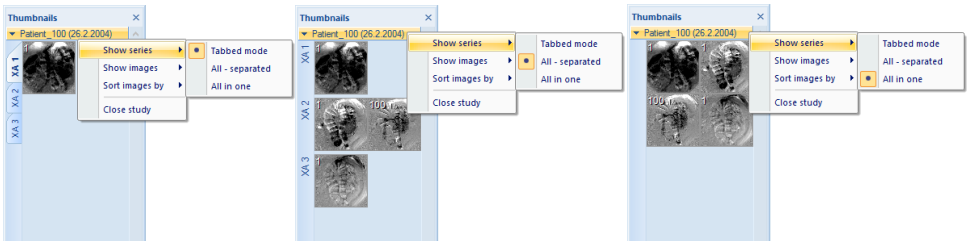
NOTE! When only one patient study is opened in TomoCon, the thumbnails are always visible and it is not possible to hide them.

When opening a new patient study in TomoCon, all existing studies in TomoCon are automatically hidden and the first series of the new patient is displayed. Use the scrollbar on the right side of the thumbnails palette to select from the series (thumbnails) that could not be viewed on the screen.

3.3.2 Displaying options

The thumbnails palette supports three different series representation types for the study:

- **Tabbed mode**; the selection of the series for which thumbnails are to be displayed is made by clicking the button with the series name in the list of series. Only one series from the study can be displayed at one time (see Figure 28a).
- **All - separated**; the thumbnails of all series of the study are displayed at one time, sorted according to series (see Figure 28b).
- **All - in one**; the reduced thumbnails of all series of the study are displayed at one time, one after another without division into series (see Figure 28c).



(a) **(b)** **(c)**

Figure 28 – Displaying series in the Tabbed mode (a), All – separated (b), All in one (c)

Similar to the selection of the series representation type in the thumbnails palette, it is also possible to select the image representation type in the series, which allows the display of only certain image thumbnails of the series. The selection of the image representation type is possible using the thumbnails palette context menu and selecting the **Show images** item (see Figure 29).

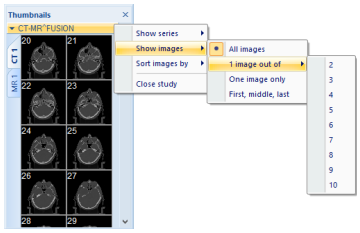


Figure 29 – Context menu for selection of the image representation type

The thumbnails palette supports the following image representation types for the series:

- **Show all images** - all images of each series of the selected study are displayed.
- **1 image out of** - the selected number specifies the image interval of each series of the selected study to be displayed.
- **One image only** - only the first image of each series of the selected study is displayed (see Figure 30).
- **First, middle and last** – only the first, middle and last image of each series of the selected study is displayed.

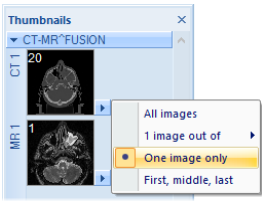
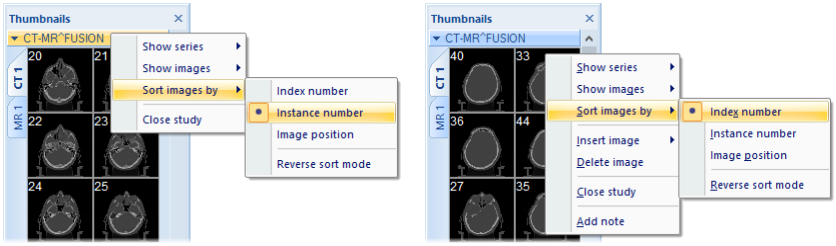


Figure 30 – One image only display (all separated series mode)

Additionally, image thumbnails from the selected study can be sorted in the Thumbnails palette by selecting the **Sort images by** item in the context menu (see Figure 31):

- **Index number** - as opened in TomoCon
- **Instance number** - the DICOM instance number value (see Figure 31a)
- **Image position** - the image sorted by position (see Figure 31b)
- **Reverse sort mode**

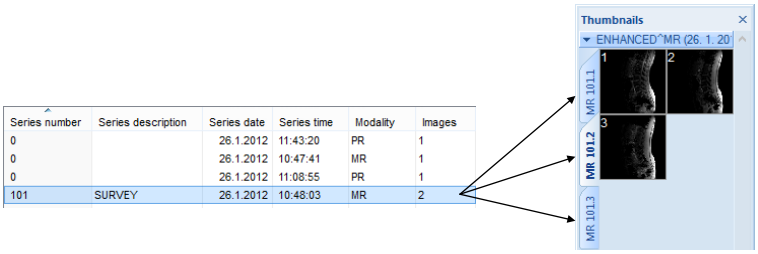


(a) **(b)**

Figure 31 – Sorted images by Instance number (a), by Index number (b)

3.3.3 Multidimensional series in thumbnail palette

A multidimensional series is an enhanced series containing multiple items with separate coded routes and timing stored in one object. Each image in such a series is identified by multiple parameters as in standard series (dimension, stack position number, temporary position, etc.). When a multidimensional series is opened in TomoCon, it is automatically divided into separated virtual series according to the enhanced attributes in the DICOM properties in the images. Each virtual series is displayed in the thumbnail palette as a separate tab with the name consisting of the main series number and the virtual series number (see Figure 32).

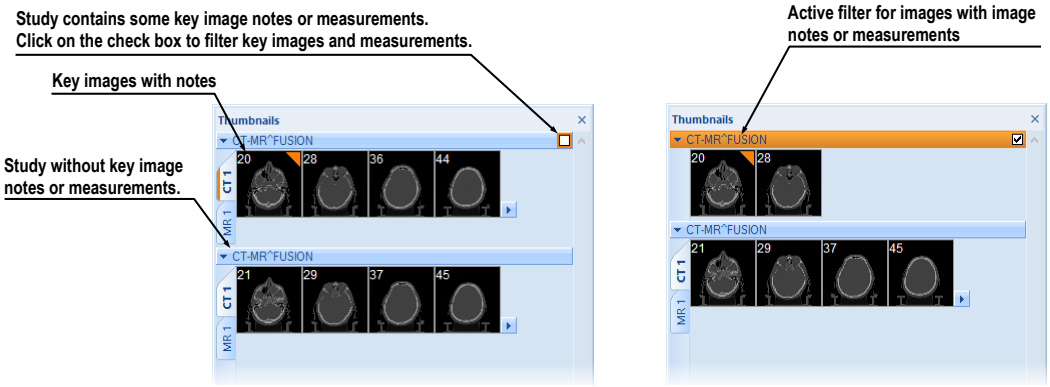


(a) **(b)**

Figure 32 – Multidimensional series MR in the Study search dialog (a), virtual series in the thumbnail palette (b)

3.3.4 Filtering images with measurements and key notes

The TomoCon thumbnails palette offers a special image filter for quick identification of defined measurements or key notes in the images. It allows you to display only images or MPRs containing one or more measurement(s) or key note(s). When a study contains a measurement (in an MPR or image) or a key note (only in an image), the study header displayed in the thumbnail palette contains the orange filter check box in the right-hand corner (see Figure 33).



(a) **(b)**

Figure 33 – Measurements and key image notes in the thumbnails palette, (a) the filter for key images is disabled, (b) the filter for key images is activated

To filter images with key notes or measurements, proceed as follows:

1. Click the check box in the right-hand corner of the study header (Figure 33a).
2. Only the images with measurements or key notes are displayed (Figure 33b).

3.4 Main menu

All TomoCon functionality and features are accessible in the main menu. The main menu provides direct access to all functions for viewing and examining images. As with a typical Microsoft Windows application, the items in the main menu are logically grouped into sub-menus. The main menu consists of the following sub-menus:

- **TomoCon** – the main application sub-menu for defining the application settings and printing (image data printing on a Microsoft Windows printer, DICOM printer, logging into and out of the application or closing it); see Figure 34.

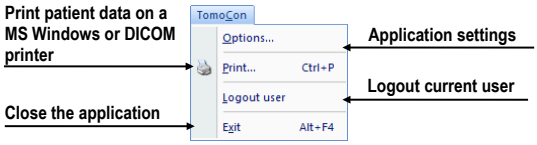


Figure 34 – TomoCon menu

- **Edit** – the clipboard operations with images in the current view and the selected ROI contour, see Figure 35.

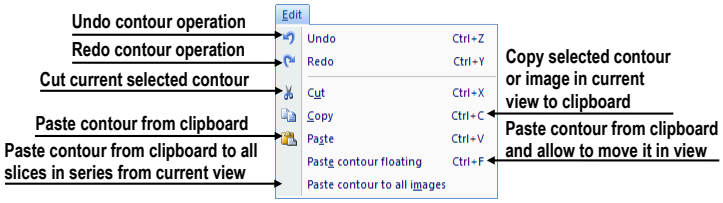


Figure 35 – Edit menu

- **Filter** – the filters for image softening or sharpening in the current view (see Figure 36).

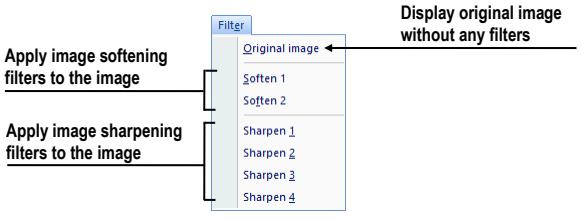


Figure 36 – Filter menu

- **Study** – patient study operations containing the functions for opening/closing/saving studies, anonymizing and burning studies onto a CD, exporting images and creating/viewing structured reports (see Figure 37).

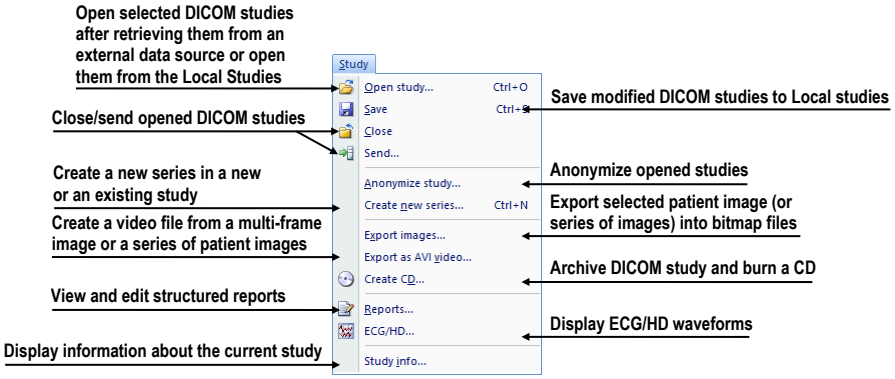


Figure 37 – Study menu

- **Tools** – the tools for image data handling such as windowing/zooming, 3D viewing, reconstructed viewing (MPR, MIP, DRR), subtraction viewing (DSA), creating regions of interests and registrations, defining multi-modal registrations and launching the touch screen mode and mammography mode (see Figure 38).

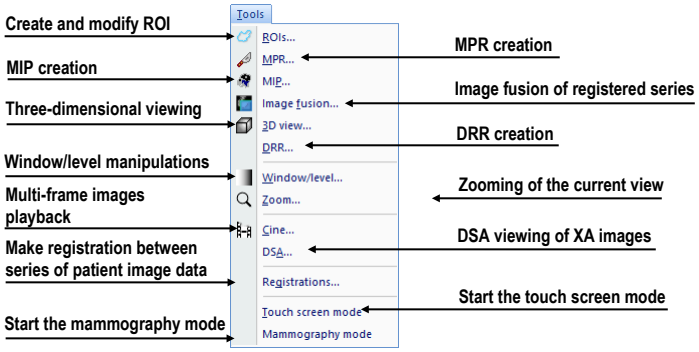


Figure 38 – Tools menu

- **Image** – the viewing and handling of images. It contains a comprehensive group of functions for windowing and zooming images in a view, creating shutters and reading raw DICOM data of images (see Figure 39).

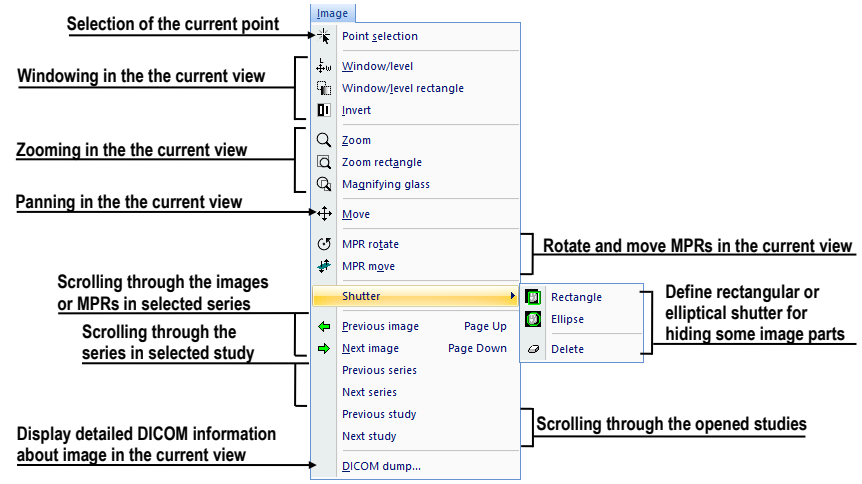


Figure 39 – Image menu

- **Annotations** – the function for annotation management in TomoCon. It allows you to create each type of annotation or measurement in the current view and to remove or edit selected annotation (see Figure 40).

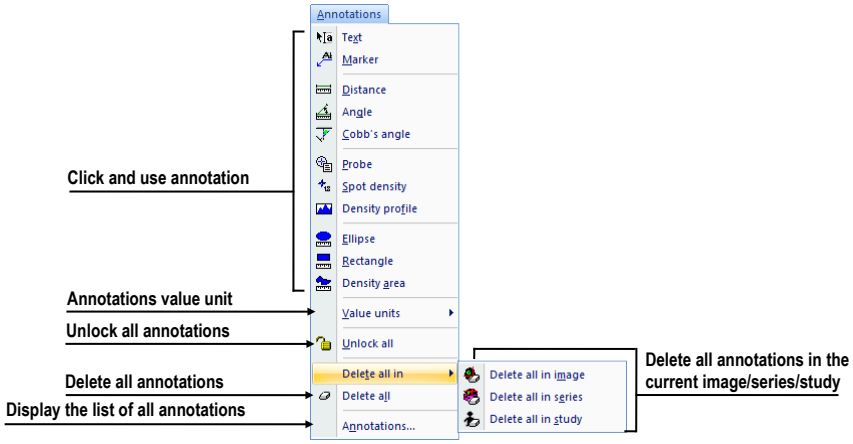


Figure 40 – Annotations menu

- **Flip/Rotate** – flipping and rotating the image in the current view (see Figure 41).

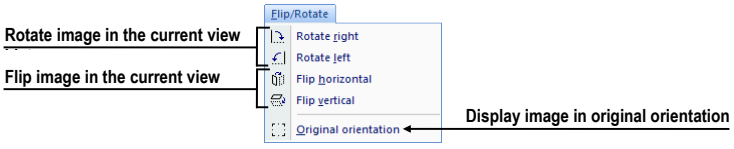


Figure 41 – Flip/ Rotate menu

- **Layout** – the functions for managing layouts and hanging protocols in TomoCon, such as creating a layout or hanging protocol, defining sequences or synchronizations, etc. (see Figure 42).

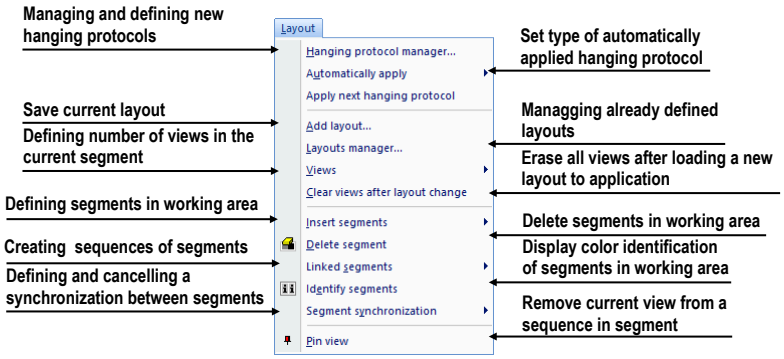


Figure 42 – Layout menu

- **View** – displaying/hiding toolbars, image descriptions, cutlines, changing the current view size, deleting views, creating new working areas or thumbnails palettes and changing the alignment of the images in the views (see Figure 43).

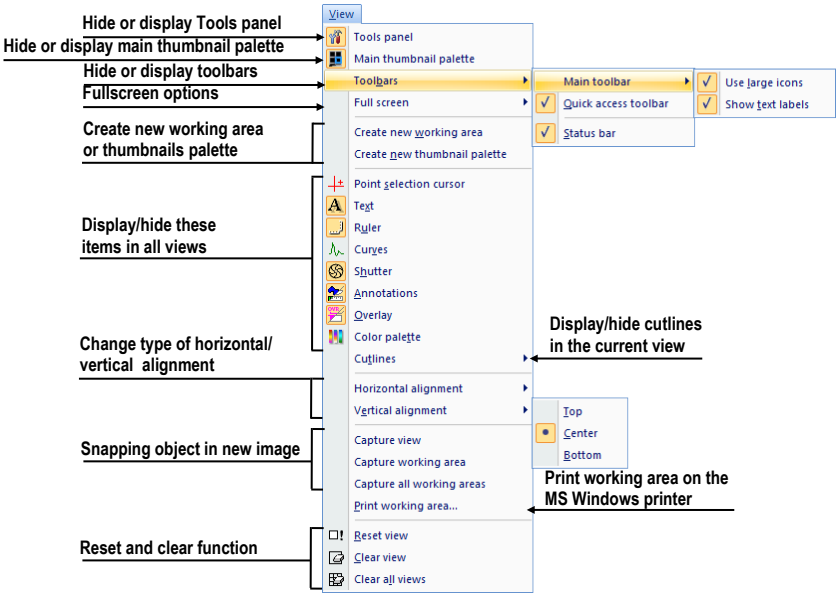


Figure 43 – View menu

- **Help** – displaying the application version, installing licenses and browsing the electronic version of the user's manual (see Figure 44).

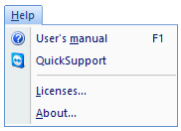


Figure 44 – Help menu

3.5 *Main toolbar*

TomoCon allows you to use the main toolbar (also called the **Standard** toolbar) buttons for frequently carried out tasks. The main functions for viewing images in

TomoCon are grouped in the main toolbar (see Figure 45), which is always visible and can be positioned at any side of the application window.

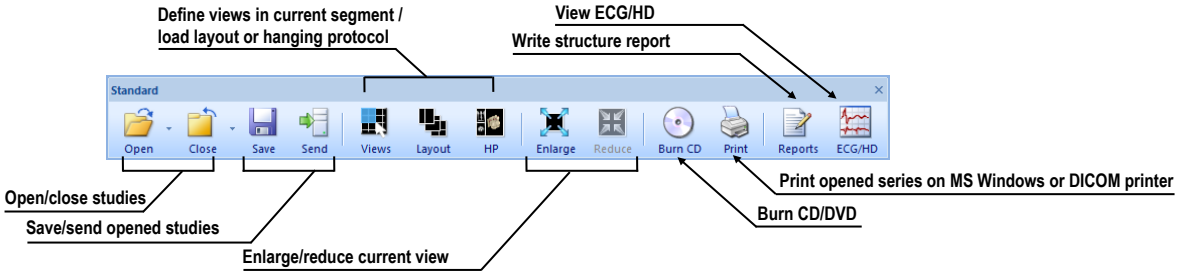


Figure 45 – Standard bar (big version)

To customize the visibility of the main toolbar in TomoCon, use the **View/ Toolbar/ Main toolbar** submenu of the application menu (see Figure 46).

Figure 46 – Sub-menu for customizing the visibility of the main toolbar

3.6 Status bar

The Status bar (see Figure 47) is the horizontal bar at the bottom of the application window that displays the visibility toolbar, the scope panel and the progress of the currently running tasks in TomoCon. It is visible by default although it is possible to hide it.

To hide/display the Status bar, uncheck/check the **Status bar** item in the **View/Toolbars** sub-menu of the application menu.

The main parts of the Status bar are located on the right-hand side:

- **Scope panel** (see 3.6.1 Scope panel) for defining the scope of changes carried out in the current view.
- **Visibility** toolbar, which allows you to display/hide selected objects (texts, curves, overlays, measurements) in all TomoCon views.

If the TomoCon application is receiving or sending studies via queue management, the number of studies remaining to be transferred is displayed on the left-hand side of the Status bar, by means of the or icon.

Moreover, if the TomoCon application is printing selected studies on a DICOM printer, the status of the printing tasks is displayed on the left-hand side of the Status bar, by means of the icon.

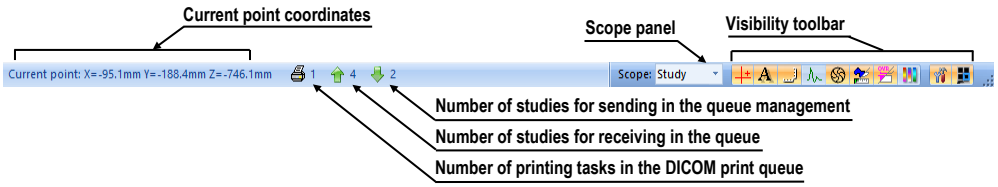


Figure 47 – Status bar

3.6.1 Scope panel

At times it is necessary to make a change to only one image in the current view of the working area and at other times, you may want to change all the images in a series or a study at one time. To do so, you can use the **Scope panel** (see Figure 48), which is always available on the right-hand side of the **Status bar**.

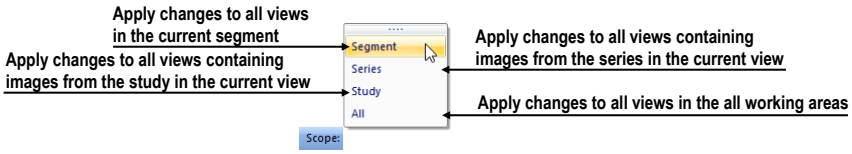


Figure 48 – Scope panel

3.7 Coordinate

To be able to display the image position in the patient coordinate space, a transformation between the images and the actual patient has to be defined.

Once the transformation has been defined, it is possible to calculate the corresponding [x, y, z] position in the patient's body.

The orientations used in TomoCon are **A**nterior, **P**osterior, **L**eft, **R**ight, **H**ead and **F**eet.

The TomoCon coordinate system is as follows:

- *+x* axis points to the **R** (the right side of the patient, direction left-to-right)
- *+y* axis points to the **A** (the front side of the patient, direction back-to-front)
- *+z* axis points to the **H** (the top of the patient, direction feet-to-head)

The coordinates are displayed in millimeters; the angles are displayed in degrees.

3.7.1 Current point

After clicking in an image with the point selection mode activated, the global current point of TomoCon is automatically calculated and is displayed as a red cross in the current view. When the image in the current view has image transformation defined,

the current point is calculated as the 3D point in the current series and is displayed with the red cross in all views related to the current view in TomoCon (see Figure 49).

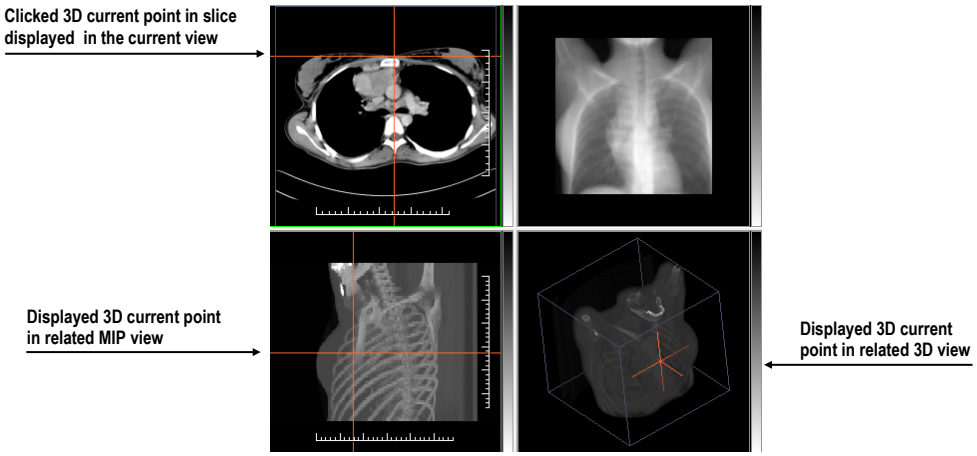


Figure 49 – Displayed 3D current point in TomoCon

3.7.2 Limits of accuracy in measurements

The image pixel size affects the precision of all measurements (the larger the pixel size, the lower the measurement precision).

In 2D measurements, the precision is a function of the pixel size:

$$D = D_m \pm \sqrt{2} \cdot P_s$$

Where D is distance, D_m is the measured distance and P_s is the pixel size.

$$S = S_m \pm 4 \cdot \sqrt{S_m} \cdot P_s$$

Where S is area, S_m is the measured area and P_s is the pixel size.

4 Setting up the application

The TomoCon application provides you with access to many of your settings through the **TomoCon options** dialog. It allows you to customize the application according to your preferences and offers categories of options (TomoCon general settings, shortcuts, modality settings, display features, etc.).

To display the **TomoCon options** dialog, select the **Options…** item in the **TomoCon** submenu of the application menu (see 3.4 Main menu).

The **TomoCon options** dialog (see Figure 50) consists of two main parts. The left side displays the category names while the right side displays the options available in the selected category. The options of the selected category having a similar task or functionality are categorized under a heading on the right side.

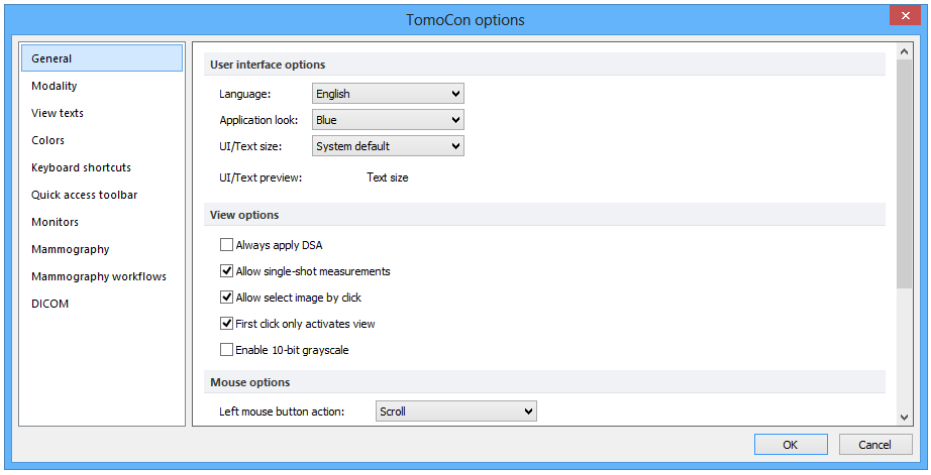


Figure 50 – TomoCon options dialog

The **TomoCon options** dialog (see Figure 50) allows you to set up options for the following categories:

- **General** – for setting up the general application options (see 4.1 General options)
- **Modality** – for defining modality-dependent settings (see 4.2 Modality options)
- **View Texts** – for displaying/hiding text types in views (see 4.3 View texts)
- **Colors** – for setting the color of the objects displayed in the TomoCon views (see 4.4 Color options)
- **Keyboard shortcuts** – for the creation of shortcuts (see 4.5 Keyboard shortcuts)

- **Quick access toolbar** – for configuring buttons in the Quick access bar (see 4.6 Quick access toolbar)
- **Monitors** – for calibrating monitors (see 4.7 Monitors)
- **Mammography** – for configuring the settings of the mammography mode (see 4.8 Mammography)
- **Mammography workflows** – for defining mammography workflows (see 4.9 Mammography workflows)
- **DICOM** – for defining the DICOM settings of TomoCon (see 4.10 DICOM options)

4.1 General options

4.1.1 Application language

TomoCon enables you to choose the application language by selecting one of the options in the **User interface options** section on the **General** tab of the **TomoCon options** dialog (see Figure 51). The language automatically changes following application restart.

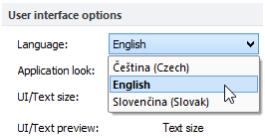


Figure 51 – User interface options section of the General tab

4.1.2 Application look

You can customize the appearance of the TomoCon application according to your own requirements. TomoCon allows you to fully change the interface so that it corresponds to other used Microsoft Windows applications. You can change the user interface in the **User interface options** section on the **General** tab of the **TomoCon options** dialog (see Figure 52).

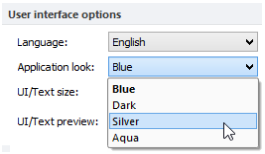


Figure 52 – User interface options section of the General tab

4.1.3 Scaling application fonts and dialogs

TomoCon is designed to work with monitors with all resolutions currently in use. The application can work with resolution starting from 1024x768 up to multi-monitor systems with high resolution. Especially when using monitors with high resolution, you may wish to adjust the size of all fonts in order to make the application more easily readable. Alternatively, you could simply choose to create more space for viewing on a small monitor. To change the size of the fonts used in all windows (dialog boxes, menus, etc.) in TomoCon, change the scale degree of the TomoCon GUI in the **User interface options** section on the **General** tab of the **TomoCon options** dialog (see Figure 53).

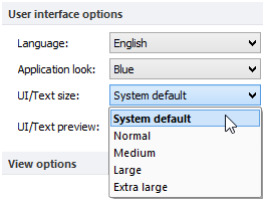


Figure 53 – User interface options section of General tab

In order to change the scale of fonts used in TomoCon, click the combo box (see Figure 53). The list of all possible font sizes will be displayed, ordered according to size starting with the smallest. Click the desired size. A preview of the selected size is then automatically displayed underneath the combo box (**Text preview**). In order to apply the new user interface scale, it is necessary to restart TomoCon.

4.1.4 View options

The following are the possible application settings for views in displayed working areas that can be set up in the **View options** section on the **General** tab of the **TomoCon options** dialog (see Figure 54):

- Turn on/off DSA mode automatic activation (**Always apply DSA**) – as long as the image in the current view contains DICOM structure for DSA.
- **Allow single-shot measurements** – when the process of measurement definition in the current view is complete, the current view mode (with the selected measurement type) is automatically turned off.
- Turn on/off the option of image selection in the current view by clicking the image in the thumbnails palette (**Allow select image by click**).
- **First click only activates a view** – after clicking in an inactive view, the view only becomes active. When clicking in an inactive view when this check box

is not selected, the view becomes active and the selected action is carried out in it immediately.

- Turn on/off 10-bit grayscale (**Enable 10-bit grayscale**) – this allows you to see more detail in views when doing diagnostic work with very dark and very light images.

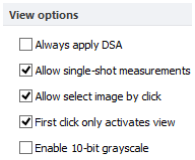


Figure 54 – View options section of the General tab

4.1.5 Mouse options

All TomoCon functions are designed to make maximum possible use of the standard mouse buttons. The application allows you to customize the use of the mouse by mapping predefined actions for selected mouse buttons as well as the scrolling wheel. These actions will then be active anytime you press the mouse button, without the need to activate it in any way. The mapping process is very simple and is carried out in the **Mouse options** section on the **General** tab of the **TomoCon options** dialog (see Figure 55).

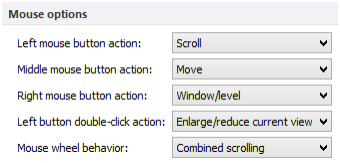


Figure 55 - Mouse options section of the General category

After mapping a predefined action, the following mouse button behavior will be retained:

The **left mouse button** is by default used to:

- Select items (a study, image in the thumbnails palette, current view, etc.).
- Click (a button, menu item, etc.).
- Carry out a primary action (window/level, zoom, etc.). A primary action is actually a selected action in the current view; it is activated by pressing the left mouse button. When you release the left mouse button, the primary action is deactivated.

The **right mouse button** is by default used to:

- Display the context menu of the current view in the working area.

- Display the context menu of any window (tools panel, thumbnails palette, etc.).
- Select a group of images in a thumbnails palette.

To map a predefined action for the left mouse button, click the **Left mouse button action** combo box (see Figure 56). The list of all possible actions is then displayed. Click the required action. To cancel a mapping, select the **--No action--** item in the list.

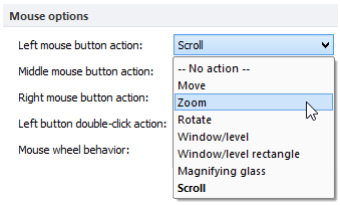


Figure 56 – Selection of left mouse button action

To define the behavior of double-clicking the left mouse button in a current view, select the item from the list of predefined functions (see Figure 57) in the **Left button double-click action** combo box. To cancel mapping for the left mouse button double-click and select the **–No action–** item.

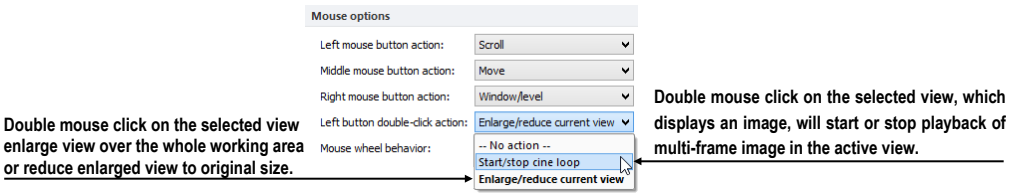


Figure 57 – Mapping action for left mouse double-click

To define the scrolling behavior of the mouse, click the **Mouse wheel behavior** combo box (see Figure 58). The list of all possible scrolling types is then displayed. Click the desired behavior.

- **Scroll by images –** moving the images within the series in the current view backwards and forwards.
- **Scroll by frames** – moving the images of the multi-frame image in the current view backwards and forwards (the function is not available for single images).
- **Combine scrolling** – moving the single and multi-frame images in the current view within the series backwards and forwards.

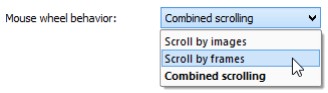


Figure 58 – Mouse wheel behaviour combo box

4.1.6 ROI options

The TomoCon application allows you to set up the number of vertices of the currently defined ROI in the **ROI options** section on the **General** tab of the **TomoCon options** dialog (see Figure 59). These settings will be applied only when drawing ROIs in TomoCon.

To simplify the contour of an ROI to the maximum of "x"points after editing, select the **Always reduce the number of vertices in a contour after editing** option (where "x" is the "**Max. number of vertices in contour**" value that can be entered).

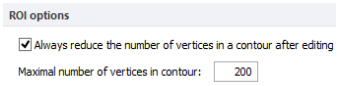


Figure 59 – ROI options part in General category

4.2 Modality options

Use the **Modality** tab of the **TomoCon options** dialog (see Figure 60) to set up the properties for each individual modality type:

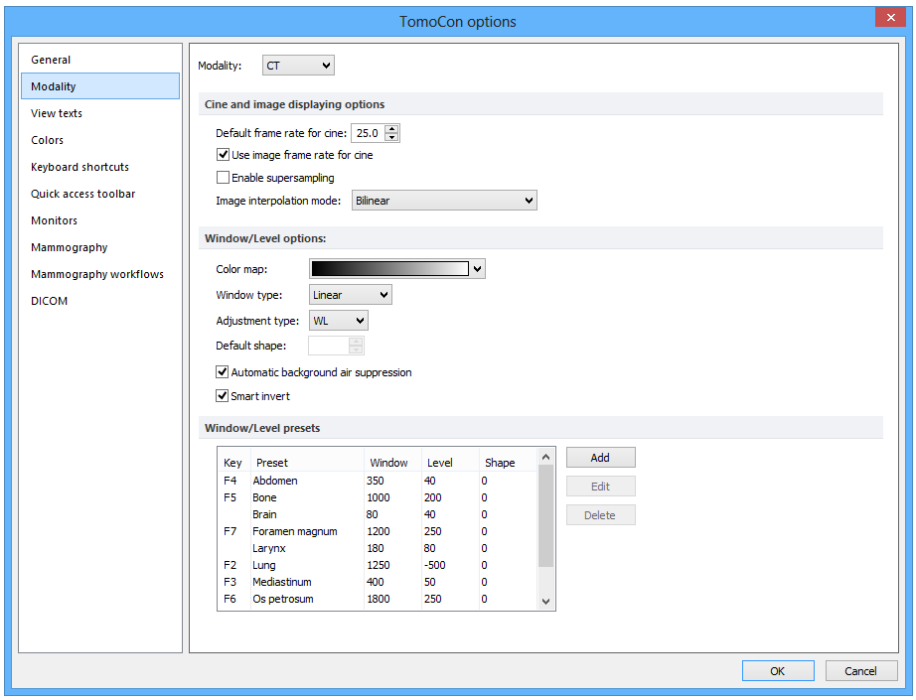


Figure 60 – Modality tab of the TomoCon options dialog

It is possible to set up the following properties for each modality:

- **Cine and image displaying options**:
  - defining the default Cine frame rate **(Default frame rate**, **Use image frame rate for cine**)

  - **Image interpolation mode –** specifying the bitmap interpolation mode for image data visualization: **None**, **Bilinear**, **Bicubic**
  - turning on/off the supersampling function in views (**Enable supersampling**)
- **Window/level options**:
  - selecting the **Color map** palette for the selected modality
  - adjusting the grayscale type (**Adjustment type**)
  - selecting the palette gradation type (**Window type** and **Default shape**)
  - checking the **Automatic background air suppression** check box in order to set the color of the area with air always in black (although the window level changes)
  - checking the **Smart invert** check box in order to set the color of the area with air always in black in the inverted view
- **Window/level presets** containing user-defined window, level and shape combinations for each modality used in image grayscale settings – these combinations can be assigned to the F2 to F9 keyboard function keys as accelerators.

  New presets can be added by clicking the **Add** button. A combination chosen from the **Window/level presets** list can be deleted by clicking the **Delete** button or edited by clicking the **Edit** button. Clicking the **Edit** button opens the **Window/Level preset** dialog (see Figure 61) in which you can make the changes.

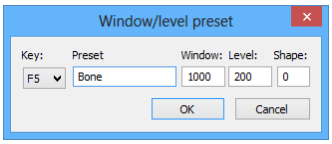


Figure 61 – The Window/level preset dialog

4.3 View texts

The TomoCon application provides you with a pre-configured set of texts, which are fully user-adjustable, displayed in each view type. It is also possible for you to define your own texts to be displayed along with the predefined texts in the views.

To define displayed texts in views, go to the **View texts** tab of the **TomoCon options** dialog (see Figure 62). Here you can select a view type to be adjusted and define the required view texts to be displayed. Four identical rectangular areas represent the four view corners and contain the descriptive texts to be displayed in the corresponding

corner. The fifth rectangular area on the left side contains unused texts. The texts can be moved between the five areas by dragging and dropping. To change the currently used font for all view texts, click the **Font** button.

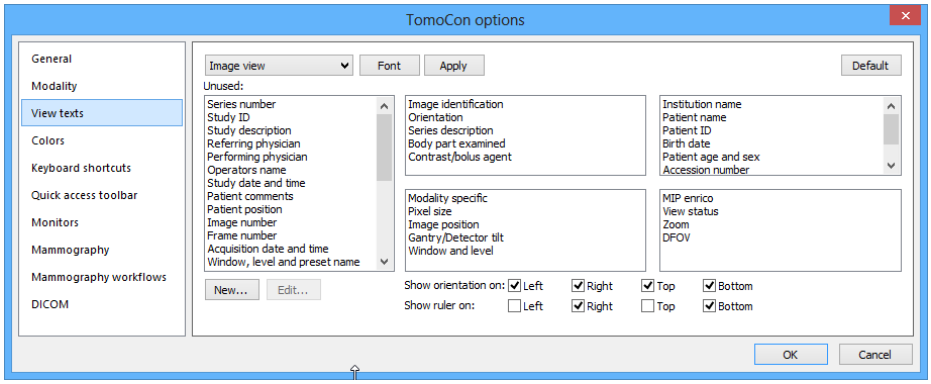


Figure 62 – TomoCon setup dialog, the View texts tab

You can define special types of displayed view text information such as position and ruler. The check boxes at the bottom (see Figure 63) enable you to display the ruler and the position at the left, right, top and bottom of the view (see Figure 64). The ruler and the position are designed to enhance the identification of the displayed image.

Figure 63 – Defining ruler and position

To apply the changes carried out on the **View texts** tab, click the **Apply** button. To restore the default view texts, click the **Default** button.

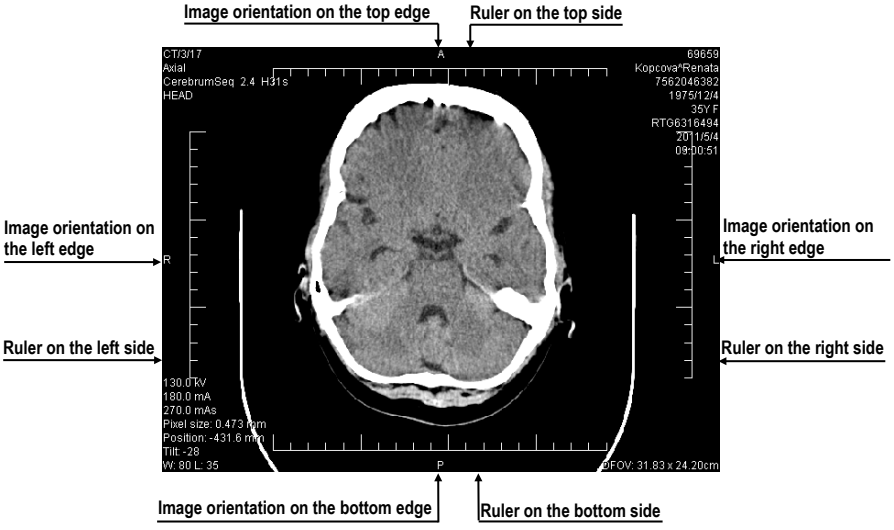


Figure 64 – Displayed view texts in view

To define your own texts to be displayed in a view, click the **New…** button in the dialog. The **Custom view text** dialog (see Figure 65) is then displayed in which you can select a particular DICOM element for display and assign a description to it. To

confirm your new text, click the **OK** button and the text will be automatically added to the predefined texts on the **View texts** tab.

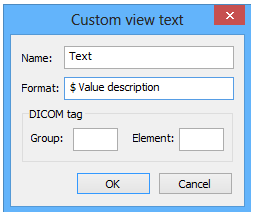


Figure 65 – Custom view text dialog

4.4 Color options

The default colors of certain displayed objects in TomoCon can be changed on the **Colors** tab of the **TomoCon options** dialog (see Figure 66).

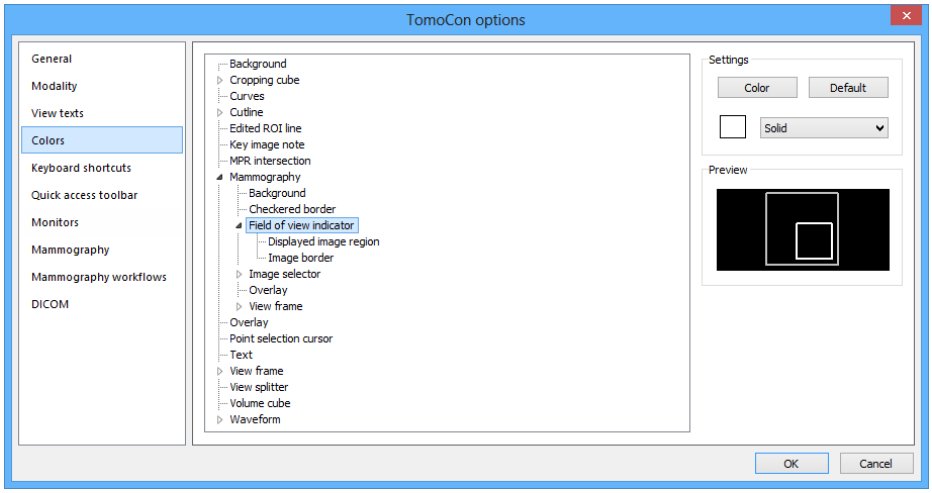


Figure 66 – The Colors tab of the TomoCon options dialog

To change the color of a selected object, click the **Color** button or click the color box in the **Settings** section that corresponds to the object. A dialog then opens containing the default color palette or a user-created palette. A preview of the object with the changed color is displayed in the **Preview** frame.

To restore the default color of the selected object, click the **Default** button.

4.5 Keyboard shortcuts

A keyboard shortcut allows you to carry out a task by pressing a key or a simple key combination. This method is often much faster than using the mouse. A keyboard shortcut can be defined as a single key or as a combination of multiple keys. In order to enhance your work efficiency and user experience, the TomoCon application allows you to define not only one but numerous keyboard shortcuts for a single task.

In addition, you can also specify for each shortcut the scope (the type of view or mode) for which the shortcut will be applicable. All of this combines to make work with the TomoCon application easier, more efficient and more user-friendly.

4.5.1 Scope

It is sometimes very useful for certain keyboard shortcut to be applicable only for a certain type of view or mode while in another view or mode the very same shortcut is used for something different. For example, you may want the **Ctrl+O** shortcut to be used to call up the **Search studies** dialog in the main frame and to display the hanging protocol **Overview** in the mammography frame. For such a reason, TomoCon provides you with the possibility to specify the shortcut scope.

The shortcut scope (see Figure 67) can be set according to the view type (image, MPR, 3D, DRR, fusion) and/or according to the current window (main application window, mammography, touch screen mode, print). If you set the **Global** scope for a shortcut, the shortcut will be accessible in all view types and modes.

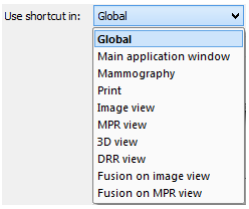


Figure 67 – Shortcut scopes

4.5.2 Managing keyboard shortcuts

The TomoCon application allows you to define your own shortcuts using the keyboard shortcut management on the well-arranged **Keyboard shortcuts** tab of the **TomoCon options** dialog (see Figure 68).

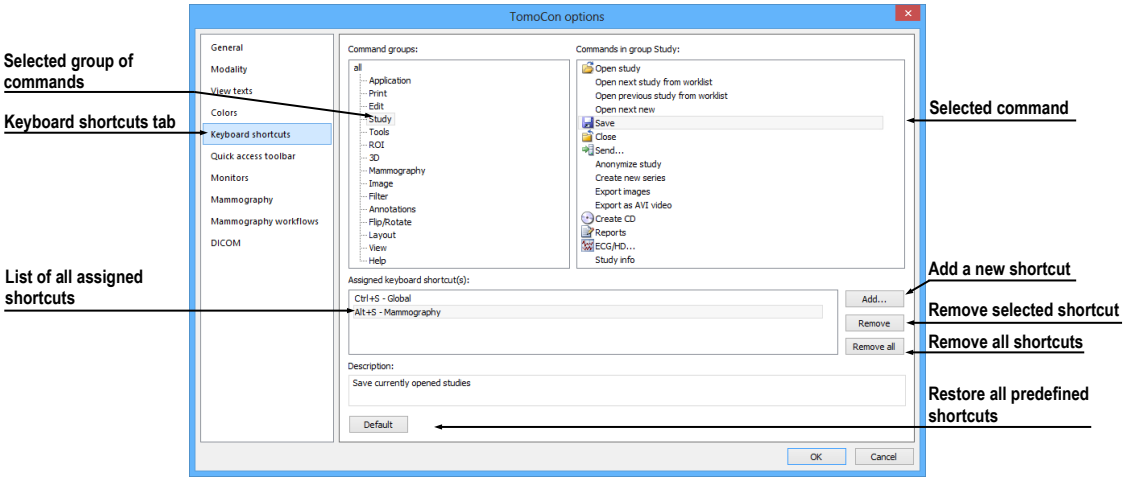


Figure 68 – The Keyboard shortcuts tab of the TomoCon options dialog

To manage shortcuts in the **Keyboard shortcuts** tab, proceed as follows:

1. Browse through the **Command groups** in the list on the left-hand side of the dialog.
2. Select the desired command from the **Commands in group** list on the right that displays the list of commands belonging to the particular group.
3. The **Description** box displays a short description of the selected command and the **Assigned keyboard shortcut(s)** list contains all (if any) shortcuts defined for the selected command.

   Use the **Add**, **Remove** and **Remove all** buttons to manage the keyboard shortcuts for the selected command.

To create a new shortcut on the **Keyboard shortcuts** tab, proceed as follows:

1. Select the desired command as described above.
2. Click the **Add** button. The **Define shortcut keys** dialog is then displayed (see Figure 69).
3. Press the key or key combination for your shortcut. The key or key combination that was pressed appears in the **Pressed key(s)** box. If you made a mistake when typing the keyboard shortcut, press the BACKSPACE key. The shortcut will be cleared and you can type a new one.
4. Select the desired scope for the shortcut in the **Use shortcut in** combo box.
5. If the shortcut you have just typed for the selected scope has already been defined for another command, it appears in the **Currently used** field.
6. Click the **Assign** button to confirm the new shortcut. The shortcut is then automatically added to the **Assigned key(s)** combo box. Using this method, you can assign any number of shortcuts for the selected command for use in multiple scopes.
7. Click the **Apply** button to confirm the changes you have made or click the **Cancel** button to discard them.

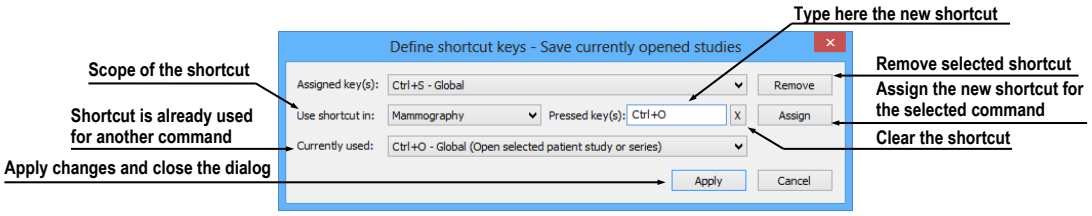


Figure 69 - Define shortcut keys dialog

To delete a previously defined keyboard shortcut, proceed as follows:

1. Select the command as described above.
2. Select the shortcut in the **Assigned keyboard shortcut(s)** list box and click the **Remove** button. The selected shortcut will be deleted.

To restore predefined keyboard shortcuts and delete all custom-defined shortcuts, click the **Default** button.

4.5.3 Predefined keyboard shortcuts

In addition to your custom-defined keyboard shortcuts, the TomoCon application provides you with predefined shortcuts and accelerator keys for many tasks. Naturally, you can change them at anytime as described in the previous section.

A complete list of the predefined shortcuts appears in the table below.

Shortcut description	Shortcut	Scope
Open user's manual	F1	Global
Quit the application	Alt+F4	Global
Display print interface	Ctrl+P	Global
Open selected patient study or series	Ctrl+O	Global
Save currently opened studies	Ctrl+S	Global
Insert new series into selected study	Ctrl+N	Global
Next image	Page Down, Num 3	Global
Previous image	Page Up, Num 9	Global
Select all images from series	Ctrl+A	Print
Deselect all images from series	Ctrl+D	Print
Invert selection	Ctrl+I	Print
Hide title bar	F11	Global
Hide title bar and menu	Ctrl+F11	Global
Hide title bar, menu and toolbars	F12	Global
Copy selected image or contour to clipboard	Ctrl+C	Global
Undo action	Ctrl+Z	Global
Redo action	Ctrl+Y	Global
Cut ROI contour	Ctrl+X	Global
Paste ROI contour	Ctrl+V	Global
Paste and edit ROI contour	Ctrl+F	Global

4.6 Quick access toolbar

The **Quick access toolbar** is a customizable toolbar that allows you to add or remove buttons that represent commands in the TomoCon application.

To add a command to the **Quick access toolbar** in the displayed **TomoCon options** dialog, proceed as follows:

1. Select the command in the list of **Available commands**. The selected item will be highlighted in blue.
2. Click a previously added command in the **Customize Quick access toolbar** list; this defines the position for inserting the new command.
3. Click the **Add >>** button (see Figure 70).
4. The new command will be inserted after the selected command in the **Customize Quick access toolbar** list.

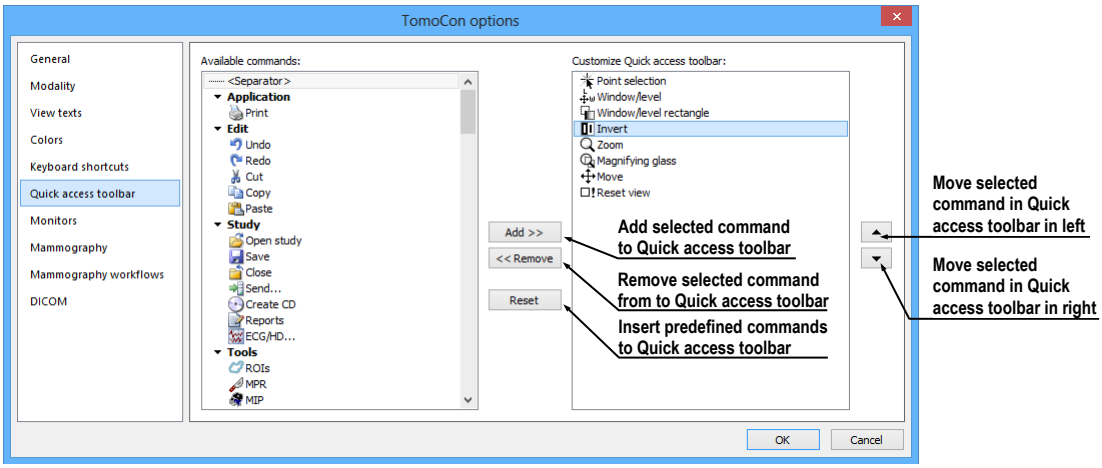


Figure 70 – Configuring the Quick access toolbar

To remove a command from the Quick access toolbar in the displayed **TomoCon options** dialog, select the command in the **Customize Quick access toolbar** list and click the **<< Remove** button. The removed command will be moved to the list of **Available commands**.

To change the order of the commands in the Quick access toolbar, use the ▲ and ▼ buttons. Select the required command in the **Customize Quick access toolbar** list and move it upward with the ▲ button or downward with the ▼ button.

4.7 Monitors

The **Monitors** tab (see Figure 71) allows you to calibrate any monitor connected to your station by defining the physical dimensions of its display area. Calibration is the first and necessary step in setting up the actual size viewing mode in TomoCon (see 7.2 Zooming an image). This mode allows you to view images in their actual size on the calibrated monitor. This means, for example, that 10x10 cm of a displayed image measures 10x10 cm on the calibrated monitor.

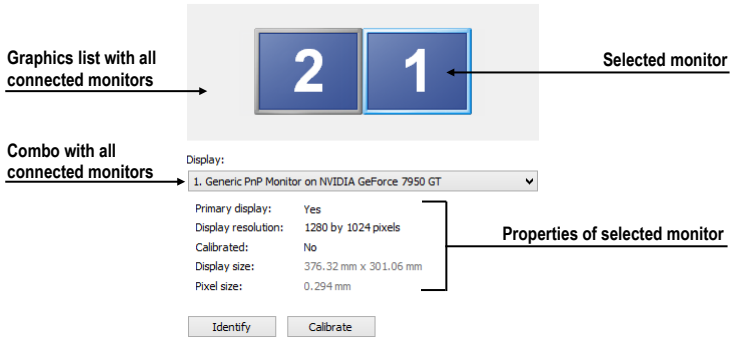


Figure 71 – Monitor settings

To calibrate all connected monitors in TomoCon on the **Monitors** tab, proceed as follows:

1. Select the required monitor in the preview frame and click the **Calibrate** button. For assistance, you can use the identify function to identify the order of the connected monitors by clicking the **Identify** button.
2. The **Full screen calibration** dialog is then displayed on the selected monitor (see Figure 72).
3. Calibrate the ruler displayed in the dialog with the measuring physical tool. Pull the ruler to real size measured by some (real-world) distance measurement tool. To minimize the measurement deviation, choose longer distance for the calibration.

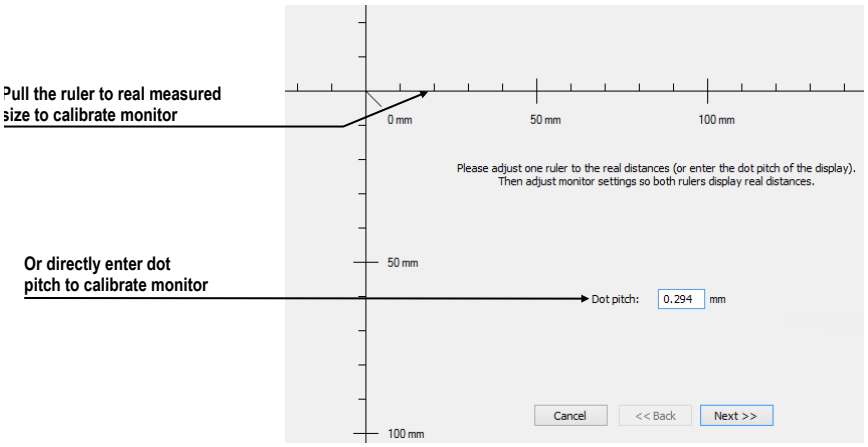


Figure 72 – Monitor calibration

4. Click the **Next** button.
5. Verify the calculated calibration size with your physical distance measurement tool and click the **Finish** button (see Figure 73).

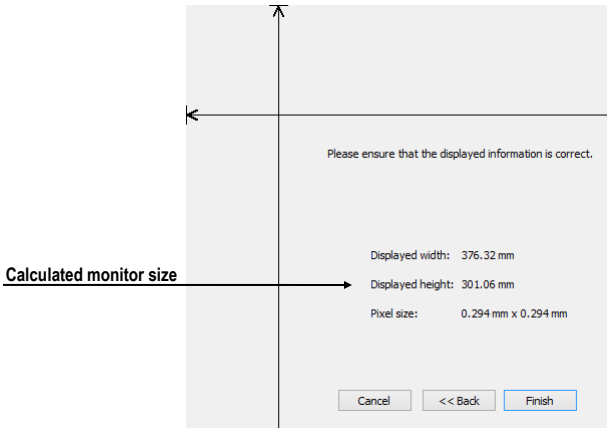


Figure 73 – Monitor calibration verification

4.8 Mammography

The **Mammography** tab of the **TomoCon options** dialog (see Figure 74) allows you to set up the main properties of the user interface, views and image roaming in the mammography mode, as listed below.

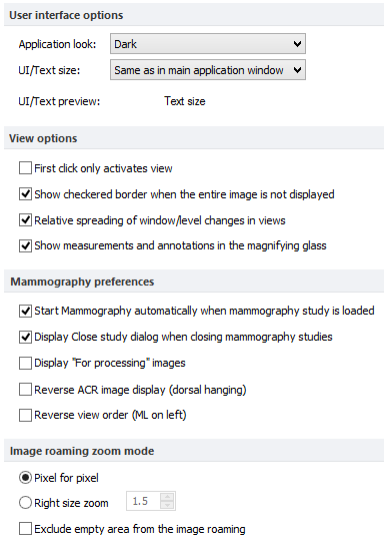


Figure 74 – The Mammography tab of the TomoCon options dialog

User interface options:

- The **Application look** combo box – allows you to fully change the mammography interface so that it corresponds to other used Microsoft Windows applications.
- The **UI/Text size** combo box – to change the font scale used for all windows (dialogs, menus, etc.) in the mammography mode.

View options:

- The **First click only activates view** check box – if checked, after clicking in an inactive mammography view, the view only becomes active; if not checked, the view becomes active and the selected action is carried out in it immediately.
- The **Show checkered border when the entire image is not displayed** check box – if checked and the image in the mammography view is zoomed out of the view's size, the image is partially bordered with a dashed line to indicate which part of the image is displayed out of the view (see Figure 75).
- The **Relative spreading of window/level changes in views** check box – if checked along with the **Scope all** check box, the percentage change of the window/level value in the current view is relatively applied to other views.
- The **Show measurements and annotations in the magnifying glass** check box – if checked, the magnifying glass in mammography is display with additional view objects such as measurements and mammography graphic annotations.

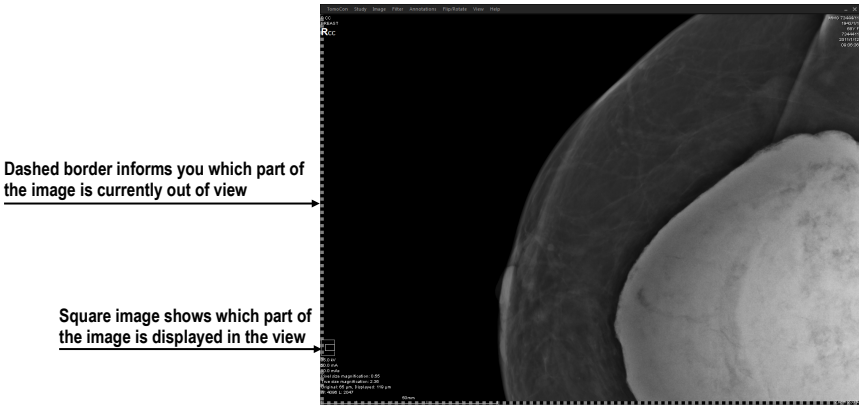


Figure 75 – Active checkered border

Mammography preferences:

- The **Start Mammography automatically when mammography study is loaded** check box – if checked, the mammography study is opened in the mammography mode.
- The **Display Close study dialog when mammography study is being closed** check box – if checked, the **Close study** dialog is displayed to confirm study closing when attempting to close a study.
- The **Display "For processing" images** check box – if checked, the "raw" data (not data adjusted for screening or diagnosing) is displayed in the mammography mode.

- The **Reverse ACR image display (dorsal hanging)** check box – if checked, the image is displayed in dorsal orientation.
- The **Reverse view order (ML on left)** check box – if checked, the ML images are placed at the first positions in the image navigator.

Image roaming zoom mode:

- The **Pixel for pixel** radio button – if selected, each image is displayed so that one pixel in the display corresponds to one image pixel.
- The **Right size zoom** radio button – if selected, the images are displayed so that the largest image of the study fits into the view size and the rest of the images are displayed in the same physical size. The magnifying factor can be modified when changing the parameter in the edit box located to the right of the radio button.
- The **Exclude empty area from the image roaming** check box – if selected and the image contains areas only with air, then these areas are skipped when image roaming is being used.

4.9 Mammography workflows

The **Mammography workflows** tab of the **TomoCon options** dialog enables the configuration of workflows of hanging protocols that are applicable in the mammography mode. For a detailed description of the configuration process, see 24.8 Workflows.

4.10 DICOM options

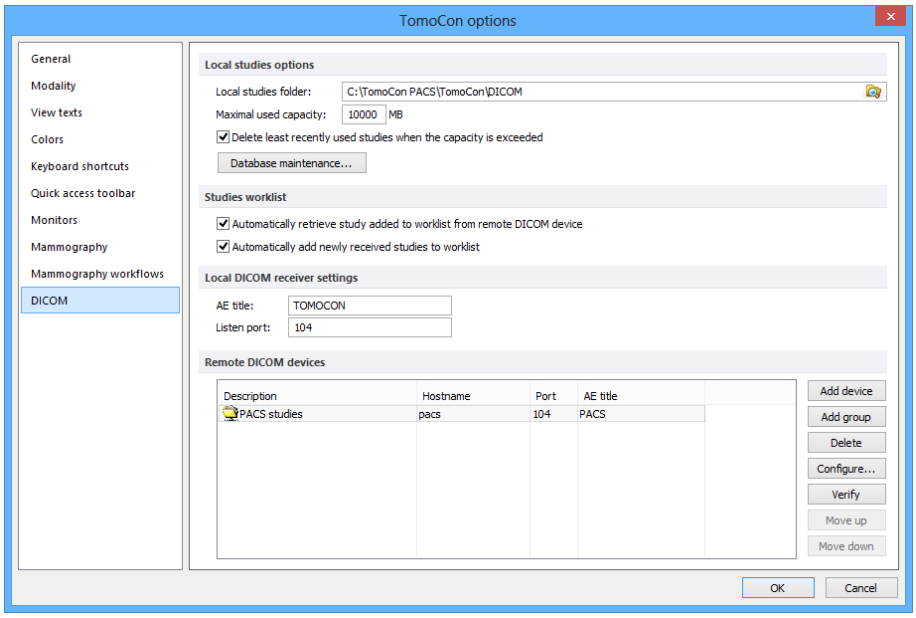


Figure 76 – DICOM page in TomoCon options dialog

The following settings of the DICOM receiver and DICOM local studies in TomoCon are available through the **DICOM** tab of the **TomoCon Options** dialog (see Figure 76):

- **Local studies options** – the local studies folder properties (see 4.10.1 Local studies properties).
- **Database maintenance** – tools for compacting and rebuilding the database of local studies (see 4.10.2 Database maintenance).
- **Studies worklist** – the settings of the patient worklist that contains the studies important for the user (see 4.10.3 Studies worklist).
- **DICOM receiver settings** – the settings for receiving DICOM data in TomoCon (see 4.10.4 DICOM receiver settings).
- **Remote DICOM devices** – the external devices settings for DICOM data exchange (see 4.10.5 Remote DICOM devices).

4.10.1 Local studies properties

It is possible to define a folder and its options for local studies in TomoCon in the **Local studies options** section of the **DICOM** tab (see Figure 77).

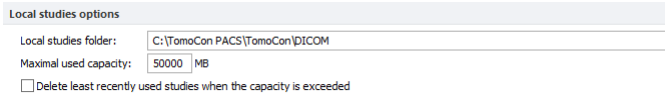


Figure 77 – Local studies options section of the DICOM tab

To define a local studies folder, click the icon. The **Browse for folder** dialog then opens in which you can define a new local studies folder. This option is inaccessible when a study is open in TomoCon.

If the **Delete least recently used studies when the capacity is exceeded** option is checked, the local saved data size in the local studies folder cannot exceed the entered **Maximal used capacity**. The least recently used studies in the local studies folder that exceeds this size are automatically deleted.

4.10.2 Database maintenance

The TomoCon local studies database is uniquely designed for maximal performance and stability work with all stored studies on your local hard disk. At times however, a significant problem can occur in this database when working with it. For example, the local studies folder can increase in size beyond the hardware limit causing certain files to become corrupted or deleted or causing the TomoCon application to shut down improperly. In such cases, the studies become no longer readable. To solve this problem, TomoCon provides you with compact and repair functions for the local studies database (called database maintenance). To display the **Database maintenance** dialog (see Figure 78) that contains these functions, click the **Database maintenance** button in the **Local studies options** section.

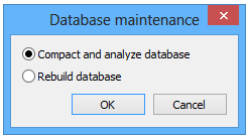


Figure 78 – Database maintenance

To avoid the generation of excess amounts of wasted space in local studies in TomoCon, select the **Compact and analyze database** option and then click the **OK** button in the **Database maintenance** dialog. The progress dialog will be displayed and the database will be optimized.

To repair a damaged database, select the **Rebuild database** option and click the **OK** button in the **Database maintenance** dialog. The progress dialog will then be displayed and the database will be recreated.

4.10.3 Studies worklist

You can use the worklist of the selected studies from the local studies or any remote DICOM device to be examined in TomoCon. This list is accessible in the **Open studies** dialog.

You can manage the worklist manually or you can check the **Automatically add newly received studies to worklist** check box on the **DICOM** tab of the **TomoCon options** dialog (see 5.8 Patients worklist), see Figure 79. If this option is checked, then all retrieved studies in TomoCon are automatically added to the worklist.

If you want to improve the performance of working with the studies in the worklist, TomoCon allows you to activate the automatic download of each study added to the worklist which has not yet been added to the local studies. To activate this function, check the **Automatically retrieve study added to worklist from remote DICOM device** check box.

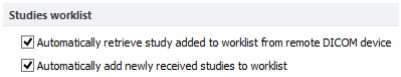


Figure 79 – Studies worklist section of the DICOM options tab

4.10.4 DICOM receiver settings

TomoCon contains a local DICOM receiver that automatically saves received patient data to the Local studies. It is possible to set the following properties in the TomoCon options dialog (see Figure 80):

- **AE Title** – the TomoCon application title to be used for DICOM connection
- **Listen port** – a port for receiving DICOM connection and DICOM data

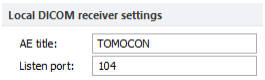


Figure 80 - Local DICOM receiver settings section of the DICOM tab

4.10.5 Remote DICOM devices

Each remote DICOM device configured in TomoCon (PACS, modality, etc.) is represented by a separate tab in the **Search studies** dialog. On each tab, you can search and download the DICOM studies directly from the relevant DICOM device. In addition, you can group multiple DICOM devices into one DICOM group, which is also represented by one tab in the **Search studies** dialog.

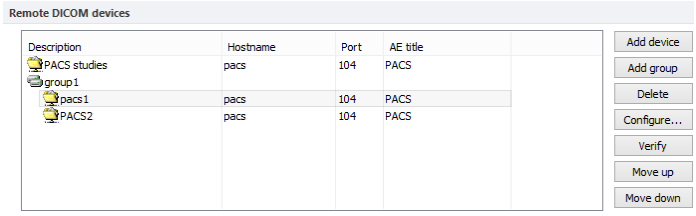


Figure 81 – Remote DICOM devices section of the DICOM options tab

To manage the DICOM devices and their groups, go to the **Remote DICOM devices** section on the **DICOM** tab of the **TomoCon options** dialog (see Figure 81):

- To add a new DICOM group, click the **Add group** button. Enter the group name into the edit box and confirm with the **OK** button.
- To add a new DICOM device as a separate item, click the **Add device** button. The **Device configuration** dialog (Figure 82) is then displayed. Fill in the fields and click the **OK** button to confirm.

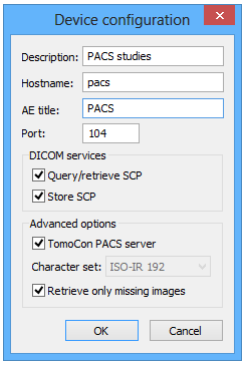


Figure 82 – Device configuration dialog

- To add a new DICOM device as a part of a defined group, selected the group in the list and click the **Add device** button. The **Device configuration** dialog (Figure 82) is then displayed. Fill in the fields and click the **OK** button to confirm.
- To modify a group or a DICOM device, click the **Configure…** button. The **Device configuration** dialog is then displayed in which you can modify the information concerning a group or device (see Figure 82).
- To verify the connection to the configured DICOM peer, click the **Verify** button.
- To change the order of the configured devices and groups and to move devices into/from groups, use the **Move up** and **Move down** buttons.

5 Studies management

For the management of DICOM studies, the TomoCon application provides the **Search studies** dialog (see Figure 83) containing comprehensive management tools for all studies stored in TomoCon, on remote DICOM devices and on CD/DVD data discs. TomoCon also makes it possible to send images and their reports and measurements to the other DICOM devices, to burn CD/DVD discs and to manage the worklists of studies.

To display the **Search studies** dialog, click the **Open** icon in the main TomoCon toolbar or select the **Open study…** item in the **Study** main menu (see 3.4 Main menu).

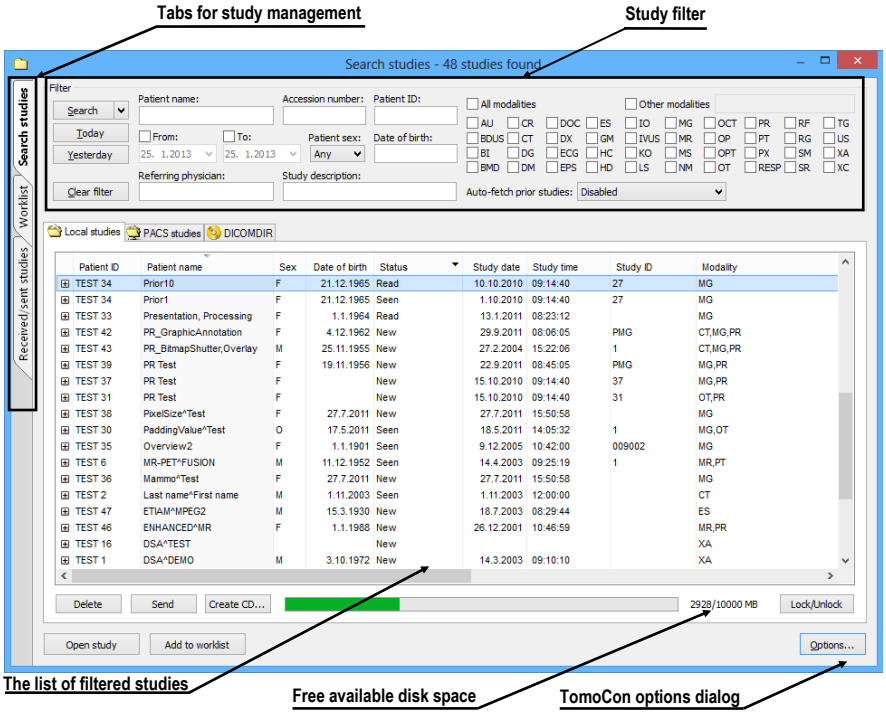


Figure 83 – Main parts of Search studies dialog

The **Search studies** dialog (see Figure 83) contains the following main parts:

- The filtering section for defining the filtering conditions for searching studies (see 5.2 Search and filter studies).
- A tab enabling quick access to important studies – the patient worklist (see 5.8 Patients worklist).
- A tab for monitoring sent and received studies (see 5.7 Monitoring and controlling send/receive jobs).

- Tabs for configurable DICOM devices, including a tab for local studies of TomoCon and DICOMDIR. Each device is represented by a separate tab on which TomoCon displays the searched studies (see 5.1 Studies list).

5.1 Studies list

Studies list displays the basic information concerning searched studies in a well-arranged manner (see Figure 84). The studies in the list are sorted according to the selected study parameter. The order of the studies can be changed by clicking the header of the column in which the selected parameter is displayed. The order of the displayed columns in the list can be rearranged by dragging and dropping.

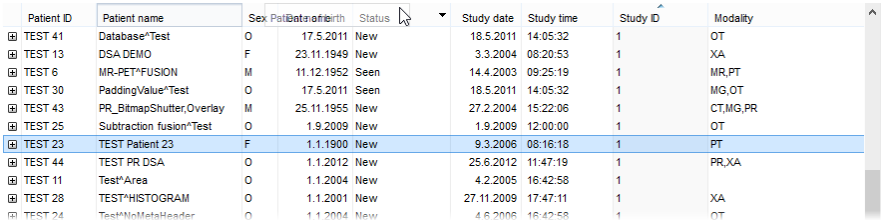


Figure 84 – Rearranging columns in the Search studies dialog by dragging and dropping

Each study is displayed as a separate row by default but it is possible to expand the list of series for each study by clicking the ⊞ symbol. The sub-list of the series with their main properties (the series date, time, description, number of images, etc.) is then displayed (see Figure 85). The study series list can be collapsed by clicking the ⊟ symbol.

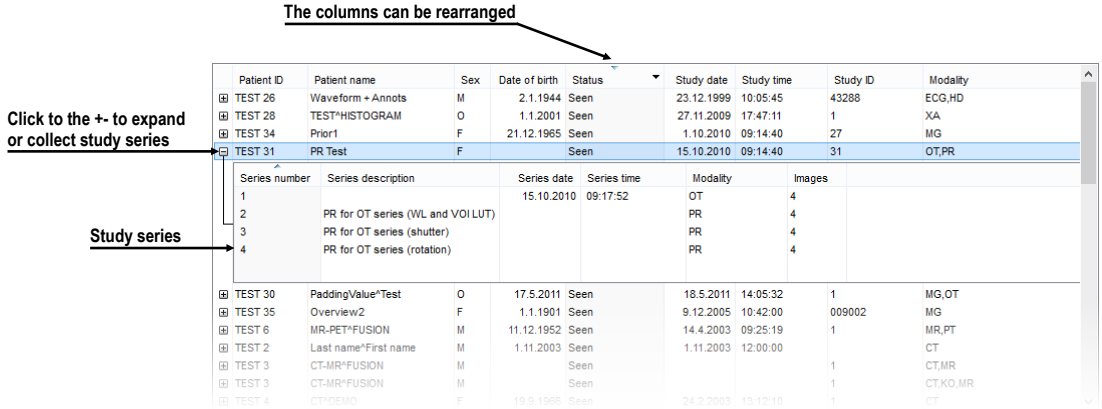


Figure 85 – Expanding study details in the Search studies dialog

Prior studies are displayed (if they exist) in a treeview for the selected study along with the series of the base study (see Figure 86). You can also expand the series of each prior study by clicking the ⊞ symbol.

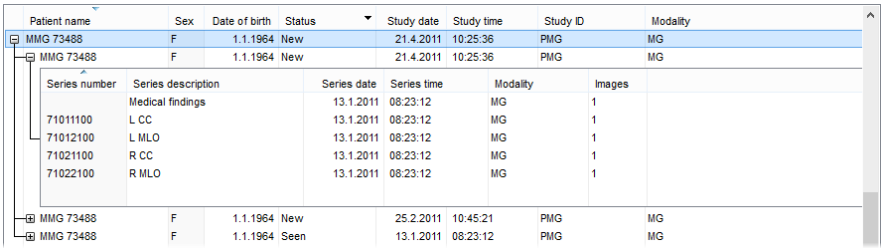


Figure 86 – Study with 2 priors

The list of searched studies allows you to define the information you want to display. By right-clicking the study list header, the context menu with the column names (see Figure 87) is displayed. You can select, using check marks, which columns you want to have displayed.

Figure 87 – Right-clicking the study header to select displayed and hidden columns

5.2 Search and filter studies

The TomoCon application allows the search of patient studies archived in any DICOM-compatible data storage. Each configured storage in the **Search studies** dialog is displayed as a separate tab with its own list of searched studies (see Figure 88).

To display the studies of configured storage in the **Search studies** dialog in TomoCon, click the tab with the storage name, define the filtering conditions and click the **Search** button. TomoCon enables work with the following three types of DICOM storage:

- Local studies (see 5.2.3 Local studies)
- DICOM media (CD, HD, etc.) (see 5.2.6 DICOMDIR)
- External device with DICOM protocol (see 5.2.5 External DICOM storage)

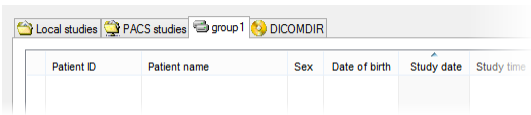


Figure 88 – DICOM storage tabs

When searching a study from any type of data source (except DICOMDIR), only the studies meeting the filtering conditions are displayed. Through the selection of the filtering conditions defined in the **Search studies** dialog, you can display only those studies you actually need.

To specify the search parameters, define the required information in the upper part of the **Search studies** dialog (see Figure 89) and then click the **Search** button to start the search process.

TomoCon provides the following parameters for criteria specification:

- **Patient name**, **Accession number**, **Patient ID**
- Examination date: **Today**, **Yesterday**, **From – To**
- **Date of birth**, **Sex**
- **Modality** (**All Modalities**, Select a modality)

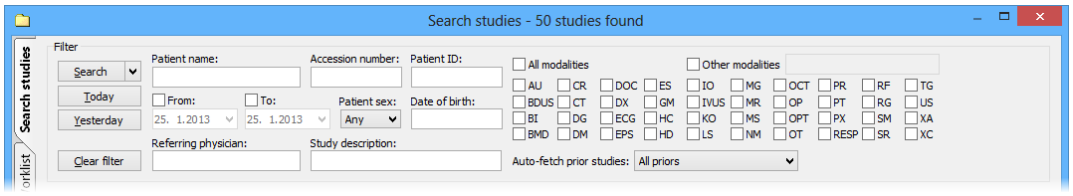


Figure 89 – Search section of the Search studies dialog

5.2.1 Managing search filters

Search filters enable you to define your own group of predefined search criteria and provide more efficient and effective study searches in TomoCon. Each search filter can be stored for subsequent usage and can be directly applicable to study search in the **Search studies** dialog through the **Search** menu (see Figure 90).

To display the **Search** menu, click the ⌄ icon on the **Search** button in the **Search studies** dialog. The list of all stored search filters is then displayed above the **Search** button where you can select the required filter by clicking it.

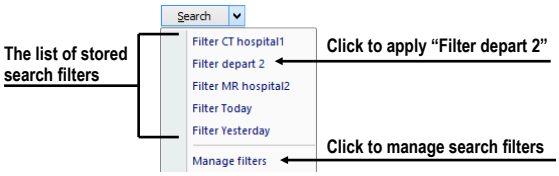


Figure 90 – Search menu with stored search filters

To manage the search filters, click the ⌄ icon on the **Search** button in the **Search studies** dialog and then click the **Manage filters** item in the displayed menu (see Figure 90). The **Manage filters** dialog (see Figure 91) is then displayed in which you can define a new search filter or edit or remove an existing one.

To create a new search filter in the **Manage filters** dialog, proceed as follows:

1. Click the **New** button.
2. Define the name of the filter in the **Filter name** edit box and define the searching criteria in the **Filter** section.
3. Click the **OK** button.

To change the search criteria of a previously defined filter, select the required filter in the **List of filters** and change its criteria in the **Filter** section.

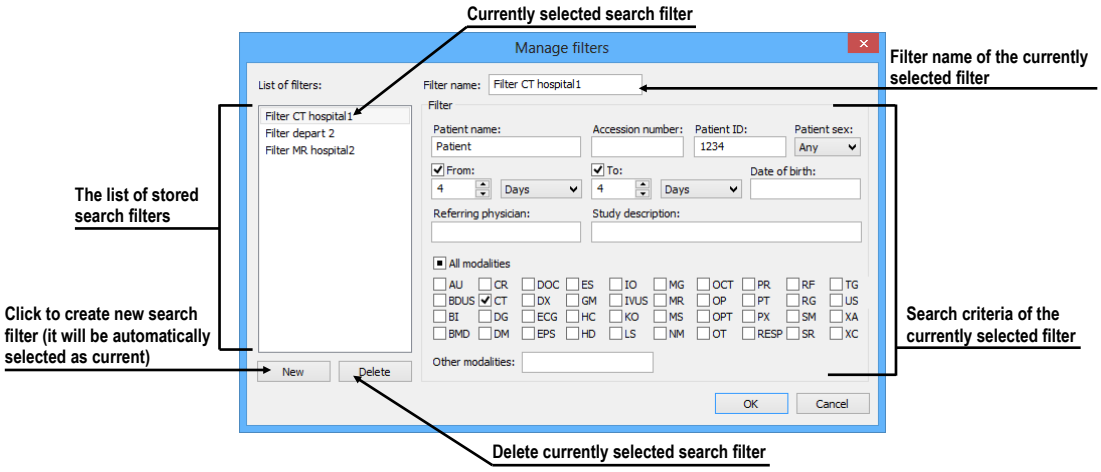


Figure 91 – Manage filters dialog

To delete a previously defined search filter in the **Manage filter** dialog, select the filter in the **List of filters** and confirm by clicking the **Delete** button.

When you are finished making the changes in the Manage filters dialog, click the **OK** button to confirm or, alternatively, click the **Cancel** button to discard the changes.

5.2.2 Search by selected study

In addition, it is possible to search studies according to the main parameters of the selected study (see Figure 92) in the **Search studies** dialog.

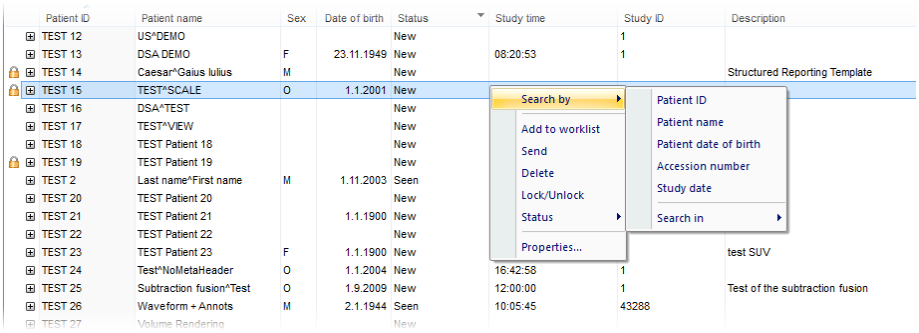


Figure 92 – Searching studies according to a selected study parameter

The search parameter is defined in the **Search by** item in the context menu of the selected study. To display the context menu, right-click the selected study. After you select a parameter, the search process in the currently selected storage starts automatically.

Searching according to the properties of the currently selected study can also be carried out in other storages. To choose another DICOM storage for searching, select the **Search in** item in the context menu of the selected study (see Figure 93).

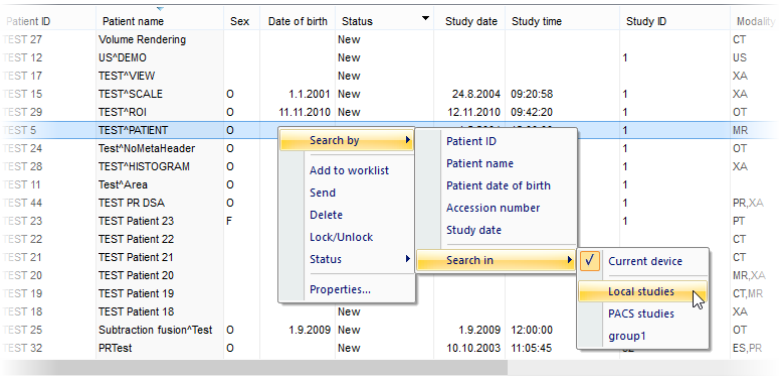


Figure 93 – Searching in a specific storage

5.2.3 Local studies

The TomoCon application saves all opened/retrieved DICOM data on the local DICOM storage on the local workstation. This storage is called "Local studies" and it is represented in the **Search studies** dialog by the **Local studies** tab (see Figure 94). In addition to storing studies in the Local studies of TomoCon, you can also export and send studies from it to external storages or medias including additional stored measurements and reports.

The **Locals studies** tab supports the following operations with each selected study in the list:

- Opening a study in TomoCon by clicking the **Open study** button.
- Locking a study against automatic deletion; by clicking the **Lock/Unlock** button, the study becomes locked against automatic deletion.
- Sending a study to an external PACS server; a selected study can be sent to a configured external DICOM storage by clicking the **Send** button.
- Deleting a selected study by clicking the **Delete** button.
- Burning a study on CD; clicking the **Create CD** button opens the **Create CD** dialog (see 23 Archiving images on a CD) in which you can add a selected study to the list of studies ready for burning.

- Defining and searching by study status (see 5.2.4 Study status).

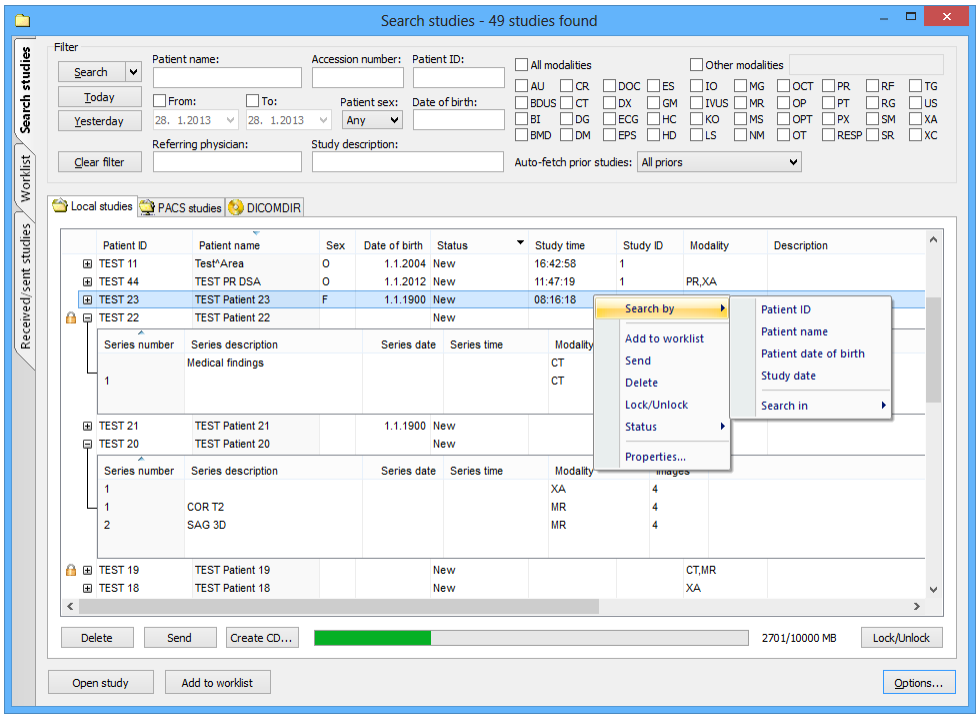


Figure 94 – Search studies dialog, the Local studies tab

If you are receiving/sending a study from/to your local studies storage and the job runs on the foreground, it is possible to move it to the **Queue management** (background) by checking the **Move to Queue** check box (see Figure 95). Consequently, the receive/send job will be moved to the **Receive/Send** queue and you can continue working with TomoCon.

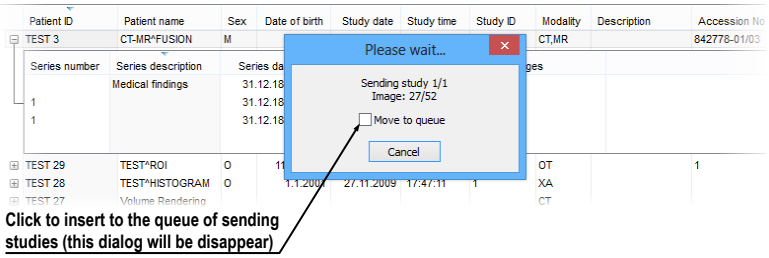


Figure 95 – Search studies dialog; receiving a study from a remote device to the Local studies

5.2.4 Study status

Each study stored in the local studies has its own defined status for identifying the current viewing and diagnosing status in the TomoCon application. It is thus possible to identify a new study which has not been opened in TomoCon and to identify a viewed, read and reported study in the local studies of TomoCon. The current study

status is displayed in the **Status** column of the list of local studies (see 5.2.3 Local studies). The **Search studies** dialog allows you to filter studies according to this status.

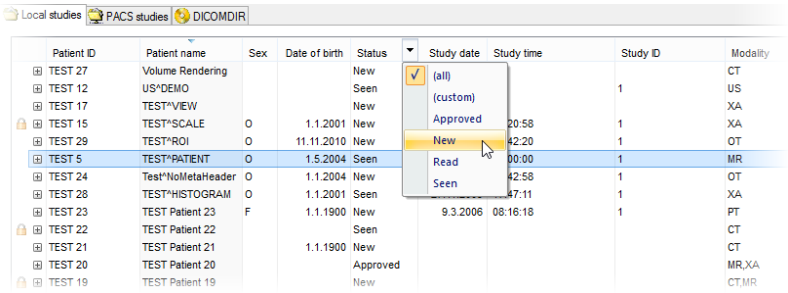


Figure 96 – Filtering by study status in the local studies

To filter studies on the **Local studies** tab, click the icon in the **Status** column header and then select the required filter status in the displayed menu (see Figure 96).

The automatically associated status of each new saved study on the local studies storage is called **New**. When a study in the **New** status is viewed in TomoCon, its status automatically changes to **Read** or **Seen** (according to the study closing process). In addition to automatic change, you can also manually set each type of study status according to the currently performed diagnosing steps.

To manually change a study status, select the **Status** item in the context menu of the selected study and choose the required status from the displayed menu (see Figure 97).

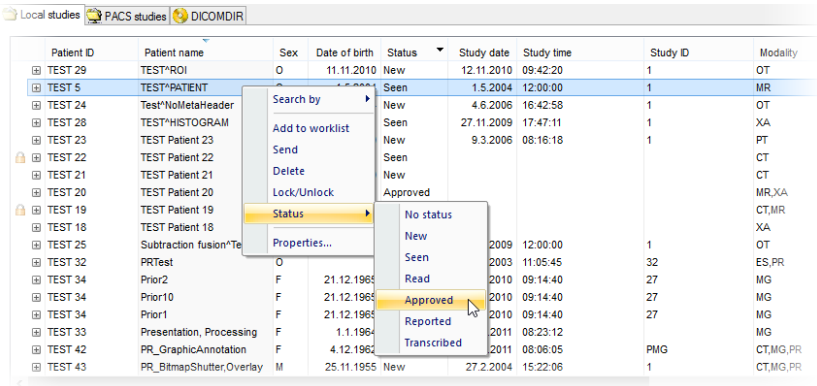


Figure 97 – Setting study status

5.2.5 External DICOM storage

As a radiologist, you are able to work with a study only if it is stored in your Local studies. On the other hand, patient studies are usually generated by modality devices and are stored in the DICOM format in remote storages – PACS servers. Therefore,

prior to working with any patient study stored remotely, it is necessary to retrieve it into your Local studies first.

The TomoCon Workstation allows you to connect to any standard external DICOM storage (a PACS server, modality, etc.), to search for required patient studies and to retrieve them to your Local studies in TomoCon. By default, the TomoCon Workstation is pre-configured so that it is possible to communicate with your TomoCon PACS server immediately without any additional adjustment. This storage is represented in the **Search studies** dialog by the PACS studies tab.

Additionally, TomoCon allows you to configure a number of external DICOM storages from which you can retrieve studies into your Local studies. The **Search studies** dialog contains a separate tab for each properly configured DICOM storage (see Figure 98).

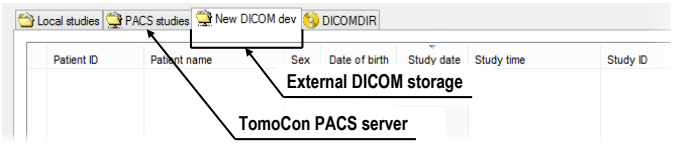


Figure 98 – New configured external DICOM storage

It is possible to merge multiple external DICOM storages into named groups. In this case, the tab in the **Search studies** dialog represents the entire group of configured external DICOM devices (see Figure 99). The search process of the studies is carried out step by step on all storages in the group. During this process, it is possible to exclude duplicate searched studies. To do so, check the **Hide duplicate studies** check box. In order to configure groups of external DICOM devices, go to the **DICOM** tab of the **TomoCon options** dialog (see 4.10 DICOM options).

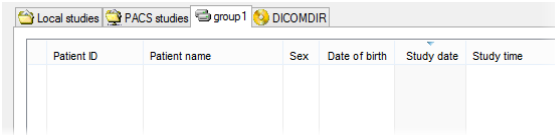


Figure 99 – Group of external DICOM devices

To retrieve a study, open a study or add a study to the worklist from a PACS server, activate the corresponding tab in the **Search studies** tab and carry out the following steps:

1. Set the filter and click the **Search** button. You may be asked to provide your authorization (the valid user name and password) in the **PACS studies login** dialog (see Figure 100).

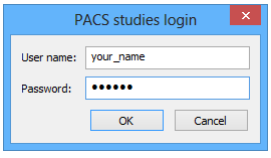


Figure 100 – PACS studies login dialog

2. The studies stored on the server that meet the filtering conditions will be included in the list (see Figure 101).
3. Select the study from the list and carry out one of the following operations:
   - Click the **Retrieve** button to only store the study in the local studies.
   - Click the **Open study** button to store the study in the local studies and open it in TomoCon.
   - Click the **Add to worklist** button to add the study to the patient worklist (see 5.8 Patients worklist).

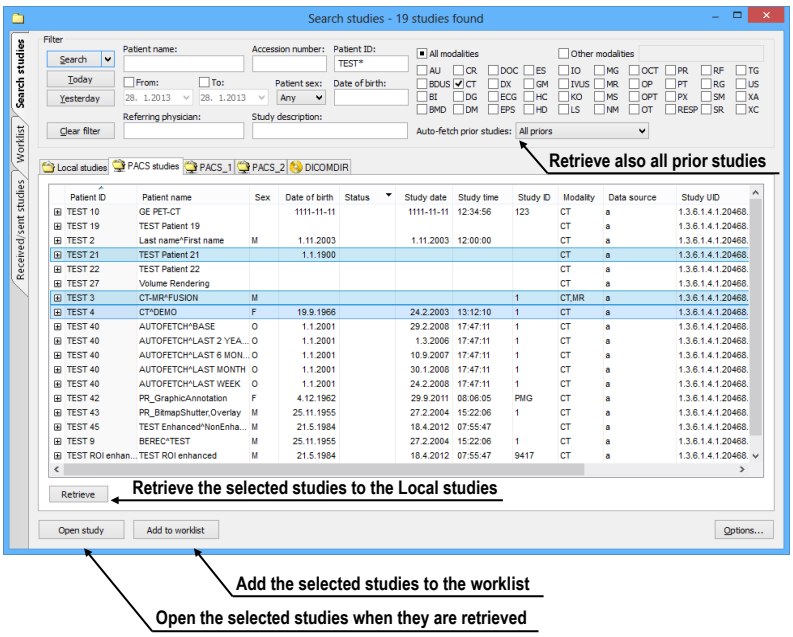


Figure 101 – Retrieving studies from the PACS server to the Local studies

The selected study is always retrieved or opened along with its prior studies according to the option selected in the **Auto-fetch prior studies** combo box (see 5.3 Auto fetch prior studies).

5.2.6 DICOMDIR

> This functionality is available only in TomoCon Workstation.

Any data stored in the DICOM format, whether on CD, HD or a shared network server directory, can be accessed using the **DICOMDIR** tab of the **Search studies** dialog in the TomoCon application (see Figure 102).

To find DICOM studies using the DICOMDIR tab, proceed as follows:

1. Click the **Search** button.

2. In the **Browse for Folder** dialog that is displayed, you can define the path to the searched folder (in which the DICOM data is stored). Alternatively, you can select the folder from the drop-down menu, which is displayed by clicking the arrow button next to the **Search** button.
3. TomoCon attempts to find the DICOMDIR file that contains the information concerning the DICOM files stored in the folder. If the file is not found, TomoCon attempts to scan the folder specified for DICOM images (you will be asked to confirm this step).
4. All DICOM files found in the specified folder (or defined in the DICOMDIR file) are displayed in the studies list.

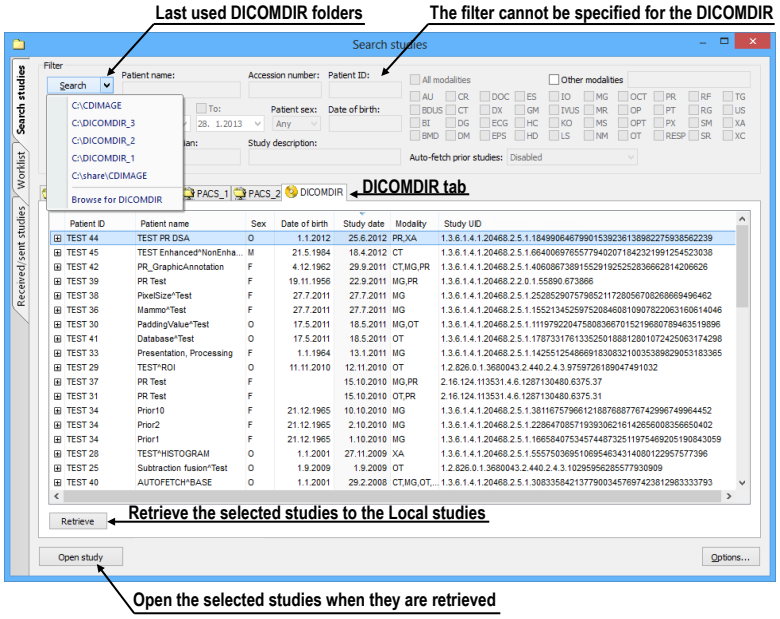


Figure 102 – DICOMDIR in the Search studies dialog

5.3 Auto fetch prior studies

The TomoCon application allows to use auto-fetching of prior studies for a selected study in the **Search studies** dialog when the following operations are carried out:

- the study is opened
- the study is added to the worklist (see Figure 103)
- the study is retrieved from the remote DICOM device

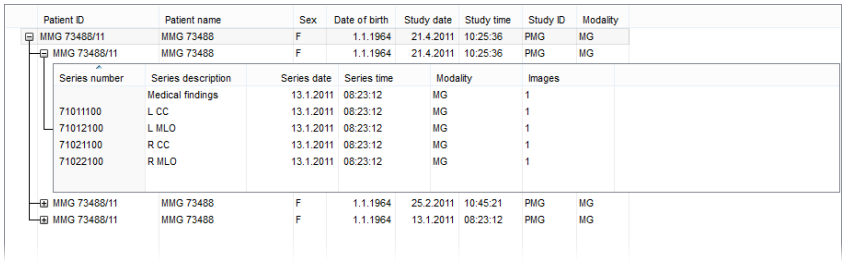


Figure 103 – Study in the worklist with 2 priors

This functionality makes it possible to work with the study and its priors as an entire package. To define auto-fetch of prior studies, click the **Auto-fetch prior studies** combo box in the filtering section of the **Search studies** dialog. The list of the timing and numerical criteria are displayed (see Figure 104) in which you can select the studies that are to be considered as priors.

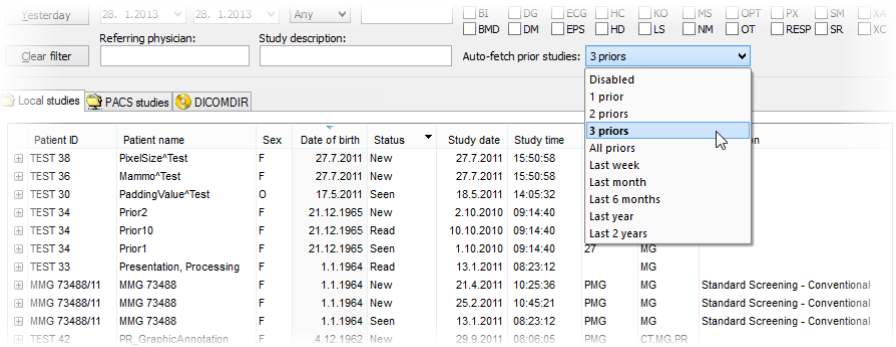


Figure 104 – Selecting Auto-fetch prior criteria

5.4 *Opening a study*

To open a study in TomoCon using the **Search studies** dialog, select the required tab (storage), click the row of the study (see Figure 105) and click the **Open study** button or double-click the row. The study immediately opens with all of its series. If the study is stored on a storage other than the local studies, the study is firstly downloaded in the local studies.

To open only a certain series of a selected study, expand the study (by clicking the ⊞ symbol), select the series you want to open and click the **Open study** button.

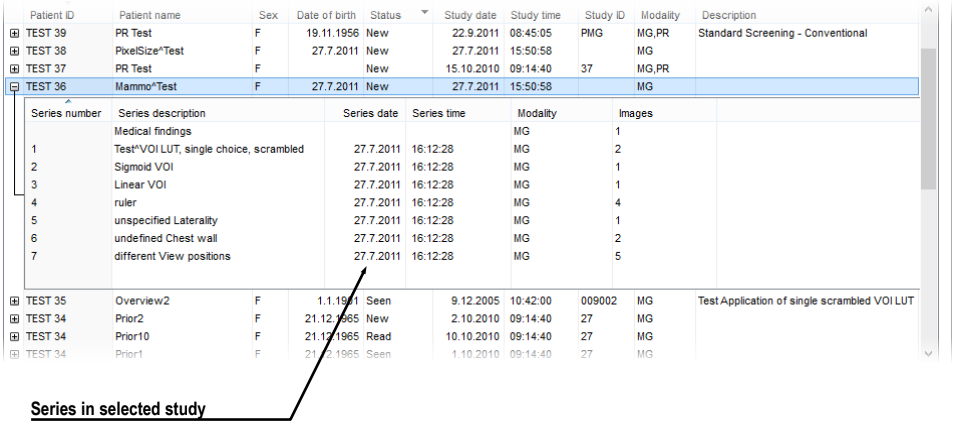


Figure 105 – Expanded series of a selected study

The list of studies in the **Search studies** dialog allows the selection of multiple studies and series that you can open all at one time. By pressing the **Ctrl** button, you can select and deselect multiple studies (see Figure 106) or series; by pressing the **Shift** button, you can select a group of studies.

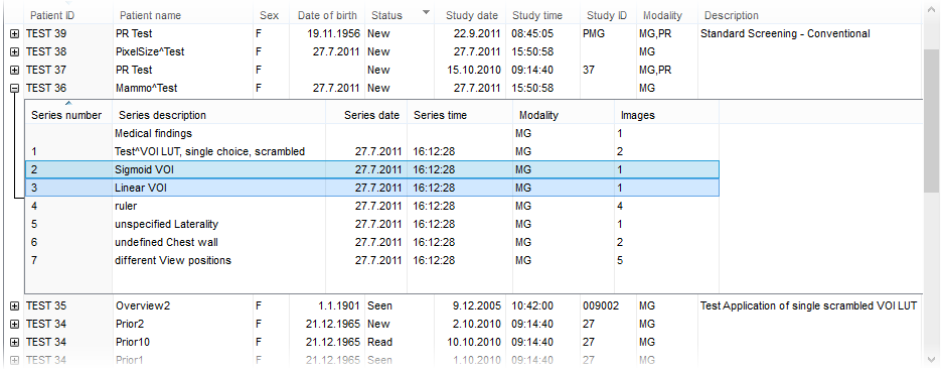


Figure 106 – Multi selection of series with enhanced CT images

5.5 *Closing and saving a study*

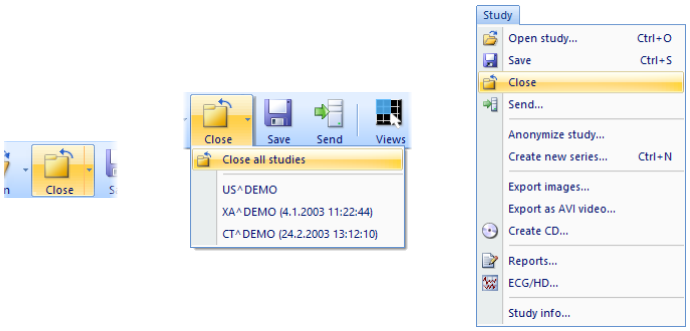
> The saving functionality is not available in TomoCon Lite.

Usually, the final step in the viewing and diagnosing process with opened study images in TomoCon is to save your changes and to close the viewed patient study. While TomoCon is running, you can save and close all opened studies in one step or you can save and close only one particular study. When TomoCon is being closed, the closing of all studies is initiated automatically.

To close all opened studies, use one of the following methods:

- Click the Close button in the main toolbar (see Figure 107a).

- Expand the **Close** button in the main toolbar and select the **Close all studies** item in the drop-down menu (see Figure 107b).
- Select the Study/Close item in the main menu (see Figure 107c).

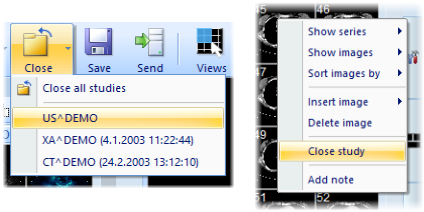


(a) **(b)** **(c)**

Figure 107 – Closing all studies

To close only one study, use one of the following methods:

- Expand the **Close** button in the main toolbar and select the item containing the name of the study in the drop-down menu (see Figure 108a).
- Right-click any image in the thumbnails palette of the study to be closed and then select the **Close study** item in the thumbnail palette context menu (see Figure 108b).



(a) **(b)**

Figure 108 – Closing a selected study

Before a study is closed, the changes you have made to the study images during the viewing and diagnosing process can be saved. TomoCon allows you to save the changes to the various objects (e.g. measurements, ROIs, correlations, reports, key notes and waveforms). These objects are saved in a DICOM-compatible format. As a result, all changes you save can be uploaded to a PACS server and consequently retrieved and opened in another TomoCon workstation.

If none of the studies to be closed have been changed, all the studies are immediately closed. If changes have been made to any of the objects mentioned above, a confirmation dialog containing the question "Do you want to save the changes?" is displayed (see Figure 109).

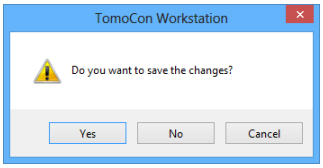


Figure 109 – Change confirmation dialog when saving a study

If you click the **Cancel** button, neither saving nor closing will be carried out. If you click the **No** button, the study will be closed without the saving of any of the changes. If you click the **Yes** button, all changes will be saved (on your local storage) and the study will be closed.

When changes are being saved, the **Please wait…** dialog is displayed (see Figure 110) in which you can monitor the progress of the saving process.

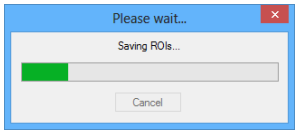
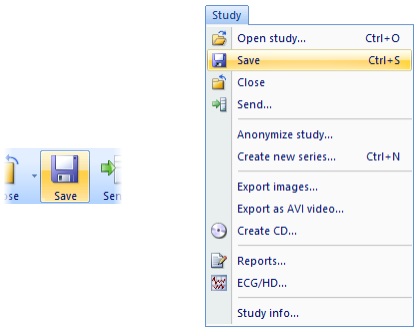


Figure 110 –Please wait… dialog when saving changes

You can of course save your changes as you work without closing the studies. This is advisable in order to safeguard against the loss of your work that could occur due to a variety of reasons (power loss, etc.). To save all changes in all opened studies immediately without closing them, use one of the following options (see Figure 111):

- Click the **Save** button in the main toolbar (see Figure 111a).
- Select the **Study**/**Save** item in the main menu (see Figure 111b).



(a) **(b)**

Figure 111 – Saving changes without closing a study

5.6 *Sending a study to an external device*

Patient data can be sent over the network to any PACS server or another DICOM data storage device. On the **Local studies** tab of the **Search studies** dialog, select the study and click the **Send** button. If multiple remote devices are available and defined, the **Select remote device** dialog (see Figure 112) is displayed in which you specify the

target device. Select the desired remote device and click the **OK** button. The study will be sent. To define the DICOM data source, go to the **TomoCon options** dialog (see 4.10.5 Remote DICOM devices).

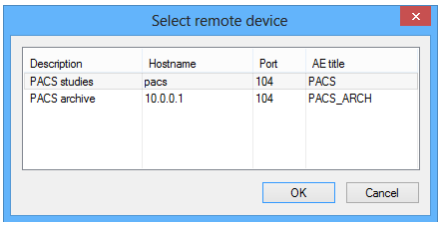


Figure 112 – Select remote device dialog

5.7 Monitoring and controlling send/receive jobs

It is extremely appropriate and practical to have the possibility to work with numbers of simultaneous jobs when dealing with network traffic. Sending/receiving numerous studies to/from various PACS systems would be a very inconvenient process if such a network-related process could start only after the previous one had been completed. For this reason, the TomoCon application provides a mechanism to control and manage numerous sending and receiving jobs on the very intuitive **Received/sent studies** tab of the **Search studies** dialog.

The **Received/sent studies** tab contains the list of all processing jobs during the current TomoCon session. The list is divided into two tab pages – the first, the **Received studies** tab, displays all receiving/received jobs and the second, the **Sent studies** tab, displays all sending/sent jobs. Each list on the tabs displays the main pieces of information concerning received/sent studies (see Figure 113) such as the current job status, the destination or source, the progress, the time at which the job started, the last access time and basic information about the study (the patient ID and name, study date, accession number and UID).

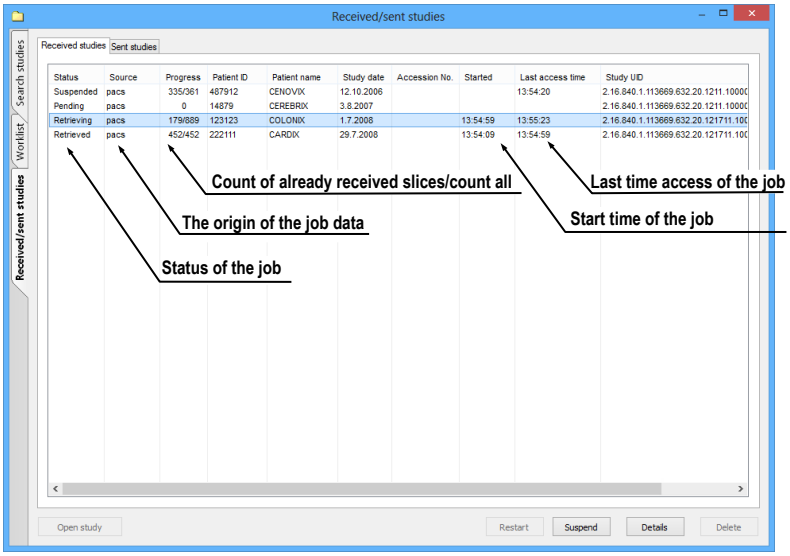


Figure 113 – Received studies tab

5.7.1 Managing receiving/sending jobs

The **Received studies** and **Sent studies** lists provide the controls for active and passive jobs management. These controls allow you to control the receiving/sending process of the studies or to obtain more precise information concerning the studies.

To manage a receiving job in the **Received studies** list, you can select from the following operations (see Figure 114):

- Suspending an active job (by clicking the **Suspend** button).
- Restarting a job from the suspended status (by clicking the **Restart** button).
- Deleting a job if it is not in the receiving status (by clicking the **Delete** button).
- Displaying detailed information concerning a job (by clicking the **Details** button).
- Opening a study in TomoCon if its job is already in the received status (by clicking the **Open study** button).

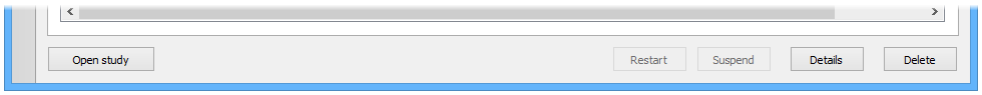


Figure 114 – Manage buttons on the Received studies tab

To manage a sending job in the **Sent studies** list, you can select from the following operations (see Figure 115):

- Suspending an active job (by clicking the **Suspend** button).
- Restarting a job from the suspended status (by clicking the **Restart** button).

- Continuing with a job from the suspended status (by clicking the **Continue** button).
- Deleting a job if it is not in the sending status (by clicking the **Delete** button).
- Displaying detailed information concerning a job (by clicking the **Details** button).

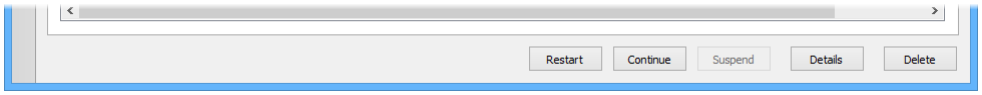


Figure 115 – Manage part of the Sent studies tab

Clicking the **Details** button (or double-clicking an item in list) opens the **Task details** dialog (see Figure 116) which displays detailed information concerning the selected job (the status information, patient/study information and task information). It also contains a list of the proceeding images.

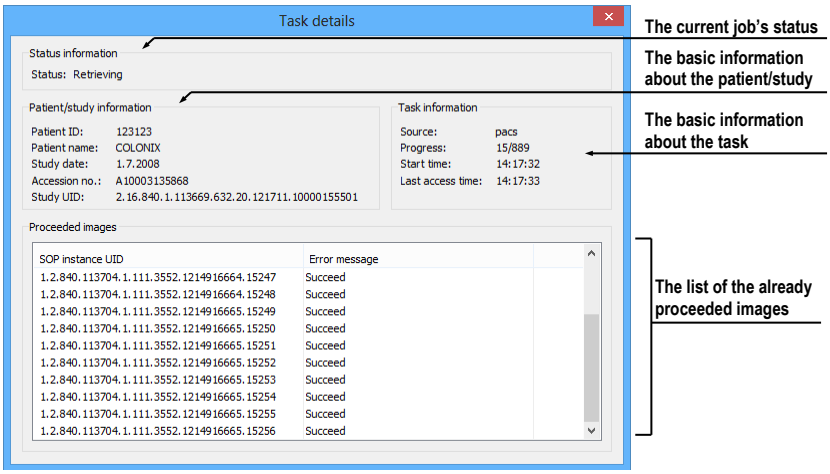


Figure 116 – The Task details dialog displaying detailed information concerning a job and study

5.7.2 Jobs notification

The TomoCon application also provides you with notification concerning running jobs without having to open the **Search studies** dialog. If an unfinished job (receiving or sending) exists, the TomoCon status bar displays the corresponding icon as well as the total number of jobs currently running. If you move the cursor to these locations, a tool tip containing information about the jobs is displayed (see Figure 117).

Figure 117 – Tool tips containing information about currently running jobs

If you attempt to exit the TomoCon application when there are any unfinished sending/receiving jobs still running, a message dialog is displayed (see Figure 118). You can then decide whether to cancel the job(s) and exit TomoCon or to wait until the process is complete.

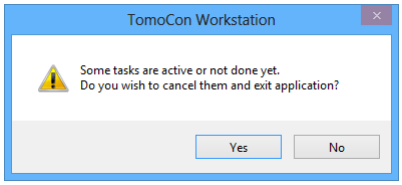


Figure 118 – When attempting to exit TomoCon, you can cancel any running jobs or wait until the process is complete

5.8 Patients worklist

When you need to load a patient study into TomoCon, you can do so directly by selecting the particular study from the configured DICOM peer or local studies or by browsing the pre-prepared patient worklist, which contains the studies designated for viewing in TomoCon. The patient worklist is the list from you can sequentially open prepared patient studies. Studies can be added to the patient worklist manually, by selecting from an arbitrary source (local studies, DICOM peer), or automatically, when a new study is received in TomoCon.

To display the patient worklist, go to the **Worklist** tab of the **Search studies** dialog. To display the **Search studies** dialog, see 5 Studies management. The patient worklist tab contains the list of the studies queued in the worklist and all tools for managing the content of the worklist (see Figure 119).

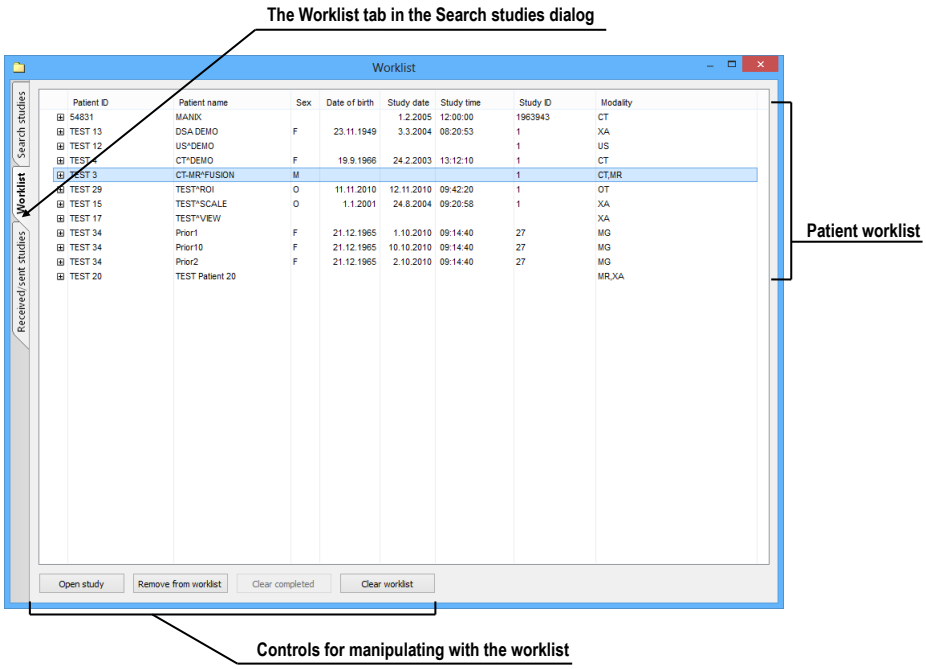


Figure 119 – The Worklist tab of the Search studies dialog

This studies list is the same as the studies list on the **Search studies** tab. The main rows in the list represent the studies (see Figure 120). When a study is expanded, the list of its content is displayed in a tree-like structure. It contains either the series list of the study itself or, if prior studies exist, it contains a list of the priors along with their content. The priors are ordered according to study date and time.

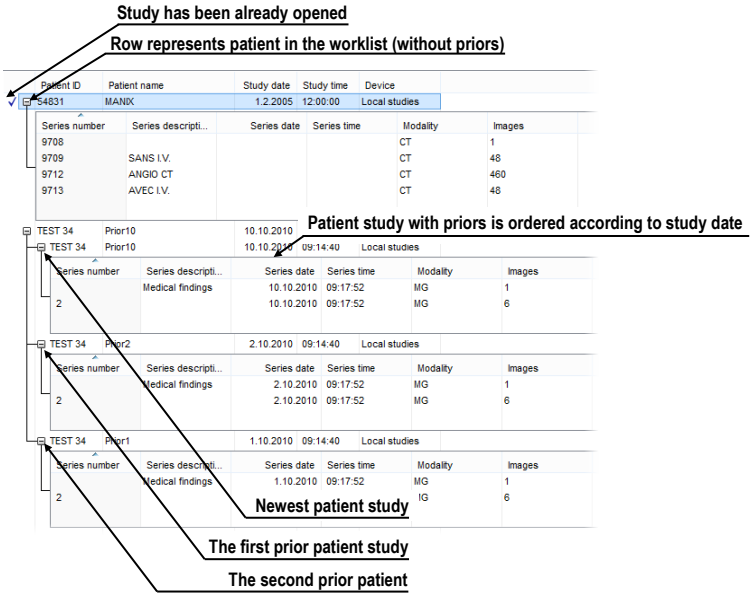


Figure 120 – Studies in a worklist

5.8.1 Adding a study to a worklist

It is possible to add a study to the worklist from your Local studies or any configured DICOM storage manually or to insert a received study automatically.

In order to add a selected patient to the patient worklist, proceed as follows:

1. Click the **Open** button in TomoCon to display the **Search studies** dialog.
2. Set the filtering parameters and carry out the search on your local studies location or any remote PACS storage.
3. Click the **Search** button and select the studies you want to add to the worklist.
4. Set the parameters of the prior studies filter (see Figure 121), which defines the group of automatically added prior studies of the selected study in the worklist.

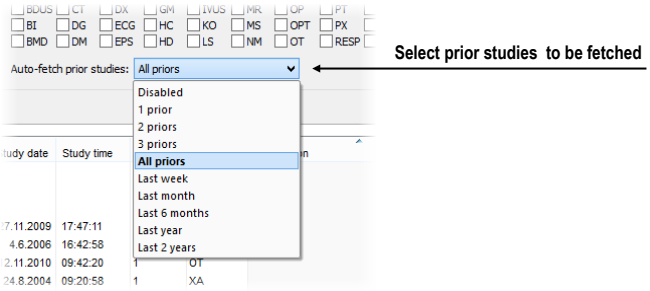


Figure 121 – Specifying which prior studies should be received

5. Click the **Add to worklist** button or select the **Add to worklist** item in the context menu.

To activate automatic addition of all received studies in TomoCon, enable the **Automatically add newly received studies to worklist** option on the **DICOM** tab of the **TomoCon options** dialog (see Figure 122).

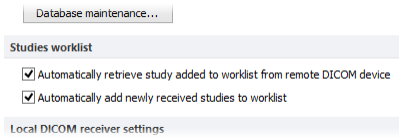


Figure 122 – Settings for automatic receiving for the worklist

To accelerate work with studies in the patient worklist, TomoCon enables automatic retrieval of a study (from the remote DICOM device) that is currently being added to the worklist (see Figure 123). As a result, whenever you add a new study to the worklist, the retrieval process starts automatically. To activate this option, check the **Automatically retrieve study added to worklist from remote DICOM device** option in the **TomoCon options** dialog.

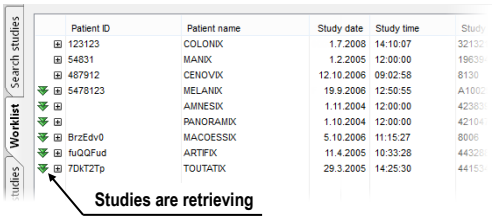


Figure 123 – Automatic retrieval of a study being added to the worklist

5.8.2 Reviewing a worklist

Your currently defined patient worklist is available at any time on the **Worklist** tab of the **Search studies** dialog. On the tab, you can select from the following operations (see Figure 125) pertaining to the patient worklist studies:

- Opening a selected study, along with all of its prior studies, from the worklist (by clicking the **Open study** button). After a study from the worklist is opened, its status changes to read. All studies in the worklist that are in the read state are marked with the ✓ icon on the left-hand side of the row (see Figure 124).

Figure 124 – Four read studies in the worklist

- Changing the order of the studies in the worklist; proceed as follows:
  1. Select one or more studies in the worklist that you want to reorder.
  2. Display the context menu by right-clicking the selection.
  3. Select the **Move up** or **Move down** menu item.
  4. The selected item(s) will be moved upward or downward within the table.

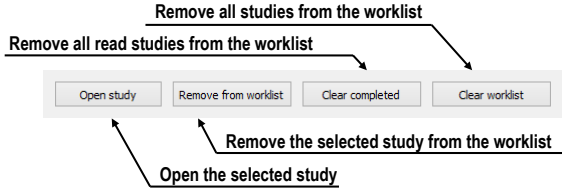


Figure 125 – Manage part of the Patient worklist tab

- Removing a selected study from the worklist (by clicking the **Remove** button, see Figure 125).

- Removing all studies from the worklist that have already been read (by clicking the **Clear completed** button).
- Removing all studies from the worklist (by clicking the **Clear worklist** button).

The mammography mode allows you to access all worklist studies automatically. By clicking the **Open previous study from worklist** button or the **Open next study from worklist** button in the mammography toolbar, you are able to review all studies prepared in the patient worklist (see Figure 126).

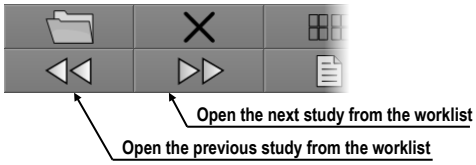


Figure 126 – Worklist buttons in the mammography toolbar

6 Viewing images

TomoCon application allows you to review images of all loaded studies, in any view of your working area (see 6.1 Display image in view). For displaying possibilities you can also use the sequence creation capability (see 6.2 Image sequence) or series synchronization possibilities (see 6.3 Series synchronization).

6.1 Display image in view

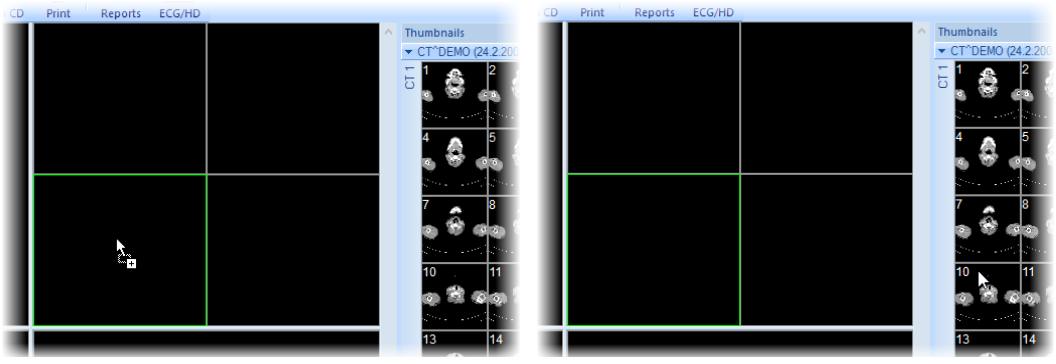
There are various ways in which to display an image in a view. You can use the selection of images in the thumbnails palette or move them by dragging and dropping.

To display an image in a selected view using the thumbnails palette, proceed as follows:

1. Move the cursor over the desired view and click (the view will change to the current view).
2. Move the cursor over the desired image in the thumbnails palette and click (see Figure 127b). The image will be displayed in the current view.

or by dragging and dropping:

1. Move the cursor over the desired image in the thumbnails palette and press and hold down the left mouse button.
2. Move the cursor over the desired view and release the mouse button. The image will be displayed in this view and the view will change to the current view (see Figure 127a).



(a) **(b)**

Figure 127 – Displaying image in view using drag&drop (a), by selecting image (b)

There is also a simplified manner of selecting a series for the current view. It is possible to quickly select the series you want to view in the context menu.

1. Move the cursor over the desired view and click (this view will change to the current view).
2. Right-click to display its context menu (see Figure 128).
3. Select the desired series in the upper **Select series…** submenu. The first image of the selected series is then immediately displayed in this view.

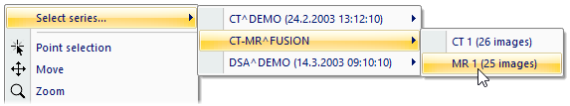


Figure 128 – Series selection using the context menu

When you select an image in the current, non-pinned view, the application automatically creates a sequence (see Figure 129) containing all non-pinned views from the current segment and from all other segments linked to it (see 6.2 Image sequence).

The identification of the image order in the series that is displayed in the current view is indicated in the scrollbar to the right of the working area. Its location represents the approximate image position in the series.

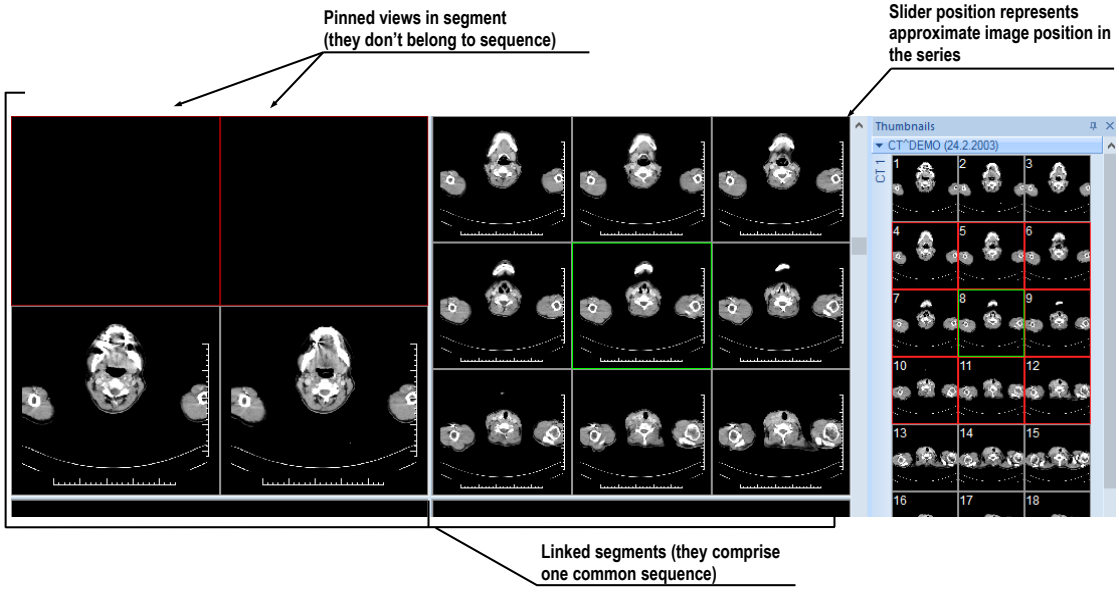


Figure 129 – Working area with non-multiframe image in current view

6.1.1 Multiframe image

When a multi-frame image is displayed in the current view, the position scrollbar is divided into two parts, separated by a square box (see Figure 130). The upper part of the scrollbar represents the image in the current series and the lower part of the scrollbar represents the frames in the current image. The current frame number of the

multi-frame image is displayed in the box between the scrollbars. It is also possible to move through the frames using the mouse wheel.

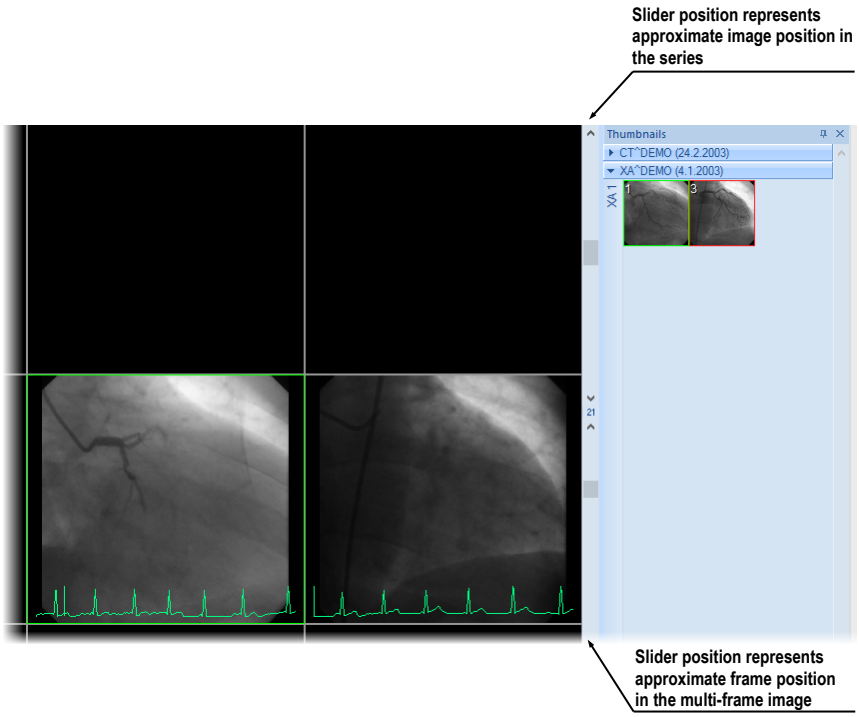


Figure 130 – Working area with multiframe image in current view

6.1.2 Multidimensional series

When a multidimensional series is loaded into the TomoCon application, it is automatically divided into virtual series and their images are displayed in the thumbnails palette. Each image in this series is identified by its dimension number, stack position (index number) and its temporary position.

When an image from a series with just one dimension is displayed in the current view, it is displayed as a standard image with the standard scrolling functionality. As a result of this, you can scroll through all of the images in the series in the current view using the vertical scrollbar (see Figure 131).

Figure 131 – Standard scrollbar of the current view

On the other hand, when an image from a series with more than one dimension is displayed in the current view, the special horizontal dimension scrollbar is displayed in the lower part of the working area (see Figure 132). Its position specifies the dimension of the displayed image in the current view. The vertical scrollbar is of course also displayed, with its standard scrolling functionality.

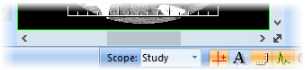


Figure 132 – Dimension scrollbar of the current view

When an image from a multidimensional series is displayed in the current view, you can scroll through the images using one of the following methods:

- Move to the next/previous image that has the same dimension as the dimension of the image displayed in the current view by scrolling with the mouse wheel or using the vertical scrollbar. The dimension will be achieved and the image will skip to the nearest image in the series (see Figure 133).
- Move to the image with the next/previous dimension that has the same position in the series as the image in the current view by scrolling with the mouse wheel while pressing down the ALT key or using the horizontal scrollbar.

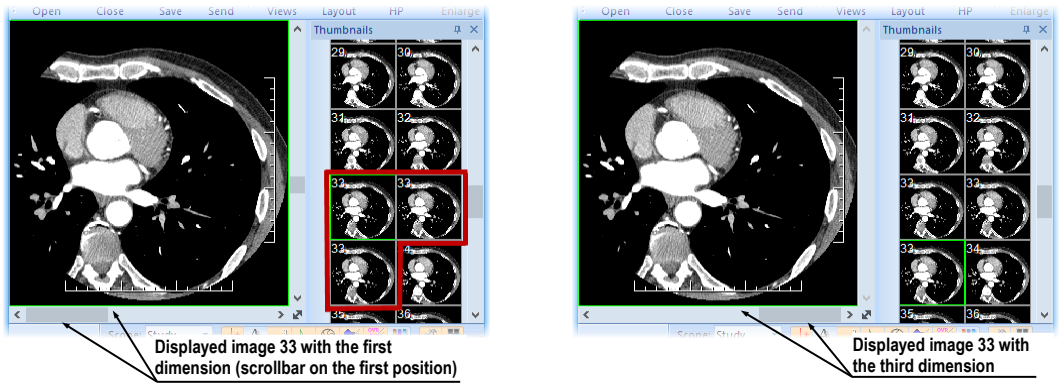


Figure 133 – Displayed image with the first and the third dimension in the current view

6.1.3 Scroll mode

Just as you can scroll through the images in the current view using the mouse wheel or the working area scrollbars, you can use the scroll view mode. This mode allows you to scroll in the current view by moving the mouse. Horizontal movement allows you to change the dimension (if applicable) in the current view while vertical movement is used to change the image position in the series.

To activate the scroll mode, select the **Scroll** item in the context menu of the current view (see Figure 134). When the scroll mode is active, the mouse cursor is displayed as .

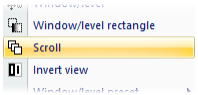


Figure 134 – Scroll item in the context menu

To scroll up/down among the images with the same dimension in the series volume, press down the left mouse button and move the mouse up/down vertically. When the mouse is moved, the cursor is displayed as .

To scroll between dimensions, press down the left mouse button and move left/right horizontally. When the mouse is moved, the cursor is displayed as .

6.2 Image sequence

When a new image is selected in the current view, the TomoCon application automatically creates a sequence of images in the current segment. This sequence contains all views from this segment (linked by rows), with the exception of so-called pinned views. A pinned view can be used to display an arbitrary image without changing the sequence or potentially to display an MPR, 3D, etc. This view is outlined with a colored frame (the default color is red although this can be changed; see 4.4 Color options).

To manually pin/unpin the current view, click the item in the context menu (which is displayed by right-clicking). The status of this icon displays the pin status of the current view (see Figure 129).

If you want to create a sequence containing more than one segment, TomoCon allows you to link selected segments (see Figure 136). Proceed as follows:

1. Click the first segment in the sequence.
2. Press the button on the second tab (the icon) of the tools panel (see Figure 135).

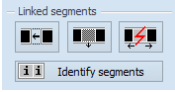


Figure 135 – Linked segments section of the Define layout tool

3. Move the cursor over the working area. The first segment in the sequence will be marked with the number 1.
4. Move the cursor over the segment which you want to add to this sequence (this segment will be marked with next number in the sequence) and click. If

you want to add additional segments to the sequence, hold down the **Ctrl** key while clicking.

5. To add further segments, repeat step 4 with the **Ctrl** key pressed. To end the process of linking segments, press the **Esc** key.

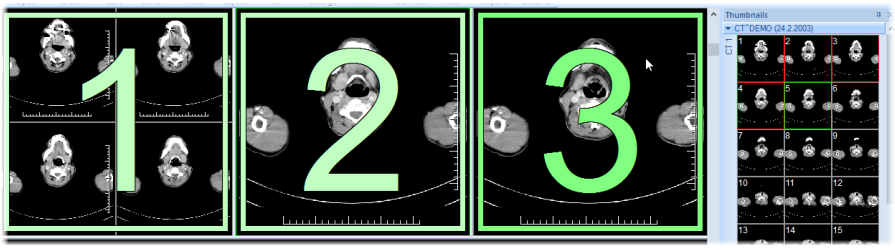


Figure 136 – Linking of segments to a sequence

To remove a linked segment from a sequence (see Figure 137), proceed as follows:

1. Press the button on the second tab (the icon) of the tools panel (see Figure 135).

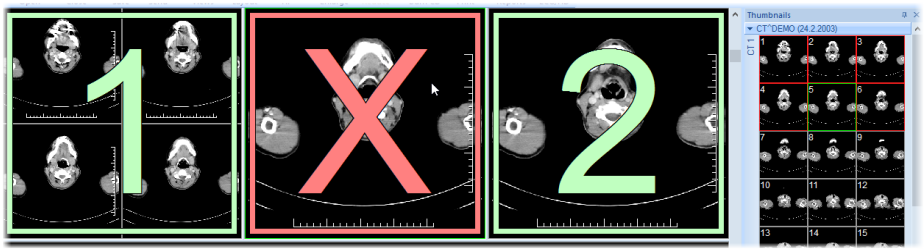


Figure 137 – Removing a segment from sequence

2. Move the cursor over the segment you want to remove (the segment will be marked with a cross) and click.
3. If you want to remove multiple segments from a sequence, hold down the **Ctrl** key while clicking.

To divide an existing sequence (see Figure 138), proceed as follows:

1. Press the button on the second tab (the icon) of the tools panel (see Figure 135).

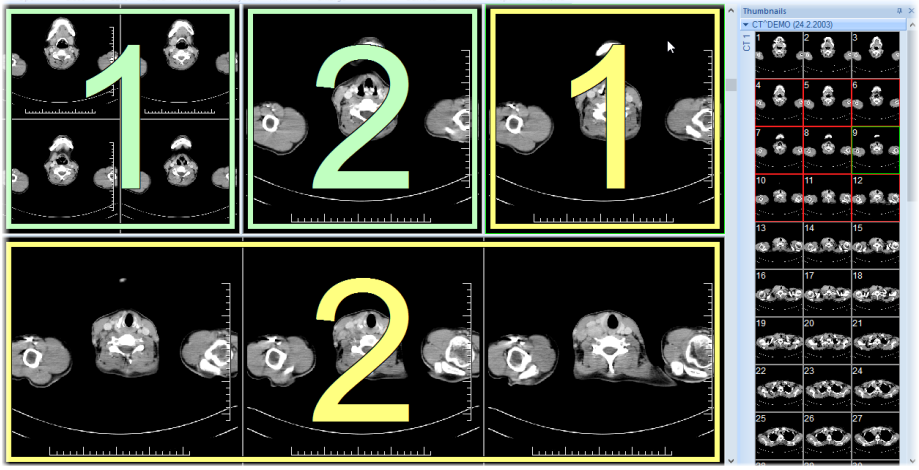


Figure 138 – Dividing an existing sequence

2. Move the cursor over the first segment of the subsequent sequence (the segment will be marked with the number 1 and all subsequent linked segments will be numbered as they will be in numbered in the new sequence) and click.

6.3 Series synchronization

Multiple series can be "locked" together in order to scroll synchronously within segments. This option is selected by means of the **Segments synchronization** section on the third tab (the tab with the icon) in the tools panel (see Figure 139).

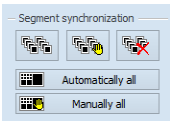


Figure 139 – Segments synchronization section of the Define layout tool

Two synchronization modes are available: the automatic and manual mode for the selected segments and the automatic (**Automatically all**) and manual (**Manually all**) mode for all working areas.

In the automatic mode, images from different series are displayed at the same or corresponding positions. When scrolling one segment, the images in the other segments are also scrolled at the same or corresponding positions. (It is not possible to use this mode when the patient is positioned differently during series scanning.)

In the manual mode, the displayed images in the segments are considered as "currently being displayed at the corresponding positions". When scrolling in one segment, the images in the other segments are scrolled in roughly the same degree.

To define automatic/manual synchronization of selected segments (see Figure 140), proceed as follows:

1. Select the layout of the working area with at least two segments which have the same layout of views.
2. Display the desired series in these segments (in the manual synchronization mode, set the position of the individual series according to your requirements).
3. Select the segment that is to be used as the primary segment (select the current view).
4. Press the button for automatic synchronization or the button for manual synchronization and move the cursor over the working area.
5. Click another segment in the working area with the same layout as the primary segment that is to be synchronized with it (the primary segment will be marked as **Pri.**). If you want to add additional segments to the synchronization, hold down the **Ctrl** key while clicking.
6. To add further segments, repeat step 5 with the **Ctrl** key pressed.

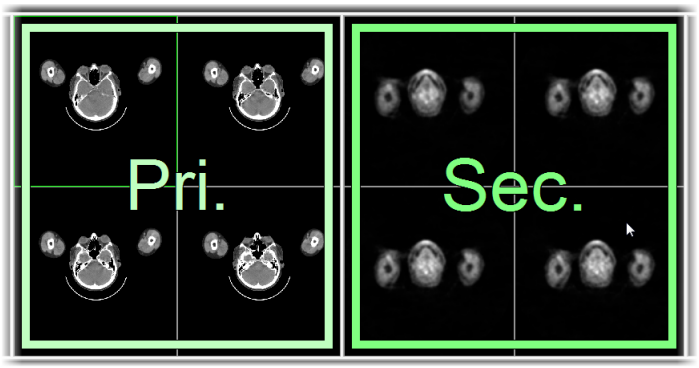


Figure 140 – Definition of synchronization for selected segments

To cancel synchronization of selected segments, proceed as follows:

1. Press the button and move the cursor over the working area.
2. To remove an entire synchronization, move the cursor over the primary segment (the segment will be marked with a red frame and the label **Pri.**) and click.
3. To remove only one segment from a synchronization, move the cursor over it (the segment will be marked with a red frame and the label **Sec.**) and click.

It is possible to synchronize/cancel synchronization of all segments in all working areas at any time simply by pressing the **Automatically all**/ **Manually all** button in the **Define layout** tool (see Figure 139).

When you insert a segment into series synchronization, the views in this segment are marked with colored icons. These icons identify the synchronization status of the

segments (see Figure 141). To define the location of these icons in the view, 4.3 View texts - the **View status** text type.

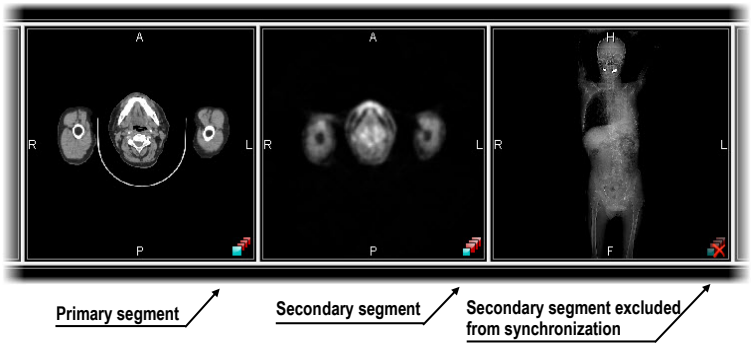


Figure 141 – Segment status in synchronization

6.4 Playing multi-frame images

Certain scanning devices (*XA*, *USG*, *MR*, etc.) are capable of capturing the entire sequence of image frames in a certain time period and storing it as one multi-frame image (like a movie). It is possible to use cine loops to automatically display a sequence of such multi-frame images in the TomoCon application. Additionally, it is possible to use cine loops to automatically display a sequence of non-multi-frame images from any series in the movie mode.

TomoCon allows you to quickly create and manipulate cine loops in any view of the working area using the **Cine** tool in the tools panel. The **Cine** tool (see Figure 142) is docked in the tools panel and is accessible at any time by clicking the tab with the icon.

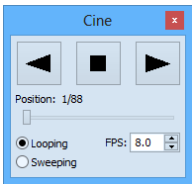


Figure 142 – Cine tool

Using this dialog it is possible to control playback of images or a multi-frame image in any current view of the workspace. You can select the current view and by the **Cine** tool you can select the playback mode. Then you can select another view and in this tool you can select the playback mode for this new current view. During selection of another current view the playback in the view will be kept.

The **Cine** dialog allows:

- play images in selected direction : forward ► or reverse ◄
- stop playing ■

- play images repeatedly: in one selected direction (**Looping**) or in back and forth (**Sweeping**)
- change the frame rate - **FPS** (frames per second)

If a multi-frame image contains curves (such as ECG), these can be projected into the image by selecting the **Curves** option in the **View** menu (see Figure 143). When playing, the current position in the sequence of frames is marked with a small vertical line inside the curve.

If the **Double click starts/stops playback** option is allowed in the TomoCon settings (see 4.1.4 View options), it is possible to start or stop the playback of a multi-frame image in the current view simply by double-clicking.

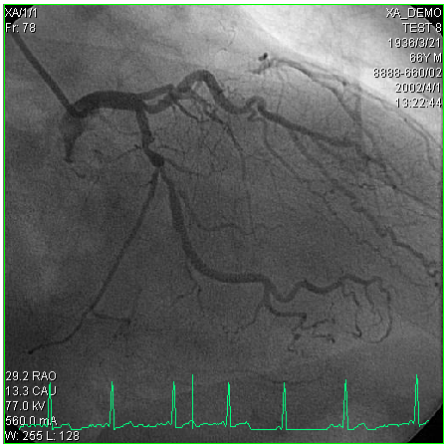


Figure 143 – Cine view playing multi-frame image with the ECG curve

7 Manipulating images

7.1 Window and level manipulations

Window and level manipulations are among the most common tasks in digital medical imaging. These functions allow you to view patient image data with appropriate contrast and image detailing in a particular grayscale range.

Each view in TomoCon uses its own window/level setting for image display. The window/level setting is defined by the window and level values and the palette graduation type with a defined shape.

To change the window and level values, you can use any of the following methods:

- Adjusting the window/level using the mouse.
- Selecting a predefined window/level preset.
- Using the **Window/level** tool in the tools panel.

All changes of the window/level setting remain valid in any view until a new image is projected in the view, e.g. a new image is displayed in the view using the thumbnails palette. In this case, all window/level settings in the view are set up according to the values in the newly selected image.

Current changes to the window/level settings in the current view are applied automatically and immediately to all images according to the limit selected in the **Scope** tool. You can limit changes to a single segment, series or study.

The window/level changes applied to the current view can also be applied to the image (which is also displayed in the thumbnail preview). Select the **Apply** item in the context menu of the current view to apply these changes to the image. Click the **Apply to all** button to apply these changes to all images and views of the current series.

7.1.1 Window/level tool

The **Window/level** tool (see Figure 144) is initially docked in the tools panel and is accessible at any time by clicking the tab with the  icon.

Using this tool, you can view and change the window/level setting of the currently selected view. To adjust the window, level and shape of the current view, use the **Window**, **Level** and **Shape** sliders in the Window level tool. Additionally, you also can change the palette graduation type by selecting a new one from the **Window type**

combo box, apply certain presets using the **Presets** button and invert the current color palette by checking/unchecking the **Invert** check box.

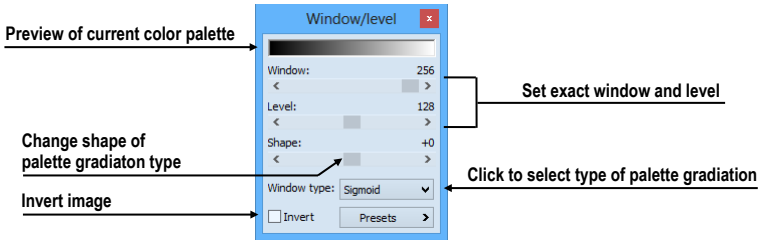


Figure 144 – Window/level tool

7.1.2 Window/level adjustment mode

The TomoCon application offers four ways in which to represent and change the values for a window/level setting. The visible range of the image data (the window) can be specified through the following methods:

- Window/level – the window value defines the width and the level value defines the center in the image data displayed in the view.
- Low/Up – the low value defines the lower (start) limit and the up value defines the upper (end) limit in the image data values displayed in the view.
- Low/Up [%] – the low value defines the lower (start) limit and the up value defines the upper (end) limit in percentage of the image data values displayed in the view.
- Contrast/Brightness – this method is accessible only for VOI LUT presets and cannot be used for other types of presets. Instead of changing the width and position of the image data, the contrast and brightness changes the width and position of the VOI lookup table (see 7.1.4 VOI LUT) defined by the preset.

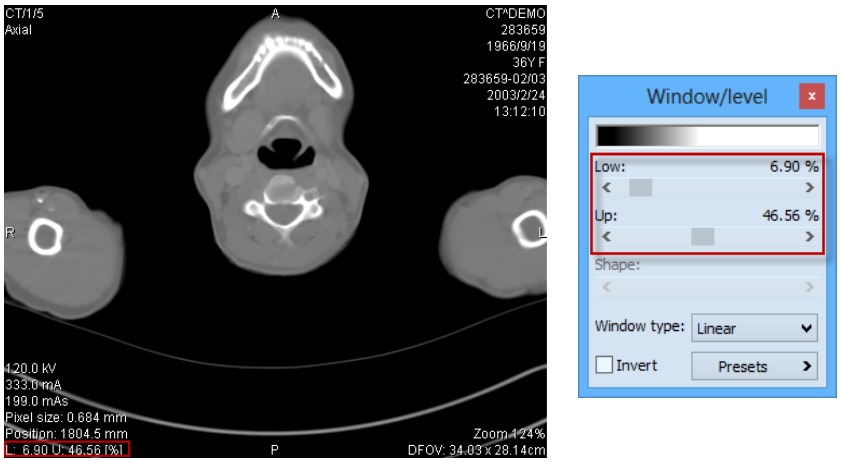


Figure 145 – Window/level tool and a view with the LU[%] adjustment type

To change the current adjustment method, select the required method in the **Adjustment type** combo box in the **TomoCon options** dialog (see 4.2 Modality options). For the specified modality, the window/level information string in the views (the view texts), as well as in the **Window/level** tool, is formatted according to this option (see Figure 145).

7.1.3 Palette graduation type

The color palette used for displaying image data is represented by the color gradient. This gradient can be modified by adjusting its curve type. Changing the graduation type slightly modifies the color gradient and therefore provides you with the possibility to refine the details displayed in the view. The TomoCon application offers base linear, sigmoid and exponential types of color graduation. Additionally, sigmoid and exponential graduation can be refined by specifying the shape factor in the **Window/level** tool in the tools panel.

To change the current window/level graduation type, select a new type in the **Window type** combo box (see Figure 146). As mentioned above, you can select one of the following graduation types:

- **Linear** – the gradient changes linearly
- **Sigmoid** – the gradient changes according to the sigmoid function
- **Exponential** – the gradient changes according to the exponent function
- **Histogram EQ** – this is a special window/level setting mode called histogram equalization. Using this method, you can optimally set the contrast of the image so that the image intensities are evenly distributed. This mode is useful for overexposed and underexposed images.

Selecting the **Sigmoid** or the **Exponential** mode in the combo box makes the **Shape** slider accessible (it is otherwise disabled) which can be used to change the shape factor in the current view.

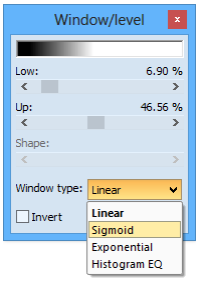


Figure 146 – Changing the palette graduation type

7.1.4 VOI LUT

Certain images may contain DICOM information about how to present image data to a user. This information is represented by a lookup table called the Values Of Interest Lookup Table (VOI LUT preset). The table can be used to transform the input image data intensities instead of the mathematical (linear, sigmoid or exponential) function.

When an image contains a VOI LUT preset, it is used for display within the view by default. In this case, the special **VOI LUT Data** graduation type is added to the **Window type** combo box in the **Window/level** tool (see Figure 147). A VOI LUT preset does not use window, level and shape values. The **Contrast** (instead of the **Window**) slider and the **Brightness** (instead of the **Level**) slider are used to adjust the contrast and the brightness of the visible range (-100%, 100%) of the image data. Both values are set to 0% by default, which means that the visible range is the entire data range.

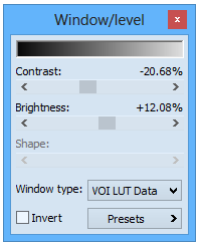


Figure 147 – Changing a VOI LUT Data preset

Once the graduation type is changed from one VOI LUT to another in the **Window type** combo box, it cannot be set back. You would instead have to reset the entire view settings or set the VOI LUT preset manually.

7.1.5 Presets

For quick and convenient adjustment of the window/level values, the TomoCon application provides you with the preset functionality. A preset is a set of the exact values for the window, level and shape. When you apply a preset, all values are applied to the view at one time. The preset values can also be defined inside any image as part of DICOM information. In addition, TomoCon provides a number of predefined presets for each modality and also offers you the possibility to create and use your own presets. Additionally, names and key shortcuts (F2-F9) can be assigned to the user-defined presets.

For each image displayed in the view, TomoCon provides an immediately accessible list of all applicable presets in the **Window/level preset** submenu in the context menu of the current view or in the drop-down list displayed by clicking the **Presets** button

in the **Window/level** tool. The DICOM presets and modality presets are separated by the menu separator.

To apply a window/level preset, select the corresponding item from the list of presets in the context menu of the view or in the list in the Window/level tool. If you have assigned any of the keyboard shortcut keys (F2 to F9) to your preset, simply press the keyboard shortcut and the preset will be applied.

To create a new window/level preset for a specified modality, proceed as follows:

1. Select the image of the modality for which you want to create a new preset in the current view.
2. Click the **Presets** button in the **Window/level** tool, which displays the drop-down list of all presets.
3. Select the **New preset…** menu item (see Figure 148) in the displayed list. The **Window/level preset** dialog (see Figure 149) is then displayed. The initial values for the window, level shape and palette graduation type (even if not displayed) are the same as the current window/level settings in the current view.

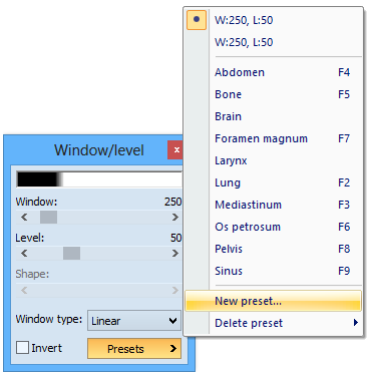


Figure 148 – Creating a new window/level preset

4. If necessary, enter a new preset name into the **Preset** edit box and enter the new values for the window, level and shape into the **Window**, **Level** and **Shape** edit boxes.
5. Optionally, you can select a keyboard shortcut (F2 to F9) from the **Key** combo box to be assigned to the new preset.
6. To save the preset, click the **OK** button.

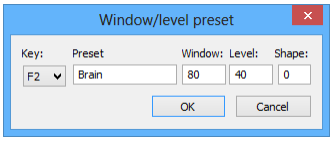


Figure 149 – Window/level preset dialog – defining a new preset

To remove a defined preset, proceed as follows:

1. Click the **Presets** button in the **Window/level** tool.
2. The drop-down list is then displayed. You can find all the defined presets in the **Delete preset…** submenu.
3. Select the preset you want to remove in the displayed submenu list (see Figure 150).

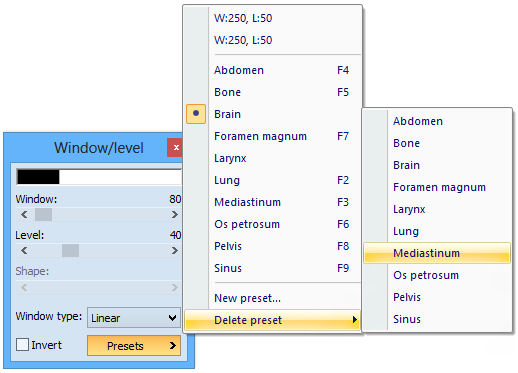


Figure 150 – Deleting a window/level preset

Alternatively, you can create a new (or edit and remove an existing) preset for each modality on the **Modality** tab of the **TomoCon options** dialog (see 4.2 Modality options).

7.1.6 Inverting a color palette

The current view color palette can be inverted so that the colors in the color gradient are ordered in reverse order. To invert the current color palette, check the **Invert** check box in the **Window/level** tool. If you want to use the original color palette within the current view, simply uncheck the **Invert** check box.

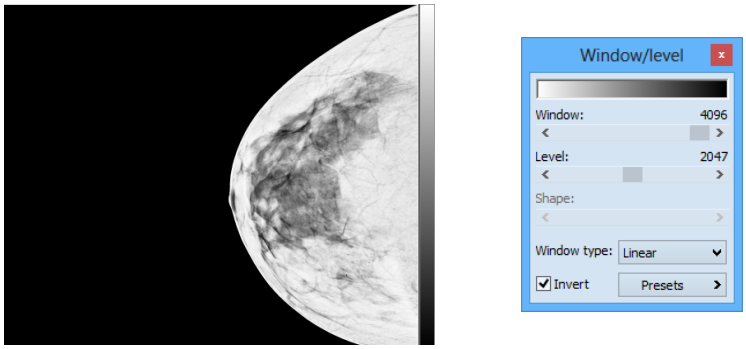


Figure 151 - Inverted view (Smart invert is activated)

If the current image contains DICOM information concerning background air and the **Smart invert** check box on the **Modality** tab of the **Options** dialog (see 4.2 Modality

options) for the image modality is checked, inverting the view inverts the entire image except for the air areas (see Figure 151).

7.1.7 Adjusting window/level using the mouse

In order to modify the window and the level simultaneously without using the **Window/level** tool, click the **Window/level** icon in the **Image** menu or select the **Window/level** item in the context menu of the view (the cursor changes to the form). Next, click in the view and move the cursor (holding down the left mouse button) horizontally (window) and vertically (level). The level and window values change immediately.

Alternatively, the level and window values can also be changed using the **Window/level rectangle**. This is accessible in the **Image** menu and in the context menu of the view through the **Window/level rectangle** item. The cursor changes to the form. Click in the image and move the cursor within the view (holding down the mouse button). A rectangle will be drawn around the area. You can cancel the dragged rectangle by pressing the **Esc** button on the keyboard. After the mouse button is released, the window and the level are set for optimal contrast in the area within the rectangle.

7.2 Zooming an image

Zooming an image allows you to change the zoom factor in the current view to examine fine details of the displayed image, e.g. when diagnosing small structures, contouring small objects or clicking reference points. TomoCon offers the following ways in which to change this factor when zooming in/out within images:

- moving the cursor within the current view using the zoom or zoom rectangle function (see 7.2.2 Zooming with the mouse)
- scrolling the mouse wheel while holding down the **Ctrl** key
- using the **Zoom** tool that is accessible in the tools panel (see 7.2.1 Zoom tool)

The interpretation of the current zoom factor depends on the currently selected zoom mode, which defines the scaling between the image and the view size. Unlike the zoom factor, the zoom mode is not set separately for each view but is set globally for the entire TomoCon application, except for the mammography mode.

TomoCon offers the following zoom modes (it is assumed that the zoom factor has not been changed, i.e. it is set to 100%):

- **Fit to view** – the image is displayed so it is entirely visible within the view.

- **True size** – the image is displayed so that 1 mm of the actual image is equal to 1 mm on the display.
- **Right size** – the images are displayed so that the largest image is fit to the view and the rest of the images are displayed in the same physical size.
- **Pixel for pixel** – each image is displayed so that one pixel on the display corresponds to one image pixel. If the Pixel for pixel zoom mode is set as the current zoom mode and you change the zoom factor of the current view (using the zoom functions or the mouse wheel), the current zoom mode immediately changes to **Fit to view**.

When using the **True size** or **Right size** zoom mode, it is required that all monitors are calibrated because these modes cannot display an image without the information concerning the physical dimensions of the display. The monitor is calibrated using the **TomoCon options** dialog (see 4.7 Monitors).

Information concerning the currently used zoom mode and the current zoom factor is also displayed in the view as part of the zoom view text (see Figure 152).

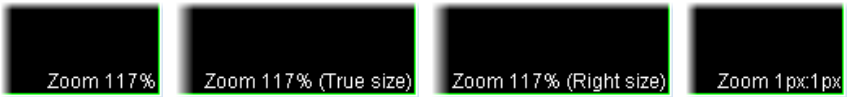


Figure 152 – Zoom view text (fit to view, true size, right size, pixel for pixel)

After the image is zoomed, some parts of the image may be moved outside the current view. You therefore may need to move the entire image within the view. To change the current image position within the current view, use the mouse with the active move function (see 7.2.3 Moving with the mouse).

The zoom and move changes in the current view are applied automatically and immediately to all images according to the limit selected in the **Scope** tool, which is part of the status bar in TomoCon. You can restrict the changes to a single segment, series or study, or you can apply the changes to all views in all working areas. These changes can also be applied directly to the image (which will also be displayed in the thumbnail preview) by selecting the **Apply** item in the context menu of the current view (or by selecting the **Apply to all** item in order to apply to all images and views of the current series).

TomoCon also provides the magnifying glass functionality, which allows you to magnify an area of interest within a small, separate magnification window without changing the zoom factor of the current view (see 7.2.4 Magnifying glass).

7.2.1 Zoom tool

The **Zoom** tool (see Figure 153) is initially docked in the tools panel and can be accessed by clicking the icon.

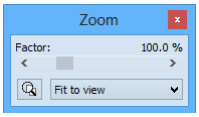


Figure 153 – Zoom tool

The **Zoom factor** can be changed by moving the slider in the dialog; it can be set to any percentage from 50% to 1600%. The new zoom value is then immediately changed in the current view and the current values are displayed automatically at the right, above the slider. The center of zooming is defined by the alignment of the current view. When changing the zoom factor, the image in the view is zoomed from this center equally in all directions. This can also be done by scrolling the mouse wheel while holding down the **Ctrl** key.

To change the current zoom mode, select a new mode from the **Zoom mode** combo box (see Figure 154). When the current zoom mode is pixel for pixel, the **Zoom factor** slider is disabled. It becomes enabled again when the zoom factor of the current view is changed using the mouse (using the zoom or zoom rectangle function), using the mouse wheel while holding down the **Ctrl** key or when a different zoom mode is set as the current one.

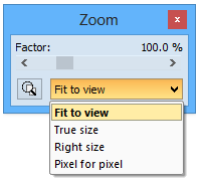


Figure 154 – Zoom mode combo box

7.2.2 Zooming with the mouse

To modify the zoom factor using the mouse (without using the **Zoom** tool), select the zoom or zoom rectangle function. These functions are accessible in the view's context menu or in the **Image** submenu of the main menu:

- To activate the Zoom function, select the **Zoom** item (the cursor changes to the form). Next, click in the view and move the cursor (holding down the left mouse button) in the image vertically. The image is then immediately zoomed and the clicked point remains in the same position. This is useful when zooming a particular detail.
- To activate the zoom rectangle, select the **Zoom rectangle** item (the cursor changes to the form). Next, click in the view and move the cursor (holding

down the left mouse button) to draw the rectangle. You can cancel the dragged rectangle by pressing the **Esc** key. After the mouse button is released, the area within the rectangle is zoomed to fit the view.

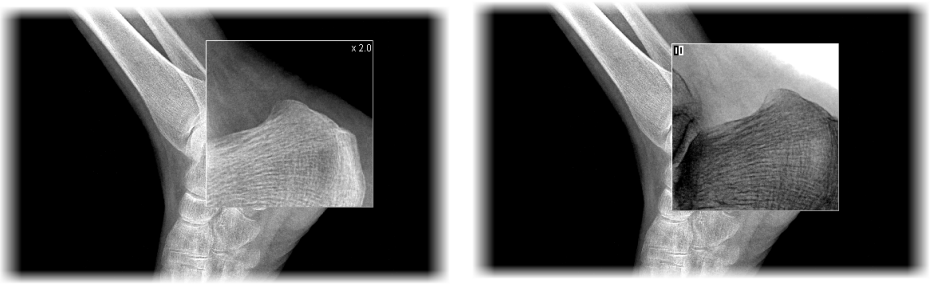
7.2.3 Moving with the mouse

To modify the position of an image within a view, use the move function, which is accessible in the view's context menu or in the **Image** submenu of the main menu, and proceed as follows:

1. Select the **Move** item to activate the move function (the cursor changes to the form).
2. Click in the current view (the cursor changes to the form) and move the mouse (holding down the left mouse button) within the view.
3. The image then moves immediately as you move the mouse. When finished moving the image, release the mouse button.

7.2.4 Magnifying glass

The magnifying glass function allows you to magnify an area of interest within a small, separate magnification window that moves along with the cursor.



(a) **(b)**

Figure 155 – Active Magnifying glass window, normal (a), invert (b)

To activate the magnifying glass, proceed as follows:

1. Click the **Magnify** button in the **Zoom** tool or select the **Magnifying glass** item in context menu of the current view (the cursor changes to the form).
2. Press and hold the left mouse button over the area of the image you want to magnify. The magnifying window appears at the position of the cursor and displays the magnified part of the view (the cursor will not be visible); see Figure 155b. Moving the cursor across the selected view changes the magnifying glass position and the part of the image it displays.

3. To change the zoom factor of the magnifying glass, press the **Ctrl** key and scroll the mouse wheel. It is possible to set a zoom factor of up to 8. The current zoom factor of the magnifying glass is displayed in the upper right-hand corner of the magnification window (it disappears after a few seconds).
4. To invert the zoomed image in the magnification window, press the **Tab** key (see Figure 155b). To turn off the invert mode, press the **Tab** key again.
5. To close the magnifying glass window, release the mouse button.

7.3 Image filters

The TomoCon application includes numerous image processing filters for noise removal and small structure enhancement. These filters can be applied to any image in the working area using the **Filter** tool (see Figure 156) in the tools panel.

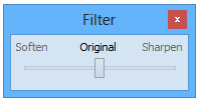


Figure 156 – Filter tool

To apply a filter to an image, select the view containing the image to be filtered. Next, select the degree of softening or sharpening using the slider (the left side is used for softening, the right side is used for sharpening and the middle position is used to switch off the filtering).

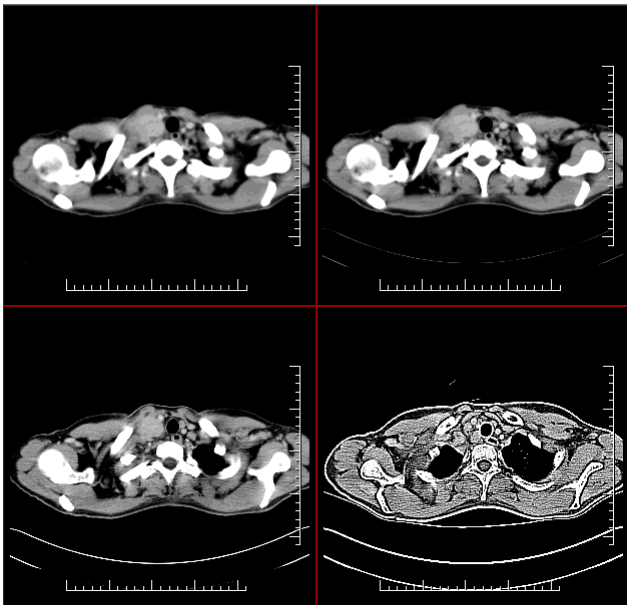


Figure 157 – The effects of the various filters available in TomoCon

7.4 DSA - Digital Subtraction Angiography

The DSA mode supports the display of multi-frame images with an image sequence taken with contrast media and without. The final DSA image is then displayed as the difference between the base image (with contrast media) and the mask image (without contrast media).

To separate the base and mask images, the following modes can be used:

- Automatic – the images contain DICOM information from the patient examination and the separation occurs automatically after opening the patient data in TomoCon (see 7.4.1 Automatic DSA mode).
- Manual – image separation has to be carried out manually (see 7.4.2 Manual DSA mode).

7.4.1 Automatic DSA mode

First, open the desired patient study with the multi-frame image containing the DICOM information concerning the DSA examination. After the image is displayed, the DSA mode, depending on the **Always apply DSA** setting on the **General** tab of the **TomoCon options** dialog (see 4.1 General options), is turned on automatically in all views for all image types. After selecting the image in the current view, all modification operations available in the application can be used to work with the image (see Figure 158).

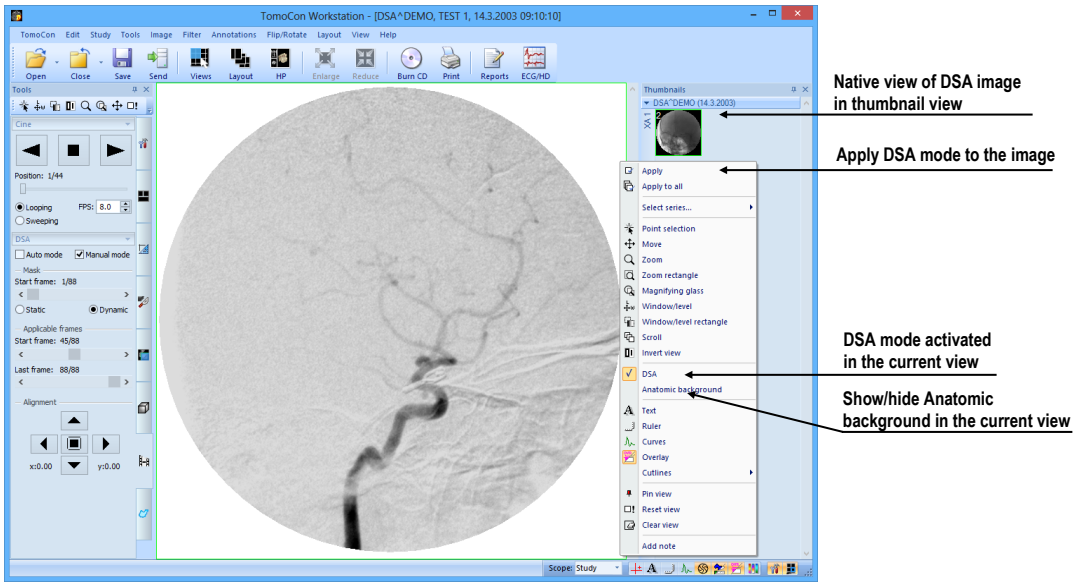


Figure 158 – Automatic DSA mode

The DSA mode in the current view can be turned off by selecting the **DSA** item in the view's context menu. The changes made in the current view can be applied to the

image's thumbnail preview by selecting the **Apply** item in the context menu of the current view. The changes are applied to all images in the current series by selecting the **Apply to all** item in the context menu of the current view.

7.4.2 Manual DSA mode

To activate the manual DSA display mode, use the **DSA** tool, which is initially docked in the tools panel. It is accessible at any time by clicking the tab with the icon or by selecting the **DSA…** item in the **Tools** menu in TomoCon. Proceed as follows:

1. Open the desired patient study containing the multi-frame image without DICOM information concerning the DSA examination and select the multi-frame image in the current view.
2. Select the **Manual mode** in the **DSA** tool (see Figure 159).

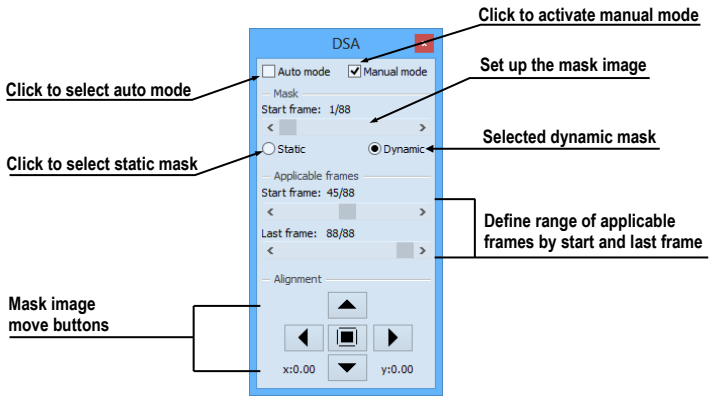


Figure 159 – DSA tool

The manual DSA mode then becomes active in the current view, according to the following parameters of the **DSA** tool:

- **Mask frame** - the starting image number in the mask (image sequence without contrast media):
  - **Static mask** - the mask frame is static for all selected frames
  - **Dynamic mask** - the mask frame changes dynamically according to the currently selected frame
- **Applicable frame** - the image sequence with contrast media covered with the mask image(s):
  - **Start** - the first sequence image number
  - **Count -** the number of sequence images

- **Alignment** - movement of the mask image relative to the base image (- up, - left, - right, - down, - center, original position)

The changes to these parameters are then applied immediately to the image in the current view.

You can switch from the automatic DSA mode of the image with DICOM information to the manual mode wherever appropriate. DSA setting changes can be made using the **DSA** tool.

To return to the original setting, select the **Auto mode** item and the settings will revert back to the original DICOM setting.

7.5 Cutlines

Cutlines are intersections of image planes in one series and a plane of a selected image from another series in which they are displayed.

The **Cutlines** function can be used between two series only if registration between the series has been created (see 16 Registrations).

Open the desired patient study with multiple series and registrations between them. Select the image in the thumbnails palette in which the cutlines are to be displayed. Select the **Cutlines** option in the view's context menu or the **View**/**Cutlines** menu to activate the **Cutlines** function (see Figure 160).

Select the patient series in the **Cutlines** menu. The cutlines of the selected series are then immediately displayed in the current view; these are called standard cutlines (if the planes are not parallel). Standard cutlines are displayed as lines with series and image descriptions (see Figure 160). You can set up the cutline color and line shape in the application settings (see 4.4 Color options).

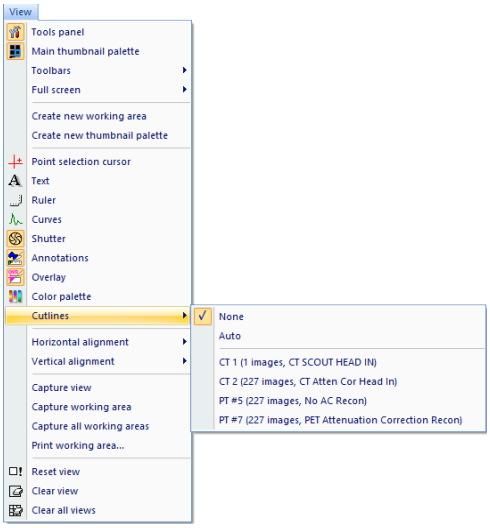


Figure 160 – View/Cutlines menu

Load the desired image from the selected series into another view; its position will be displayed in the view with the displayed cutlines (the current cutline). The current cutline is displayed as a line; you can set up the color and line shape in the application settings (see 4.4 Color options). The cutline automatically changes when another image of the selected series is chosen. This is also displayed when scrolling the images of the series with the displayed cutlines (as long as the planes are not parallel).

It is possible to project cutlines of multiple series into one image. Select the series you want to display in the image in the **Cutlines** menu.

It is also possible to display cutlines in multiple views at one time (see Figure 161). In each view, right-click and select the **Cutlines** and the registered series.

If the cutlines cannot be displayed, one of the following is true:

- There are no registrations defined between the series.
- The section planes are parallel (they do not intersect).

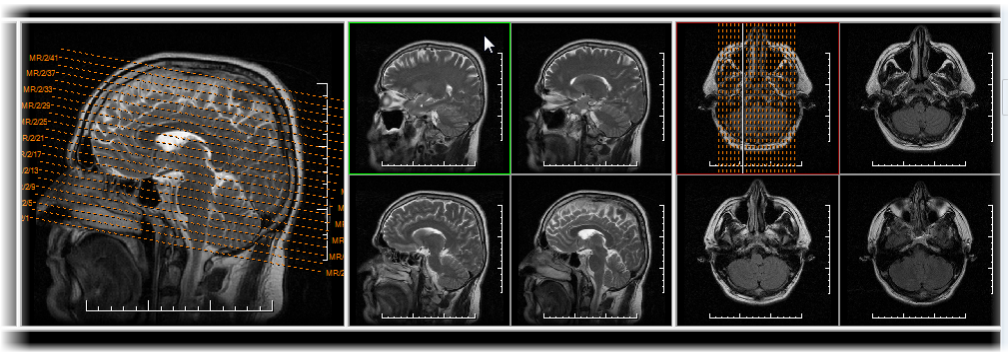


Figure 161 – Displayed cutlines in the working area

7.5.1 Hiding cutlines

The **None** item in the **Cutlines** menu (see Figure 160) is a predefined option which means that no cutlines will be displayed. Once the cutlines have been activated, select the **None** item to turn off the display of the cutlines (right-click and select **Cutlines/None**).

It is also possible to hide **Cutlines** by clicking the selected series in the **Cutlines** menu.

7.5.2 Auto mode

First, right-click in the current view, select the **Cutlines**/**Auto** item in the context menu (see Figure 160) and open an image from any patient series in a new window. The cutlines of the new series are then automatically displayed in the view with the

Auto mode. The selected image is displayed as the current cutline. The current cutlines automatically change when the image in the current view is changed.

7.5.3 Printing cutlines

Defined cutlines can be printed out with the image on a standard Microsoft Windows printer or a DICOM printer (see 17 Print images).

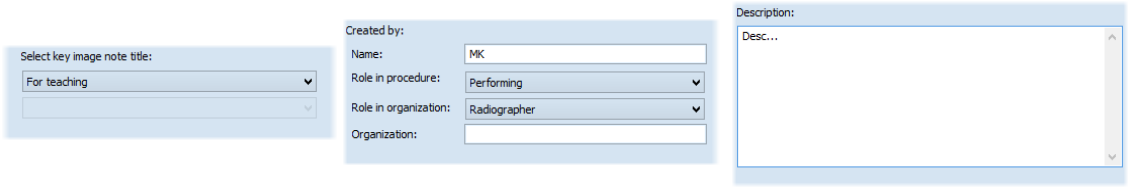
7.6 Key image notes

Key image notes provide a mechanism for indicating the importance of an image to a group of viewers. Each key image note is comprised of various attributes including a reason code signifying the basis for the note, an optional text description supplied by the user and a reference to the image to which the key image note refers.

7.6.1 Adding a key image note

To add a key image note, proceed as follows:

1. Move the cursor over the thumbnail preview of the image for which the key image note is to be defined.
2. Right-click to display the context menu of the thumbnail palette.
3. Select the **Add note** item (the **Key image note** dialog for defining the new note is then displayed).
4. Enter the information concerning the new note into the displayed dialog. First, enter the name of the new note (see Figure 162a) and click the Next button. Next, fill in the information about the creator (see Figure 162b) and click the Next button. Finally, type in the description of the new note (see Figure 162c) and click the **Finish** button. The new note is then automatically added to the image.



(a) (b) (c)

Figure 162 – Key image note dialog, Note title (a), Information about creator (b), Description (c)

7.6.2 Reviewing and editing a key image note

Each key image note belongs to just one image. If one or more notes have been defined for the image, a small triangle of the defined color is displayed in the thumbnail preview of the image (see Figure 163).

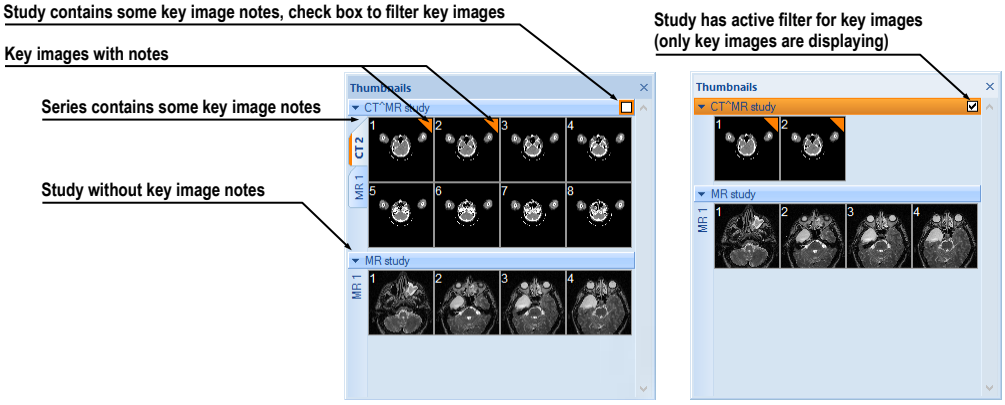


Figure 163 – Key image notes in the thumbnails palette, (a) the filter for key images is disabled, (b) the filter for key images is enabled

By moving the cursor over the triangle and double-clicking, detailed information of the key image note is displayed in the **Key image note** dialog (see Figure 164).

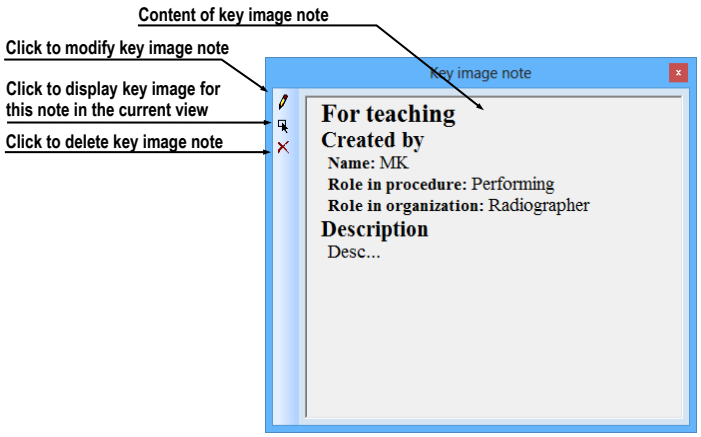


Figure 164 – Key image note dialog

If the image has more than one note, the **Key image notes** dialog (see Figure 165) is displayed in which you select the note by double-clicking.

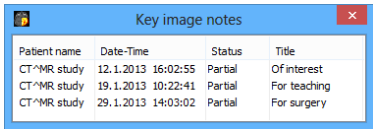


Figure 165 – Key image notes dialog for note selection

7.6.3 Loading and saving a key image note

The TomoCon application allows you to save the notes of all opened studies as DICOM objects in the Local studies storage. The notes can further be sent to the PACS. Key image notes can be saved by selecting the **Save** item in the **Study** menu or, when attempting to close the TomoCon application, a dialog is displayed allowing you to save unsaved changes.

If a series has key image notes, these are displayed in the **Search studies** dialog as objects with KO modality (see Figure 166). When a study with key image notes is opened, the key image notes that belong to the study also open automatically.

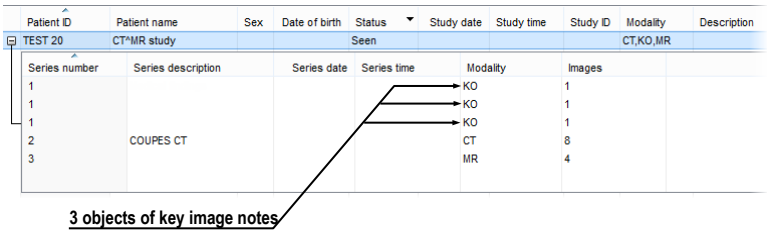


Figure 166 – Search studies dialog, study with key image notes

7.7 Exporting images

The TomoCon application enables the export of patient image data in the following formats:

- JPEG, DICOM, TIFF, BMP (see 7.7.1 Export of images)
- AVI (see 7.7.2 Exporting images to an AVI format video file)

7.7.1 Export of images

It is possible to export a selected patient image (or an entire series of patient images) into a bitmap file or a DICOM file. The **Export** dialog is opened by selecting the **Export images…** item in the **Study** menu (see Figure 167).

The available bitmap file formats are JPEG, BMP, TIFF and DICOM. Select the image dimensions for the bitmap file or leave the dialog's presetting (**Use original image dimensions**).

If you selected the entire series option in the dialog and then press the **Save** button, the **Images to export** dialog will be displayed in which you can define the range of images to be exported (see Figure 168).

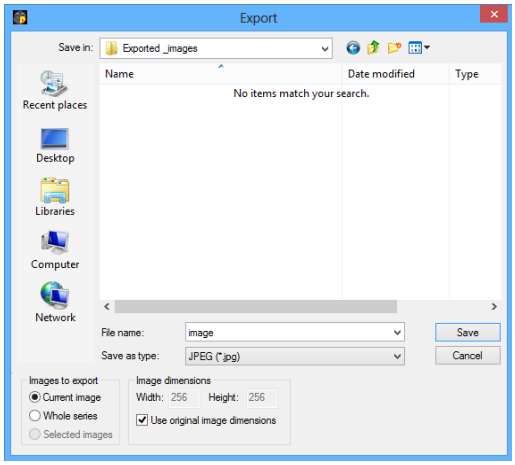


Figure 167 – Export images dialog

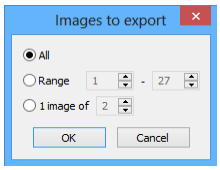


Figure 168 –Images to export dialog

7.7.2 Exporting images to an AVI format video file

At times, it is useful to create a video file from a series of patient image data in order to play back the data on another computer.

The **Create AVI** dialog (see Figure 169) opens by selecting the **Export as AVI video…** item in the **Study** menu.

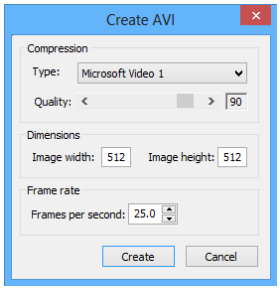


Figure 169 – Create AVI dialog

The **Create AVI** dialog allows you to define the following:

- **Compression -** series video compression of any available type to create an AVI format video file. Please keep in mind that the used codec (or an equivalent one) should be available on the other computer in order to play back the video file; if not, it will not be possible to play back the file.
- **Dimensions** - the image dimensions.
- **Frame rate** - the playback speed.

You can also choose to retain the default values supplied in the dialog.

Once you finish defining the video parameters in the dialog, click the **Create** button. In the **Frames to export** dialog that is then displayed (see Figure 170), you can define the range of images to be exported.

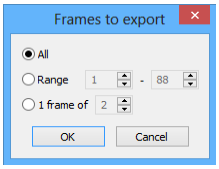


Figure 170 – Frames to export dialog

7.8 Adding and removing images of series

At times, it is necessary to remove unneeded images from a series or to add certain images to a series, potentially a screenshot or a copy of the working area as a separate image. You can use the functionality of the thumbnail palette or the capture functions in the main menu of the TomoCon application to carry out these tasks.

To insert a screenshot of the working area by means of the thumbnail palette (see Figure 171), proceed as follows:

1. Select the desired working area (by clicking any view in the working area).
2. Move the cursor over the images belonging to the target series to which you want to add the screenshot.
3. Right-click to open the context menu and select the **Insert image/Insert working area screenshot** item (see Figure 174). The image from the current view is then automatically inserted at the end of the target series.

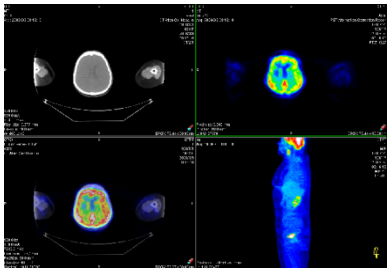


Figure 171 – New image created as a screenshot from the current working area

Alternatively, you can use the main menu of the TomoCon application as follows:

1. Select the desired working area (by clicking any view in the working area).
2. Select the **View/Capture working area** item in the main menu.
3. The screenshot of the working area is then inserted at the end of the OT series in the current study (if the OT series does not exist, it will be created).

To insert a screenshot of the current view by means of the thumbnail palette (see Figure 172), proceed as follows:

1. Prepare the image for the screenshot in the current view.
2. Move the cursor over the thumbnail previews of the images from the series into which the new image is to be inserted.
3. Right-click to display the context menu and select the **Insert image/Insert view screenshot** item (see Figure 174). The screenshot of the current view is then automatically inserted at the end of the series.

Alternatively, you can use the main menu of the TomoCon application as follows:

1. Prepare the image for the screenshot in the current view.
2. Select the **View/Capture view** item in the main menu.
3. The screenshot of the current view is then automatically inserted at the end of the OT series in the current study (if the OT series does not exist, it will be created)

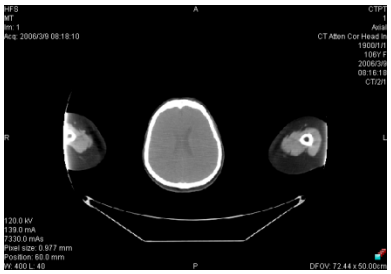


Figure 172 - New image created as a screenshot from the current view

To insert a screenshot of all working areas using the main menu of the TomoCon application (see Figure 173), proceed as follows:

1. Select the **View/Capture all working areas** item in the main menu.
2. The screenshot of all working areas is then automatically inserted at the end of the OT series in the current study (if the OT series does not exist, it will be created). A separate image will be created from each working area.

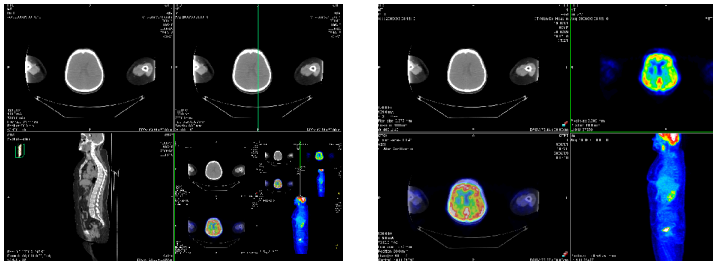


Figure 173 – New images created from two working areas

To insert a copy of a selected image into the current view (it will be copied as a DICOM image), proceed as follows:

1. Select the image for insertion into the current view.
2. Move the cursor over the thumbnail previews of the images from the series into which the new image is to be inserted.
3. Right-click to display the context menu (see Figure 174) and select the **Insert image**/**Insert image copy** item (see Figure 174). The image from the current view is then automatically inserted at the end of the series.

To delete a selected image from a series, proceed as follows:

1. Move the cursor over the thumbnail preview of the image to be deleted. If you want to delete a group of images from the same series, right-click the first image holding down the mouse button, move to the last image and release the mouse button. The images for deletion will be highlighted in blue.
2. Right-click to display the context menu (see Figure 174) and select the **Delete image** item. The image is then automatically deleted from the series.

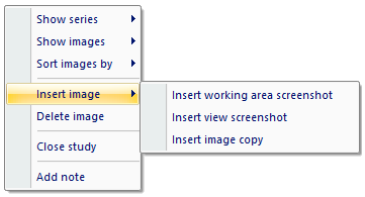


Figure 174 – Context menu of the thumbnails palette

8 Hanging protocols

If you frequently work with the same type of data series of individual patients, the TomoCon application provides you with the possibility to display images from these series according your own guidelines. Such a group of guidelines defines a hanging protocol, which can be saved in the application for future use. You can later view or edit all stored hanging protocols or define new ones using the Hanging protocols manager (the **Hanging protocols manager** dialog, see Figure 175). To display the **Hanging protocols manager** dialog, select the **Hanging protocols manager…** item in the **Layout** menu.

You can apply defined and stored hanging protocols to the loaded studies in TomoCon manually or you can activate the option for them to be applied automatically according to the first loaded study.

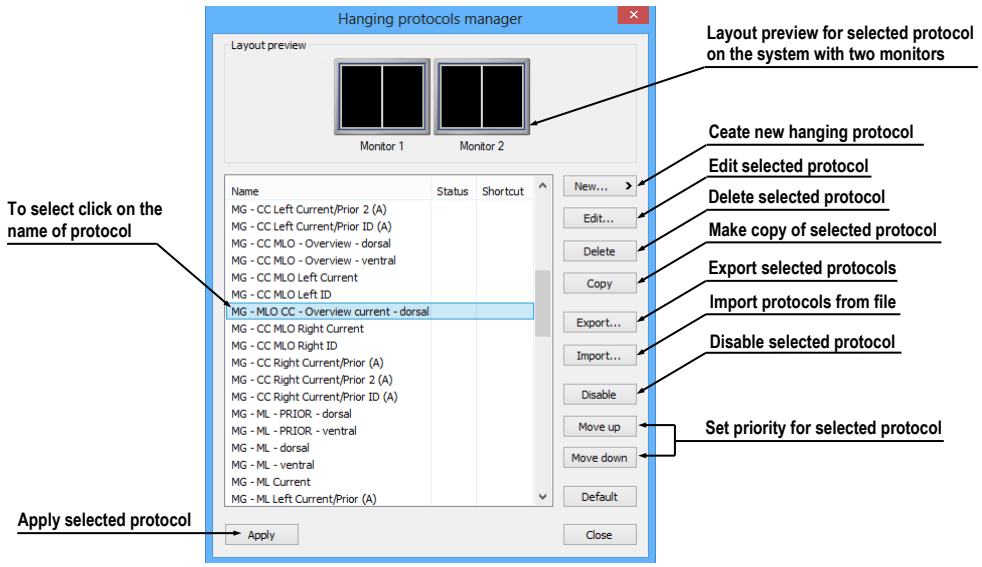


Figure 175 – Hanging protocols manager dialog

The layout preview in the **Hanging protocol manager** dialog enables advanced drag-and-drop functionality, which can be used for moving working areas to a selected monitor. You can move the working areas between the monitors and place multiple working areas from one monitor onto another (see Figure 176). The number of working areas depends on the number of monitors connected to the workstation.

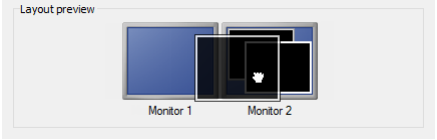


Figure 176 – Drag-and-drop functionality in the layout preview

8.1 Applying a hanging protocol

The TomoCon application provides you with the possibility to apply a selected hanging protocol to the current working area manually or automatically.

To apply a hanging protocol automatically, check one of the following items in the **Layout** menu:

- **Automatically apply/Auto-apply hanging protocol –** the protocol is selected according to priority. TomoCon browses through all protocols one by one starting with the one with the highest priority and applies the first protocol whose criteria conforms to the opened study.
- **Automatically apply/Apply last used hanging protocol –** when you open the first study in TomoCon, the most recently used protocol is applied to the given study automatically.

To apply a hanging protocol manually, proceed as follows (see Figure 177):

1. Click the **HP** icon in the main toolbar.
2. In the displayed window, click the required hanging protocol to be subsequently applied.

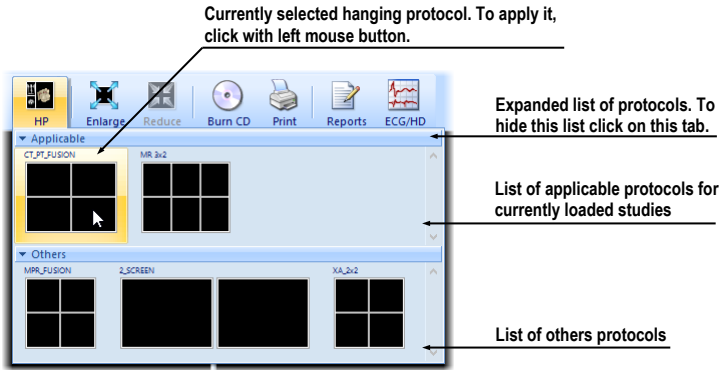


Figure 177 – List of hanging protocols

8.2 Importing and exporting hanging protocols

To transfer previously defined hanging protocols from one computer to another, you can use import and export functions in the **Hanging protocol manager** dialog (to display the **Hanging protocol manager** dialog, select the **Hanging protocol manager…** item in the **Layout** menu).

To export hanging protocols, proceed as follows:

1. Select the protocol(s) for export in the displayed list (to make multiple selections, hold down the **Ctrl** key).

2. Click the **Export…** button and, in the displayed dialog, enter the name of the file designated for export.

To import a hanging protocol, proceed as follows:

1. Click the **Import…** button and select the required file.
2. The imported hanging protocol will be added to the list of all protocols. If the imported protocol already exists, you can overwrite it or you can leave the original protocol.

8.3 Manually creating and modifying a hanging protocol

The **Hanging protocol manager** dialog allows you to define a new protocol or edit an existing one. To display the **Hanging protocol manager** dialog, select the **Hanging protocol manager…** item in the **Layout** menu.

The main part of each protocol is the defined layout of the working area (for an explanation of how to define a layout, see 3.1.1 Working area layout). Once you apply the selected protocol to the opened study, the existing application layout is replaced by this layout and consequently, all properties of the protocol are then applied to the individual parts of the working area.

To define a new hanging protocol, proceed as follows:

1. Click the **New…** button and select the working area layout in the displayed list.
2. In the displayed **Hanging protocol properties** dialog, define the properties of the new protocol and click the **OK** button.

To modify the properties of a hanging protocol, proceed as follows:

1. In the list of all protocols, select the hanging protocol to be changed and click the **Edit…** button.
2. In the displayed **Hanging protocol properties** dialog, make the required changes to the properties and click the **OK** button to confirm the changes.

The **Hanging protocol properties** dialog (see Figure 178) allows you to attach various criteria and properties to a selected hanging protocol. These criteria and properties relate to a particular view of the layout of the protocol and can differ for each view. As a result, you first have to select the view in the **Layout preview** window before defining the criteria and properties.

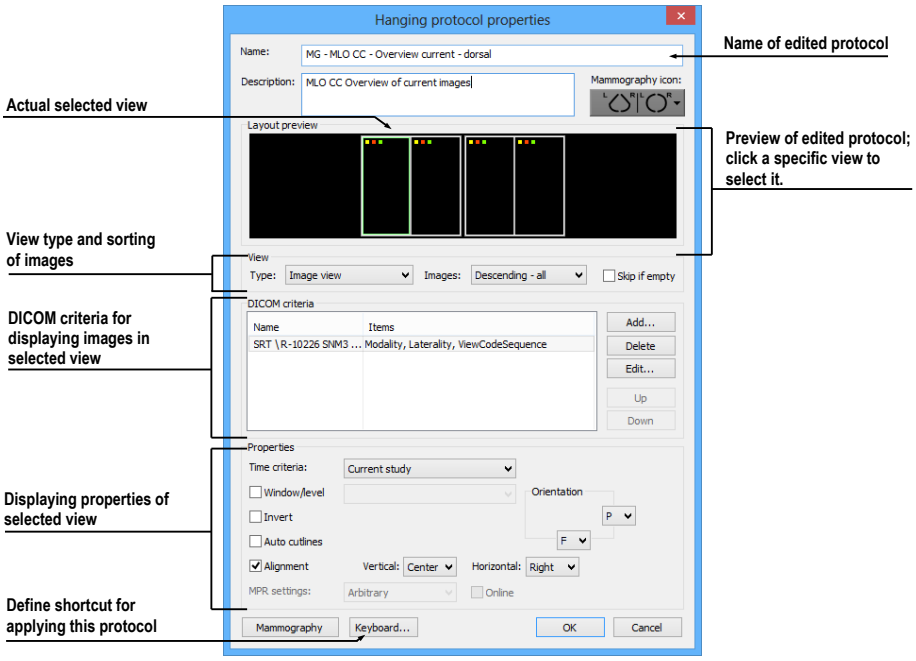


Figure 178 – Hanging protocol properties dialog

8.3.1 DICOM criteria

The DICOM criteria determine which images can be displayed in a particular view. They can be formulated using sets of selected DICOM tags with their allowed values.

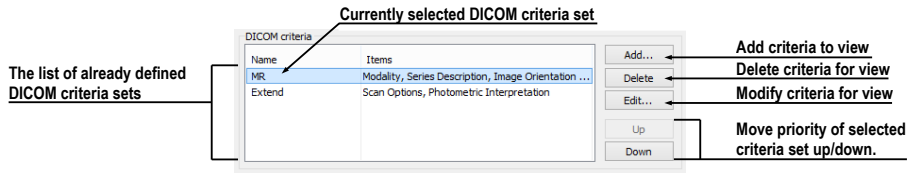


Figure 179 – Hanging protocol properties dialog

To add new sets of DICOM criteria, click the **Add…** button in the DICOM criteria section (see Figure 179). The **DICOM criteria set** dialog (see Figure 180) is then displayed in which you can edit or define new allowed values of the selected DICOM tags.

To add new DICOM criteria, click the **Add** button (see Figure 180) and make a selection in the displayed menu:

- **(custom)** – to add a new criterion defined by the DICOM group and element.
- **(from DICOM dump)** – to add a new criterion by selecting it directly in the DICOM dump of the image displayed in the current view in TomoCon. This option is allowed only when the layout of hanging protocol is the same as current layout in tomocon and current view contains some displayed image.
- One of the predefined criteria (**Modality**, **Image Laterality**, **View Position**).

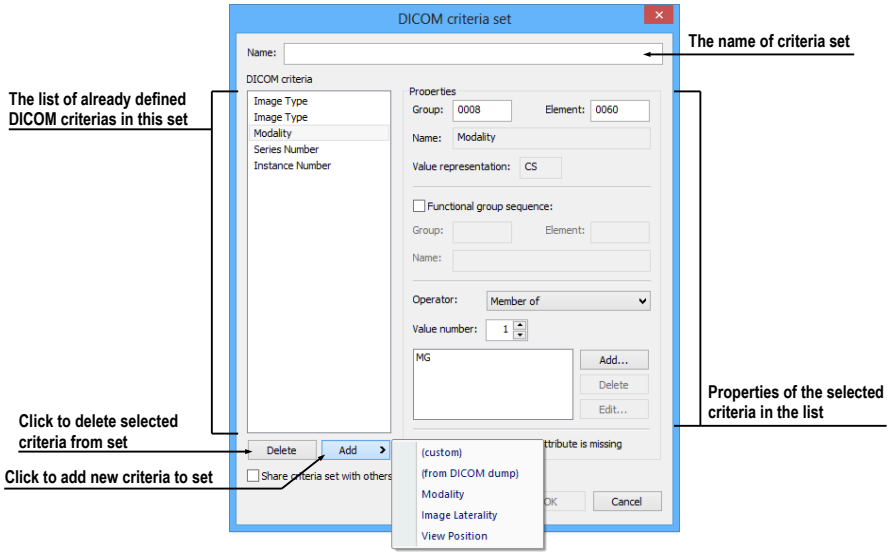


Figure 180 – DICOM criteria set dialog

After adding a new criterion, you can edit its properties in the **Properties** section of the **DICOM criteria set** dialog in the following manner:

1. Select the DICOM criteria in the list.
2. Define its DICOM group and element in the **Group** and **Element** boxes. The name of the DICOM tag is then automatically displayed in the **Name** box.
3. Check the **Functional group sequence** check box and define its DICOM group and element if the edited DICOM tag refers to another functional DICOM tag.
4. Define the allowed values for the specified DICOM tag (see Figure 181):
   - Select the operation to be used to compare the defined value with the value in the image.
   - To add a new value, click the **Add** button. The **Edit value** dialog is then displayed in which you can enter the desired value. Confirm by clicking the **OK** button or discard the change by clicking the **Cancel** button.
   - To delete a defined value, select the required value in the list and click the **Delete** button.

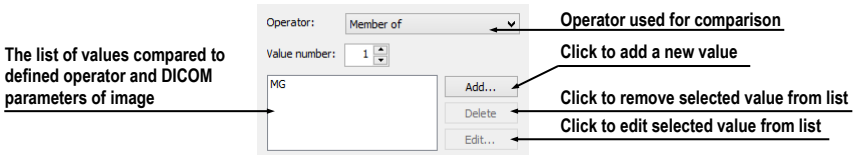


Figure 181 – DICOM criteria set dialog

To remove a DICOM criterion from a set, select the given DICOM criterion in the list and click the **Delete** button.

8.3.2 View properties

In this part of the **Hanging protocol properties** dialog (see Figure 182), you can specify various properties for the selected hanging protocol DICOM criteria set.

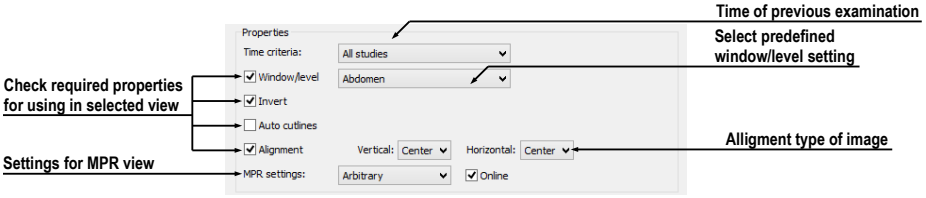


Figure 182 – Hanging protocol properties dialog

To define time sequencing criteria, select the time constraint in the displayed list (see Figure 183). If a time constraint is defined for a view, all the images that are to be displayed in the view must comply with the time constraint.

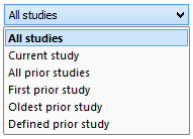


Figure 183 – Time criteria list

To apply selected properties, check the particular named properties in the dialog and, if necessary, set their parameters (see Figure 182). The following properties can be set:

- **Window/level** (select the specific type of window/level preset)
- **Invert**
- **Auto cutlines**
- **Alignment** (select the type of alignment for the horizontal and vertical direction)

8.3.3 Identification of criteria and properties

When you assign hang criteria and properties to particular views, small colored squares appear in the corresponding views (in the upper left-hand corner of each view) in the **Hanging protocol properties** dialog in the **Layout preview** window (see Figure 184) that identify the criteria and properties. The meaning of the colors is as follows:

- yellow – DICOM criteria is defined for the view
- red – time criteria is defined for the view
- green – properties are defined for the view

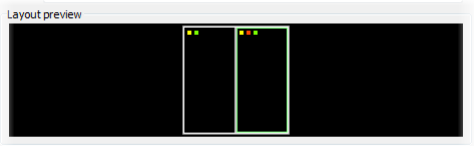


Figure 184 – Color identification of criteria and properties

8.4 Automatically creating a hanging protocol

The TomoCon application allows you to create a hanging protocol automatically from the current layout and the displayed images in the views. The newly created hanging protocol will have the same layout as the currently displayed layout in TomoCon and each view will have the basic criteria assigned, selected from the currently displayed image.

To automatically create a hanging protocol, proceed as follows:

1. Select the **Hanging protocol manager…** item in the **Layout** menu in TomoCon. The **Hanging protocol manager** dialog will be displayed.
2. Click the **New…** button. The menu with the previously defined layouts will be displayed.
3. Select the **(current layout and views)** item in the displayed menu (see Figure 185).

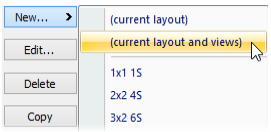


Figure 185 – Current layout and views item

4. The new hanging protocol will automatically be created and its properties will be displayed in the **Hanging protocol properties** dialog in which it can be further modified.

9 Annotations and measurements

Annotations and measurements in the TomoCon application are used for measuring distances, angles, areas and density profiles and for describing specific parts of patient data. TomoCon offers the following annotation and measurement tools:

- **Text -** for a detailed description concerning a specific location in an image (see 9.2 Text annotations)
- **Marker -** for a description along with a marker (an arrow) pointing to the point described (see 9.3 Marker annotations)
- **Distance -** the distance between two points (see 9.4 Distance)
- **Distances and angle** (see 9.5 Distances and angle)
- **Cobb angle -** an angle between two independent lines (see 9.12 Cobb angle)
- **Probe -** a tracking circle tool for displaying point level values in the specified circular area (see 9.6 Probe)
- **Density spot -** desired point level values (see 9.7 Density spot)
- **Density profile -** characteristics of all image points between two points (see 9.8 Density profile)
- **Ellipse** - characteristics of all image points included in the elliptical area (see 9.9 Ellipse)
- **Rectangle** - characteristics of all image points included in the rectangular area (see 9.10 Rectangle)
- **Area** - characteristics of all image points covered by a free area (see 9.11 Free area)

All annotations and measurements are included in the **Annotations** menu (see Figure 186). It is also possible to activate them in the tools panel (the tab with the  icon).

After using an annotation and measurement tool, it is possible to set up its properties using the annotations and measurements context menu (see Figure 186). The context menu is displayed by moving the cursor over the tool (it will be highlighted and the cursor will change from an arrow to a cross) and pressing the mouse context button. The following operations are available:

- **Font** settings and **Color** settings
- **Keep settings -** the color and font settings for newly created annotations and measurements (**For all** tools, **For same type** of tools)

- **Edit label -** it describes the measurement or annotation (see 9.1 Label editing)
- **Delete** (a tool) and **Locked -** the latter for locking a tool in an image to prevent moving, deleting or the operations mentioned above

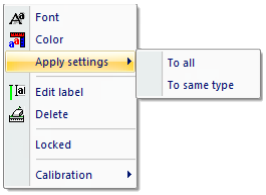


Figure 186 – Annotations and measurements context menu

When using a tool defining an area (Ellipse, Rectangle, Free area), the **Show text** item is added to the context menu (see Figure 187). This option allows you to display or hide the **Size** of the outlined area, the **Min value**, the **Max value**, the **Mean value** and the **Deviation**.

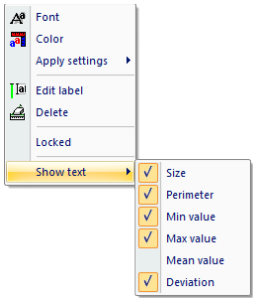


Figure 187 – Context menu for ellipse, rectangle and free area

When using the Density profile tool, the **Show/Hide graph** item is added (see 9.8 Density profile).

If the image selected in the current view contains DICOM information concerning the measuring units, the **Value units** item is added to the context menu of the selected measurement through which it is possible to change the value of the currently used measuring unit.

To move the annotation and measuring tool to a different position within a view, move the cursor over the annotation/measuring tool until it is highlighted (the cursor changes from an arrow to a cross). Press and hold down the left mouse button and then release it at the desired location (the annotation text moves along with the tool). Additionally, if the selected measurement type is Density spot, Density profile, Rectangle, Ellipse or Density area and the image within the current view is changed with the left mouse button pressed, the selected measurement tool moves to the new image.

When moving the angle and distance measuring tool, it is also possible to move only one point at the end of the measuring line. When the cursor is placed over the selected

end point, it changes into a red circle (see Figure 192). Press and hold down the left mouse button and move the point to the alternate location within the current view. After moving the annotation and the measurement tool or its point, the displayed values are immediately recalculated.

For patient images with transformation, TomoCon calculates the actual point distances or area automatically. Images without transformation rarely contain sufficient information in the patient study data that is required for such calculations and therefore the calculations are given in the pixels. In this case, you can convert the pixel units to length units (mm) or area units (cm^2) manually, using the calibration tool (see 9.13 Calibration).

9.1 Label editing

Each measurement can be labeled with additional informational text. This is useful when you want a measurement to be labeled with a description or note. When you define a label for a measurement, it then becomes a part of it and will take over the measurement font size and color. Afterwards, when you move the measurement within the view, the label follows along with it and its position is automatically updated. You can also simply change the relative position of the label (with regard to the measurement) by dragging it.

To define a new label or to change the existing label of a selected measurement, proceed as follows:

1. Display the context menu of the measurement (by right-clicking the measurement) and select the **Edit label** item.
2. An edit box is then displayed near the measurement (see Figure 188). To speed up the entry of the most frequently used labels, a combo box is available containing up to 20 of the most recently used labels (sorted chronologically) for each measurement type. You can select any of these recently used labels or edit one to create a new label.

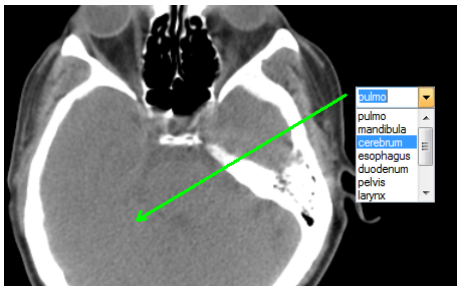


Figure 188 - Editing a label using recently used labels

3. To confirm the entered text, press the **Enter** key or click in the view.

4. To discard the changes when editing a label, press the **Esc** key.

It is not possible to add an additional text label for the text and marker annotation or the probe measurement.

9.2 Text annotations

Short text descriptions can be written directly inside an image, for an important structure or object, using the **Text annotation** tool. To define a **Text annotation**, select the **Text** item (with the icon) in the **Annotations** menu or click the **Text** button in the **Annotations** tool (the tab with the icon) in the tools panel (see Figure 189).

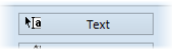


Figure 189 – Annotations tool

Next, click the point in the image to be annotated. An edit box then opens in which you can type in the description (see Figure 190). Press the **Enter** key to confirm the change and to complete the editing process (see 9.1 Label editing).

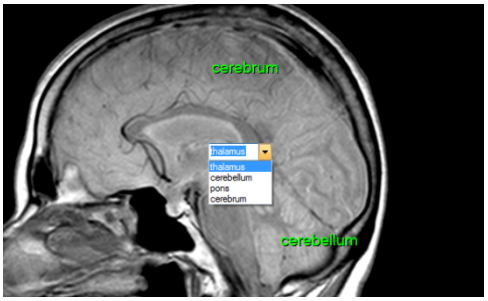


Figure 190 – Image with Text annotations

9.3 Marker annotations

A short text description for an important structure or object can be written directly inside an image using the **Marker annotation** mode. The mode is activated by selecting the **Marker** item in the **Annotations** menu or by clicking the **Marker** button in the **Annotations** tool (the tab with the icon) in the tools panel (see Figure 191).

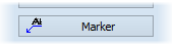


Figure 191 – Annotations tool

Click the point in the image to be annotated. Drag the thin line to the location where the annotation text is to be placed and click. An edit box then opens in which you can

type in the description (see Figure 192). Press the **Enter** key to confirm the change and to complete the editing process (see 9.1 Label editing).

Figure 192 – Image with Marker annotations

9.4 Distance

The distance measurement can be used after selecting the **Distance** item in the **Annotations** menu or clicking the **Distance** button in the **Measurements** tool in the tools panel (see Figure 193).

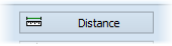


Figure 193 – Measurements tool

Click the first point and the second point while dragging the measurement line. The distance between these two points is displayed next to the second point (see Figure 194).

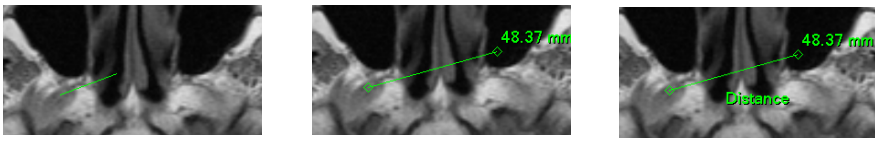


Figure 194 – Distance between 2 points

9.5 Distances and angle

The distances and angle measurement can be used after selecting the **Distances and angle** item in the **Annotations** menu or clicking the **Angle** button in the **Measurements** tool in the tools panel (see Figure 195).

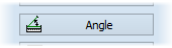


Figure 195 – Measurements tool

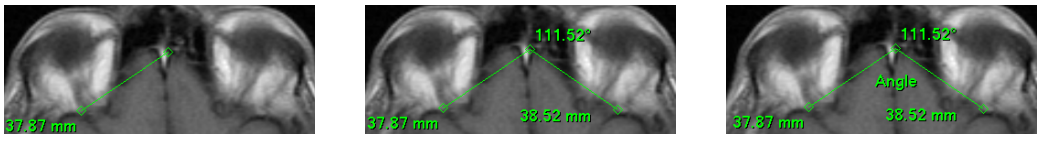


Figure 196 – Distances and angle between 3 points

The use of this measurement is similar to the use of the Distance measurement, except that an additional third point has to be defined. Both the distances and the angle between the distance lines are displayed (see Figure 196).

9.6 Probe

The Probe tool is a special circular measurement tool for tracking an actual pixel value at a specified location within a selected view. This measurement can be used after selecting the **Probe** item in the **Annotations** menu or clicking the **Probe** button in the **Measurements** tool in the tools panel (see Figure 197).

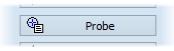


Figure 197 – Measurements tool

Click the desired point and, holding down the left mouse button, move the measurement through the image within the selected view and the Probe will display the current minimal pixel value, the maximal pixel value and the mean value of the pixels that lie within the probe's circle (see Figure 198). To finish displaying the values, release the left mouse button and the Probe measurement tool will be hidden. Additionally, if the selected image within the view is changed with the left mouse button pressed, the Probe will display the actual pixel values on the newly selected image.

To change the size of the circle of the measurement, press the **Shift** key while holding down the left mouse button at any location within the selected view and move the cursor. The size of the Probe measurement changes according to the movement of the cursor. When the desired size is reached, release the left mouse button and the **Shift** key and the new specified size will be stored.

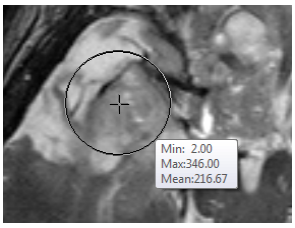


Figure 198 – Probe measurement

9.7 Density spot

The density spot measurement tool can be used after selecting the **Density spot** item in the **Annotations** menu or clicking the **Density spot** button in the **Measurements** tool in the tools panel (see Figure 199).

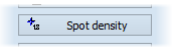


Figure 199 – Measurements tool

Click the desired point. The value of the image point is then displayed next to the defined point (see Figure 200).

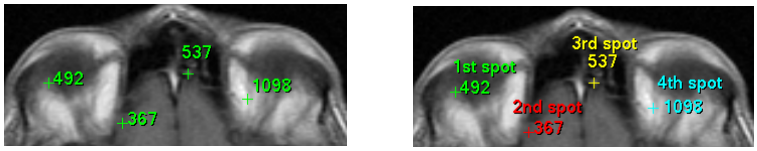


Figure 200 – Density spot at various points

9.8 *Density profile*

The Line Density profile can be measured after selecting the **Density profile** item in the **Annotations** menu or clicking the **Density profile** button in the **Measurements** tool in the tools panel (see Figure 201).

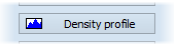


Figure 201 – Measurements tool

Click the first point and, holding down the left mouse button, drag the measurement line to the desired location and release the mouse button. The characteristics of all image points covered by the line are summarized and displayed as a tool tip (see Figure 202).

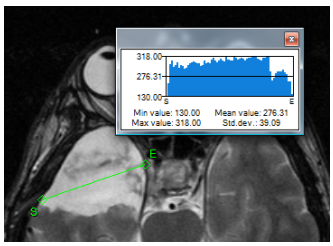


Figure 202 – Density profile of a line between 2 points

In the images of opened studies, you can create multiple measurement lines. The corresponding Density profile of a line can be temporarily hidden by clicking the button in the upper right-hand corner of the graph. After clicking the measurement line with the context mouse button, the Density profile reappears by selecting the **Show/Hide graph** option (see Figure 203).

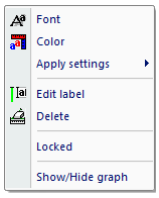


Figure 203 – Density profile context menu

9.9 Ellipse

Ellipse drawing is activated by selecting the **Ellipse** item in the **Annotations** menu or by clicking the **Ellipse** button in the **Measurements** tool in the tools panel (see Figure 204).

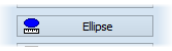


Figure 204 – Measurements tool

Click the first point and, holding down the left mouse button, move the cursor to the desired position and click again to define the second point of the ellipse. The characteristics of all image points covered by the elliptical area are summarized and displayed above the ellipse (see Figure 205).

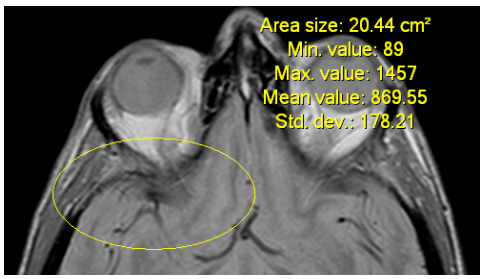


Figure 205 – Elliptical area profile

You can move the ellipse to any location inside an image simply by dragging it or you can resize it by dragging its corners. The displayed values are then recalculated.

9.10 Rectangle

Rectangle drawing is activated by selecting the **Rectangle** item in the **Annotations** menu or by clicking the **Rectangle** button in the **Measurements** tool in the tools panel (see Figure 206).

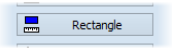


Figure 206 – Measurements tool

Click the first point and, holding down the left mouse button, drag the cursor to the desired position and click again to define the second point of the rectangle. The characteristics of all image points covered by the rectangular area are summarized and displayed above the rectangle (see Figure 207).

You can move the rectangle to any location inside the image simply by dragging it or you can resize it by dragging its corners. The displayed values are then recalculated.

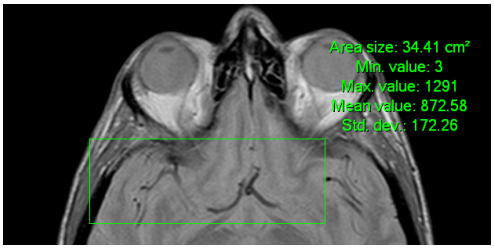


Figure 207 – Rectangular area profile

9.11 Free area

Free area drawing is activated by selecting the **Density area** item in the **Annotation** menu or by clicking the **Density area** button in the **Measurements** tool in the tools panel (see Figure 208).

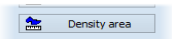


Figure 208 – Measurements tool

An area can be outlined by dragging the cursor with the left mouse button pressed. The characteristics of all image points covered by the free area are summarized and displayed next to the free area (see Figure 209).

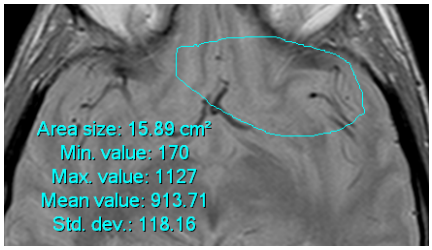


Figure 209 – Free Area

To add an additional area to the existing area, click the **Area** icon and hold down the **Ctrl** key with the left mouse button pressed (the mouse cursor will have the form). To remove a part of the area, click the icon again holding down the Shift key with the left mouse button pressed (the cursor will have the form).

You can move an area to any location inside the image by means of the mouse. The displayed values are then recalculated.

9.12 Cobb angle

The Cobb angle measurement can be used after selecting the **Cobb's angle** item in the **Annotations** menu or clicking the **Cobb's angle** button in the **Measurements** tool in the tools panel (see Figure 210). This measures the angle between two independent lines.

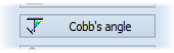


Figure 210 – Measurements tool

Click the first point and the second point of the first line and then the first point and the second point of the second line. The smaller angle between these defined lines will be displayed at the end of one of them (see Figure 211).

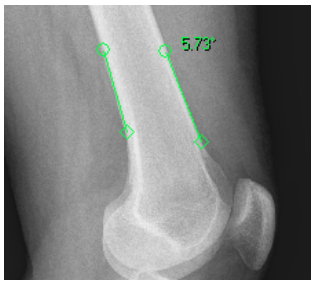


Figure 211 – Cobb's angle

9.13 Calibration

> Calibration can not be used for images containing transformation.

For images without transformation in which the pixel size is unknown, calibration can be used to calculate the approximate distance between two points.

To activate calibration, select the **Calibration** item (see Figure 212) in the **Annotations** context menu, which is displayed by pressing the mouse context button on the Distance measurement.

The following two options are available:

- **Calibrate measurement -** to open the **Calibration** dialog in order to define the calibration (see Figure 212).
- **Apply to whole series -** to apply a defined calibration to a series.

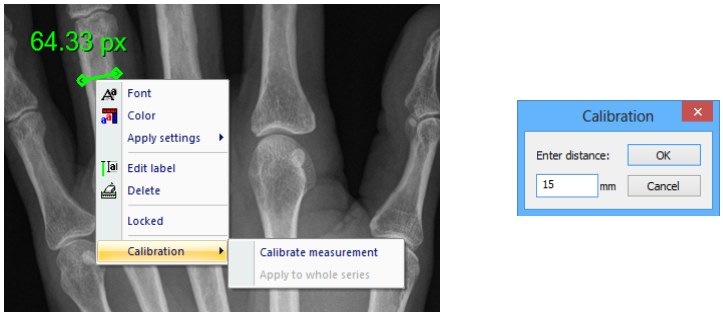


Figure 212 – Calibration context menu and the Calibration dialog

The **Calibration** dialog allows you to define calibration by entering a selected line length in millimeters into the **Enter distance** box. After clicking the **OK** button, all measured distances and areas in the image are calculated according to the defined calibration.

The calibration of previously calibrated images without transformation can be changed again using the **Calibration** dialog. A dialog will be displayed stating that the image has already been calibrated (see Figure 213).

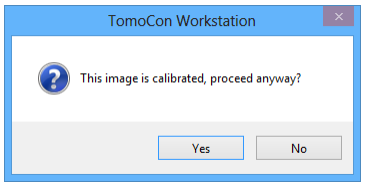


Figure 213 – Calibration dialog: This image is calibrated, proceed anyway?

If you want to change the calibration in a series with previously calibrated images, select the **Apply to whole series** option. If other images in the series are already calibrated, a warning dialog will be displayed (see Figure 214).

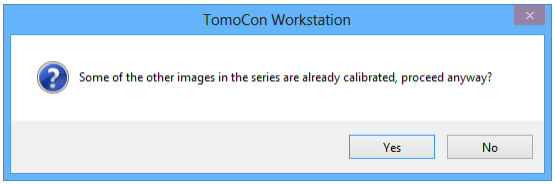


Figure 214 – Some of the other images in the series are already calibrated, proceed anyway?

9.14 Hide / show annotations

To hide or display existing annotations in all views and TomoCon working areas, select the **Annotations** item in the **View** menu or click the **Hide all** button on the third tab (the tab with the icon) of the tools panel (see Figure 215).

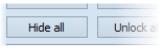


Figure 215 – Hide all buttons

9.15 Discard annotations

An individual annotation can be deleted by clicking it with the context mouse button and selecting the **Delete** item in the displayed **Annotations** context menu. Alternatively, you can select the **Annotations…** item in the **Annotations** menu (see 9.16 List of annotations).

To discard all annotations defined in all opened patient studies, select the **Delete all** item in the **Annotations** menu.

It is also possible to discard annotations in the current image, series or study using the corresponding items in the **Annotations / Delete all in** menu:

- **Delete all in image**
- **Delete all in series**
- **Delete all in study**

9.16 List of annotations

To open the dialog containing the list of all annotations defined in the opened studies, select the **Annotations…** item in the **Annotations** menu or click the **Annotations…** button (see Figure 216) on the **Annotations** tab (the tab with the icon) of the tools panel (see Figure 217).

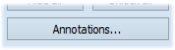


Figure 216 – Annotations… button

The list contains the type, the location (in the "series/image" format), the description and the value of the annotations. The **value** column contains the measured values obtained using the measurement tool (distance, angle, density, etc.). For the ellipse, rectangle and density area measurements, the value column contains only the size of the measured area. No value is displayed for the density profile measurement.

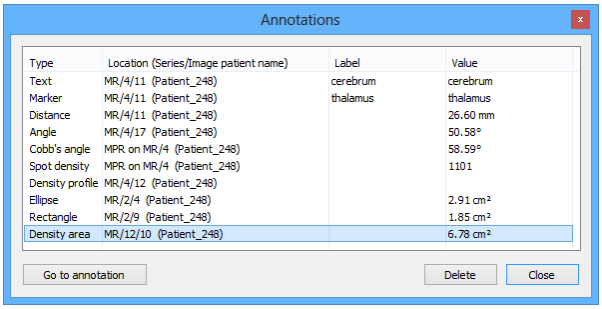


Figure 217 – Annotations dialog

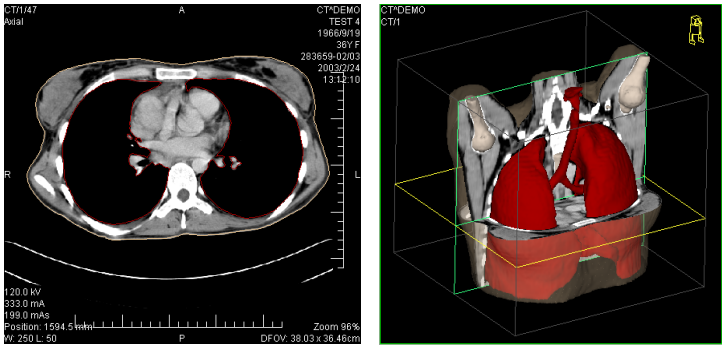
By selecting an annotation and clicking the **Go to annotation** button, the image with the selected annotation is displayed in the current view.

By clicking the **Delete** button, the selected annotation is deleted from both the list and the image.

10 Contouring the patient – create ROIs

Patient contouring is carried out using two-dimensional (2D) display that provides sharper imaging and better recognition of patient anatomical structures through colored highlighting in images (see Figure 218). When creating contours on multiple images, an ROI (Region of Interest) is automatically created, along with the automatically calculated volume (in cm^3), which can be displayed in the space in three-dimensional (3D) patient presentation (see Figure 218).

NOTE! The calculated ROI volume in TomoCon depends on the resolution setting for the specific ROI (see 10.7 Editing ROI properties).



(a) **(b)**

Figure 218 – Displaying ROI, (a) contour in 2D, (b) ROI in 3D

The TomoCon application allows you to create Regions of Interest (ROIs) of various types using the manual and automatic tools accessible on the ROI tab of the tools panel (the tab with the icon); see Figure 219. This includes 2D and 3D viewing functionality of image series and drawn ROIs, as well as advanced 2D and 3D drawing tools. Each ROI can be created in the original image direction or any reconstructed direction. The output from an ROI definition can be a DICOM RT Structure set (with an installed DIOCM RT Structure license in TomoCon), which can be sent to another DICOM-compatible system (e.g. the Treatment Planning System).

The ROI tab of the tools panel consists of the following three main parts (tools) that simplify work with ROIs and ROI contours (see Figure 219):

- **ROIs** tool - it allows you to set the currently selected ROI in TomoCon, to delete an ROI or to create a new one as well as to manage previously defined ROIs in the **Administration** dialog.
- **ROI properties** tool - for defining the properties of 2D and 3D visibility of the currently selected ROI in TomoCon.

- **ROI drawing** tool - it contains the group of manual and automatic tools for defining the contours of the currently selected ROI in TomoCon.

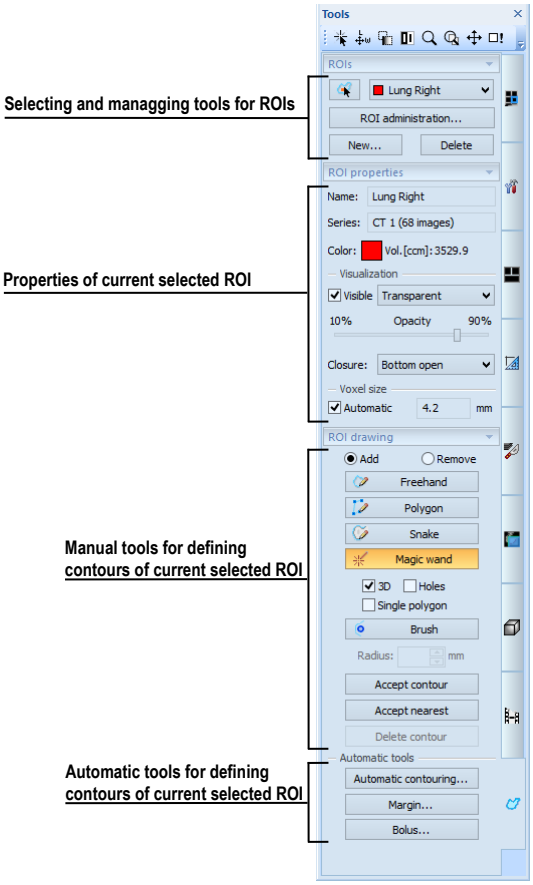


Figure 219 – ROI tab of the Tools panel

10.1 Creating new ROIs

TomoCon allows you to create a new ROI on an image of the selected series by clicking the **New...** button in the **ROIs** tool (on the tab with the icon) in the tools panel (see Figure 220). The newly created ROI will automatically be added to the ROI list and set as the currently selected ROI in TomoCon. You can then immediately define the ROI contours using the **ROI drawing** tool in the tools panel.

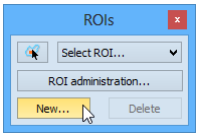


Figure 220 – Creating a new ROI in ROIs tool

To create a new ROI in TomoCon, proceed as follows:

1. Click the **New...** button in the **ROIs** tool in the tools panel.

2. The **New ROI** dialog for defining the main properties of the new ROI is then displayed (see Figure 221).
3. Select the series for the new ROI in the **Series** combo box. The default selected series is the series from the current view.
4. Select the ROI catalog type from the **Type** drop-down list and enter the name of the new ROI into the **Name** box. If no name is entered, the new ROI will be named "New ROI …" by default.
5. Select the color for the new ROI by clicking the color button next to the **Name** box. The default ROI color is randomly set.
6. Click the **OK** button. The new ROI will then be created automatically and set as the currently selected ROI in TomoCon.

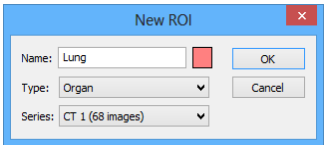


Figure 221 – New ROI dialog

10.2 Selecting ROI and contour

The currently selected ROI in TomoCon is a previously created ROI that is currently selected in the **Select ROI...** combo box in the **ROIs** tool in the tools panel (see Figure 222). Its properties are displayed in the **ROI properties** tool in the tools panel. All ROI drawing tools can only be used for this ROI in TomoCon.

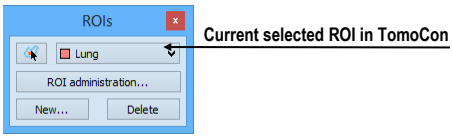


Figure 222 – Currently selected ROI in TomoCon

To set the currently selected ROI in TomoCon, proceed in one of the following manners:

- Select the ROI from the **ROIs** drop-down list in the **ROIs** tool in the tools panel (see Figure 223).

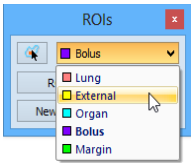
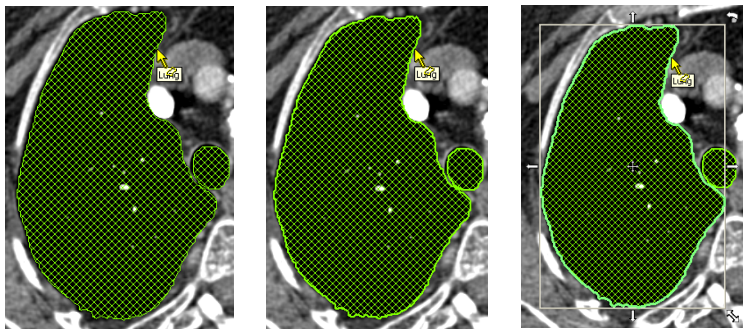


Figure 223 – Selecting the current ROI in TomoCon

- Use the Select contour tool to select the ROI contour. Once a contour is selected, the corresponding ROI is set as the currently selected ROI in the **Select ROI ...** combo box in the **ROIs** tool.

To select a contour with the Select contour tool in the view, proceed as follows:

1. Click the button in the **ROIs** tool in the tools panel and move the cursor towards the contour until the contour area is highlighted with the mesh pattern (see Figure 224a). The contour must be drawn with a continuous line; an interpolated contour drawn with a dashed line is unacceptable.
2. Click the highlighted contour (see Figure 224b) to select the ROI (if the ROI is not yet selected in the **Select ROI...** combo box).
3. Click again to select the contour (see Figure 224c).



(a) **(b)** **(c)**

Figure 224 – Selecting a contour in TomoCon

If you activate the Select contour tool when an ROI is selected in the **Select ROI...** combo box, the first polygon of the ROI in the current slice is selected automatically.

When a contour is selected (see Figure 224c), it can be moved, rotated, resized or deleted as follows:

- To delete a selected contour in its entirety, press the **Delete** key.
- To move a selected contour, move the cursor towards the middle of the contour until the mouse pointer changes into an arrow cross ✣. You can then drag the contour to the desired position.
- To rotate a selected contour, move the cursor to the rotate arrow (↻). The mouse pointer changes into the same form as the rotate arrow. Press the left mouse button and rotate the contour while holding down the mouse button until the desired position is reached.
- To resize a selected contour, move the cursor to the resize arrow (↘, ↔, ↕). The mouse pointer changes into the same form as the resize arrow. Drag the

corner/side of the contour selection frame outward (to enlarge it) or inward (to make it smaller).

10.3 Saving ROIs

When any changes to ROIs have been made in the opened studies in TomoCon, an asterisk (*) is displayed after the study time in the TomoCon title bar at the top of the window (see Figure 225).

Figure 225 – TomoCon title bar with asterisk

If any unsaved changes to ROIs exist in opened studies when attempting to close them, you are asked whether or not you wish to save the changes. If you want to save changes when a study is still open, press the **Ctrl+S** key combination on the keyboard or select the **Save** item in the **Study** menu of the main application menu. The changes to the ROIs will automatically be saved in the Local studies storage of TomoCon. To send these changes from TomoCon to a PACS, select the **Send...** item in the same menu.

10.4 Deleting an ROI

To delete an ROI in the ROIs tool in the tools panel, proceed as follows:

1. Select the current ROI in the **ROIs** drop-down list in the **ROIs** tool in the tools panel.
2. Click the **Delete** button in the same tool. After confirming the deletion operation, the currently selected ROI will be removed.

For an explanation of how to delete an ROI in the **ROI administration** dialog, see 10.5 ROI administration.

10.5 ROI administration

All ROI administration functions, such as rename, algebra, copy of ROI, etc., can be applied using the **ROI administration** dialog (see Figure 226).

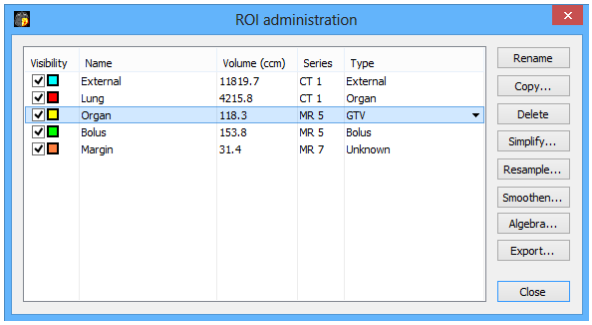


Figure 226 – ROI administration dialog

The **ROI administration** dialog contains a list of all defined ROIs in TomoCon including the visibility indicator, color, name, image series name and ROI type. The following operations can be carried out with the ROIs displayed in the list:

- renaming, deleting and changing the visibility, color and DICOM ROI type
- copying an ROI to the same series or to another series (see 10.5.1 Copying an ROI)
- simplifying ROI contours (see 10.5.2 Simplifying an ROI)
- resampling ROI contours (see 10.5.3 Resampling an ROI)
- smoothening ROI contours (see 10.5.4 Smoothing an ROI)
- carrying out an algebraic operation between ROIs (see 10.5.5 ROI algebra)
- exporting an ROI to external files (see 10.5.6 Exporting an ROI to a DXF or VTK file)

To change the visibility of an ROI, check the check box to the left of the colored box in the relevant row (see Figure 227). The display or hiding of the ROI is then immediately applied to all views in TomoCon.

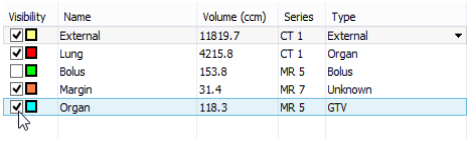


Figure 227 – Hiding the Organ ROI

To change the color of an ROI, double-click the colored box in the relevant row (see Figure 228) and then select the color in the displayed **Color** dialog. The new color of the ROI is then immediately applied to all views in TomoCon.

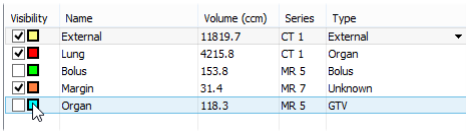


Figure 228 – Changing the color of the Organ ROI

To change the DICOM type of an ROI, display the drop-down list of the **Type** column (by clicking the ▼ button) in the relevant row and then select the desired DICOM type item in the list (see Figure 229).

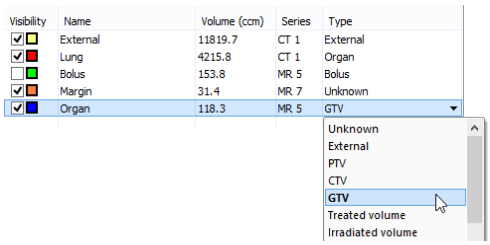


Figure 229 – Changing the ROI DICOM type

To rename an ROI, select the ROI in the ROI list and click the **Rename** button. Type the new name into the displayed name box (see Figure 230) and press the **Enter** key.

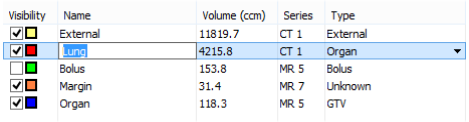


Figure 230 – Renaming a selected ROI in the ROI administration dialog

To delete an ROI, select the ROI in the ROI list and click the **Delete** button. A dialog is then displayed in which you are asked to confirm the operation (see Figure 231).

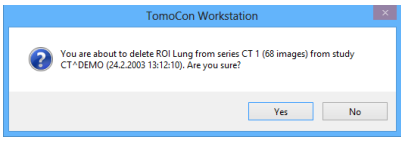


Figure 231 – Delete confirmation dialog

10.5.1 Copying an ROI

To copy an ROI to the same series or to another series using the **ROI administration** dialog, proceed as follows:

1. Select the ROI in the ROI list.
2. Click the **Copy...** button. The **Copy ROI** dialog is then displayed.
3. Type the name of the new ROI into the **ROI name** box.
4. Change the color of the new ROI by clicking the colored box to the right of the **ROI name** box.
5. Select the target series from the **Series** drop-down menu, if desired (see Figure 232). It is only possible to select a target series that is registered with the source ROI series. The "source ROI" series is the default target series.
6. Once the copying process is complete, click the **OK** button

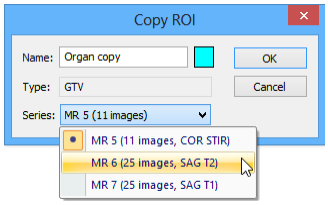


Figure 232 – Copy ROI dialog - selecting the target series

The new ROI created as a copy from the source ROI is then added as a visible ROI at the end of ROIs list in the **ROI administration** dialog (see Figure 233).

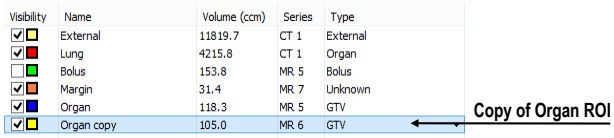


Figure 233 – New ROI created as a copy from the Organ ROI

10.5.2 Simplifying an ROI

To simplify the contours of a selected ROI using the **ROI administration** dialog, proceed as follows:

1. Select the ROI in the ROI list.
2. Click the **Simplify...** button. The **Simplify ROI** dialog is then displayed (see Figure 234).
3. Select the simplification method type in the **Simplify ROI** dialog:
   - **Remove holes** - all holes will be removed from each ROI contour.
   - **Single polygon** - only one polygon will remain in each image with all holes being removed.
   - **Reduce number of vertices** - all polygons of each contour will be reduced according to the entered number of vertices.
4. Once the simplification process is complete, click the **OK** button.

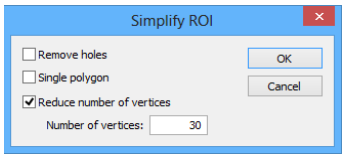


Figure 234 – Simplify ROI dialog

10.5.3 Resampling an ROI

TomoCon allows you to resample contours in original slices onto reconstructed slices. As a result, an ROI in any direction can be drawn and modified.

To resample the contours of an ROI using the **ROI administration** dialog, proceed as follows:

1. Display the image in the current view in the direction in which the ROI is to be resampled.
2. Select the ROI to be resampled in the ROI list and click the **Resample...** button. The **Resample...** dialog is then displayed (see Figure 235).
3. Enter the number of contours you wish to be drawn in the new direction (that is, the number of planes to be used to cut the original ROI).
4. In the **Into series** drop-down menu, select the target series in which the resampled ROI is to be created. The source ROI series is the default series.
5. Check the **As new ROI** check box to create the new ROI from the resampled data and leave the source contours as they are.
6. Check the **Original slices** check box to resample only to original slices (the option to select the number of slices remains inaccessible because this is determined by the number of original slices intersected by the ROI).
7. Click the **OK** button to apply resampling.

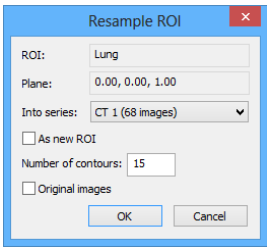


Figure 235 – Resample ROI dialog

The result of the resampling process is a resampled ROI in your selected direction with drawn contours in as many slices as you have chosen (dashed contours are applied to intermediate slices).

10.5.4 Smoothing an ROI

Smoothing makes jagged contours rounder. The more smoothened, the more of an ellipse-like shape each ROI contour has.

To smoothen ROI contours using the **ROI administration** dialog, proceed as follows:

1. Select the ROI for smoothing in the ROI list and click the **Smoothen...** button.
2. The **ROI Smoothing** dialog is then displayed (see Figure 236).

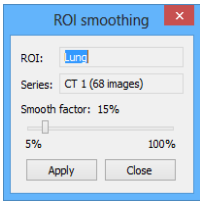
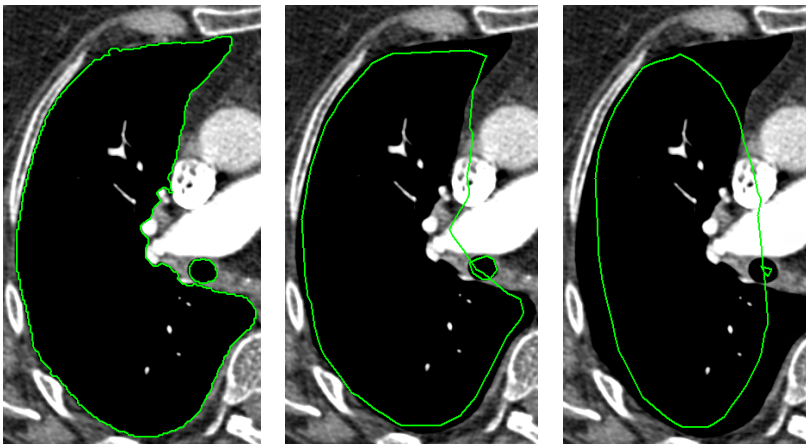


Figure 236 – ROI smoothing dialog

3. Use the slide bar to set the **Smooth factor** (5-100%).
4. Click the **Apply** button as many times as necessary to achieve the desired setting. The result is immediately displayed in the current view (see Figure 237).
5. When finished, click the **Close** button.



(a) **(b)** **(c)**

Figure 237 – (a) Source ROI, (b) smoothen ROI (1st applied), (c) smoothen ROI (5th applied)

10.5.5 ROI algebra

If any two ROIs are defined in the same series, TomoCon allows you to carry out basic algebraic operations such as Union, Intersection and Subtraction between them using the **ROI algebra** dialog (see Figure 238). The result of a specified algebraic operation can be saved to a new ROI or to the ROI that was selected as the first ROI for the operation.

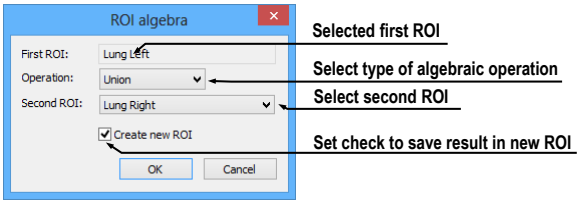


Figure 238 – ROI algebra dialog

To carry out algebraic operations between two ROIs using the **ROI administration** dialog, proceed as follows:

1. Select the first ROI for the algebraic operation in the list of ROIs and click the **Algebra...** button.
2. The **ROI Algebra** dialog is then displayed.
3. Select the algebraic operation in the **Operation** combo box (see Figure 239).

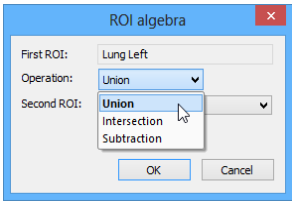


Figure 239 – ROI algebra dialog, defining the algebraic operation

4. Select the second ROI in the drop-down list that is displayed by clicking the **Second ROI** button (see Figure 240).

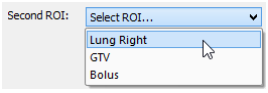


Figure 240 – Selecting the second ROI for algebra

5. To save the algebra result as a new ROI, check the **Create new ROI** check box.
6. To carry out the specified algebraic operation with the defined parameters, click the **OK** button.

10.5.6 Exporting an ROI to a DXF or VTK file

All defined ROIs in TomoCon can be exported to external files in the AutoCAD DXF or VTK format.

To export an ROI using the **ROI administration** dialog, proceed as follows:

1. Select the ROI for export in the ROI list and click the **Export...** button.
2. Select the desired file format, the file name and the target folder in the displayed **Export** dialog (see Figure 241).
3. To save the file, click the **Save** button.

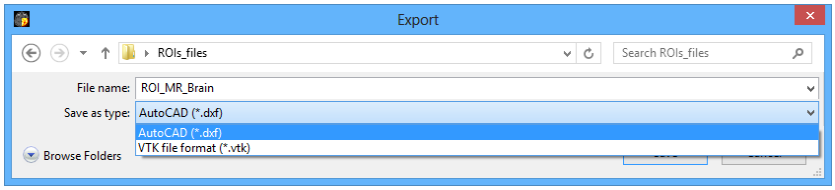


Figure 241 – Export dialog

10.6 Accepting and deleting a contour

The accept contour operation in TomoCon allows you to accept an interpolated contour or the nearest contour in the displayed image using the **ROI drawing** tool (see Figure 242). The accepted contour is then inserted into the currently selected ROI in TomoCon as a new 2D contour.

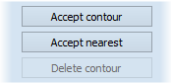
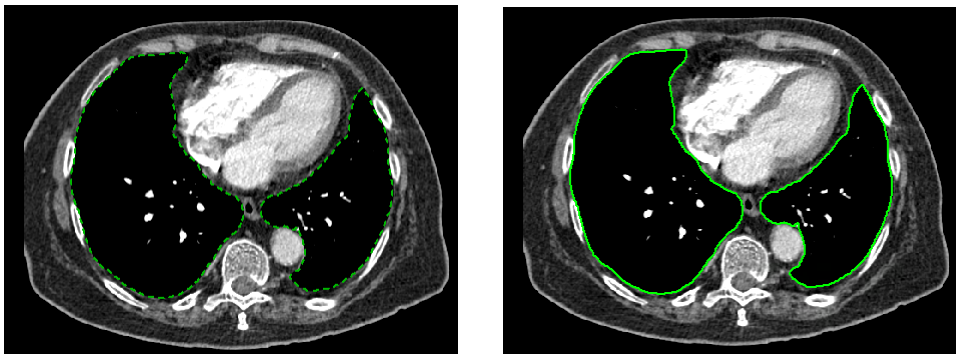


Figure 242 – Accepting section of the ROI drawing tool

To accept an interpolated contour, proceed as follows:

1. Display the image with the interpolated contour (see Figure 243a) in the current view. The interpolated contour is outlined with a dashed line.
2. Click the **Accept contour** button in the **ROI drawing** tool.
3. The interpolated contour is then inserted into the currently selected ROI (see Figure 243b).
4. The dashed line changes into a continuous line and the interpolated contour is changed from a proposed contour to an actual contour.

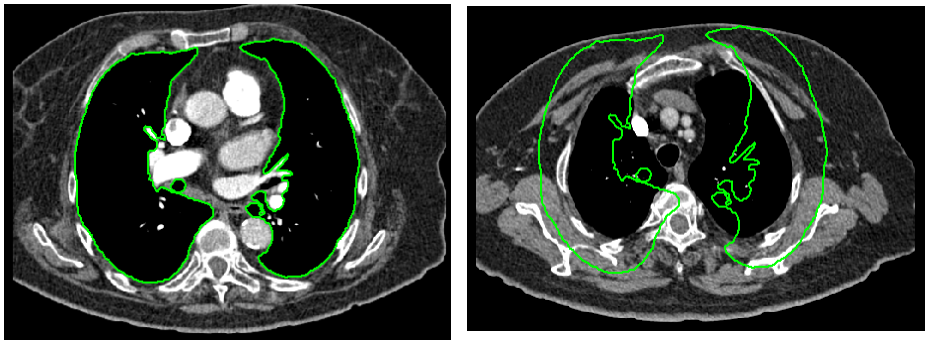


(a) **(b)**

Figure 243 – Interpolated contour (a), Accepted interpolated contour (b)

To accept the nearest contour, proceed as follows:

1. Check that there is no contour drawn for the ROI in the current view.
2. Click the **Accept nearest** button in the **ROI drawing** tool.
3. The nearest drawn contour is then automatically copied to the current image (see Figure 244).



(a) **(b)**

Figure 244 – Contour on the last image (a), Accepted nearest contour from the last image into the 1st image (b)

To delete a contour of the currently selected ROI in the displayed image in the current view, click the **Delete contour** button in the **ROI drawing** tool in the tools panel.

10.7 Editing ROI properties

All 2D and 3D visibility properties of the currently selected ROI in TomoCon can be changed using the **ROI properties** tool in the tools panel (see Figure 245).

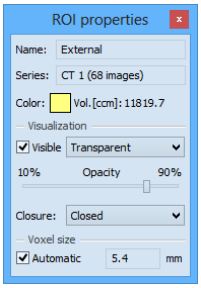


Figure 245 – ROI properties tool

The currently selected ROI in TomoCon is labeled with the following in the **ROI properties** tool:

- **Name/Series** – the name of the currently selected ROI and the image series in which the ROI is drawn.
- **Vol.[ccm]** – the volume size of the currently selected ROI in cubic centimeters. Volume calculation is not possible until the ROI is defined in at least one image.

The **ROI properties** tool allows you to change the following properties of the currently selected ROI in TomoCon:

- Color – click the **Color** button to change the color of the currently selected ROI.

- Visibility – check/uncheck the **Visible** check box to display/hide the currently selected ROI in the views.
- Visualization type – this specifies the rendering types (surface presentation) for the currently selected ROI in the 3D view as follows:
    - **Solid** – the ROI is displayed as an opaque object. A new current point can be defined by clicking the ROI object surface in the 3D view.
    - **Transparent** – the ROI is displayed as a transparent object with the transparency ratio that is defined by the **Opacity** slider (10% to 90% opacity). It is not possible to click to define a current point on the transparent surface of a drawn ROI in the 3D view.
    - **Stripes** – the ROI is displayed as a set of contours laying in parallel planes (the wire-frame model).
    - **Transparent with stripes** – the ROI is composed of the transparent and wire-frame model object.
- **Closure** – by default, the ROI is displayed in the 3D view with closed-end surfaces. It is however also possible to display it as Bottom open, Top open or Open (both ends open). If the ROI is not displayed with closed-end surfaces, you can view the inside of the ROI through the open ends.
- Voxel size – the voxel size determines the granularity of the 3D reconstruction of an ROI. 3D reconstruction entails the processing of ROI contours and the creation of 3D representation from 2D contours.
    - To set the voxel size manually, enter the required size into the **Voxel size** box. To obtain the highest precision, the voxel size should be set to the minimal acceptable value (0.1 cm).
    - To calculate the voxel size automatically, check the **Automatic** check box. The voxel size is then automatically set to the value based on the voxel/cm³ ratio.

10.8 Editing contours using drawing tools

Each ROI consists of separate contours that can be edited or created with the manual and automatic drawing tools of the TomoCon application. All the tools are accessible in the **ROI drawing** tool in the tools panel (see Figure 246).

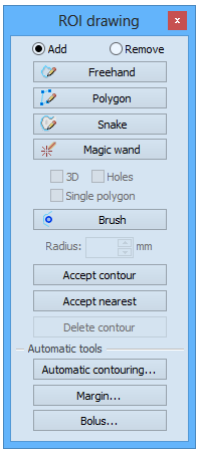


Figure 246 – ROI drawing tool

The TomoCon application provides you with five manual and three automatic drawing tools for contour editing in the displayed image in the current view, as listed below.

- Manual drawing tools:
  - **Freehand** – to contour an area freehand (see 10.8.1 Freehand drawing tool).
  - **Polygon** – to contour an area using a polygon (see 10.8.2 Polygon drawing tool).
  - **Snake** – to contour an area using a semi-automatic tool called Snake (see 10.8.3 Snake drawing tool).
  - **Magic wand** – to contour an area by joining adjacent image pixels with similar gray level values (see 10.8.4 Magic wand drawing tool).
  - **Brush** – to contour an area using a circle (see 10.8.5 Brush drawing tool).
- Automatic drawing tools:
  - **Automatic contouring** – to generate ROI contours in several adjacent images at the same time automatically (see 10.8.6 Automatic contouring drawing tool).

- **ROI margin** – to generate a margin with defined properties of a previously created ROI automatically (see 10.8.7 ROI margin drawing tool).
- **Bolus ROI** – to generate the bolus type of an ROI placed on the surface of a previously created ROI automatically (see 10.8.8 Bolus ROI defining drawing tool).

10.8.1 Freehand drawing tool

The Freehand drawing tool is a manual tool for defining the contour of the currently selected ROI in TomoCon by drawing the contour outline by dragging the cursor.

To use the Freehand drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to edit a contour.
2. Select the adding contour mode (see Figure 247). To add a drawn contour to the ROI, check the **Add** radio button. To remove a drawn contour from the ROI, check the **Remove** radio button.

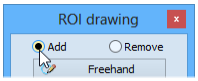


Figure 247 – Set Add/Remove mode for contour editing

3. Click the **Freehand** button in the **ROI drawing** tool.
4. Press and hold down the left mouse button to draw the contour (see Figure 248).
5. Release the mouse button to close the contour.

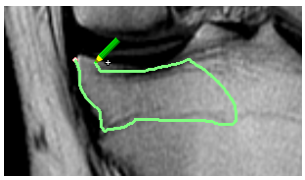


Figure 248 – Drawing a contour with the Freehand tool

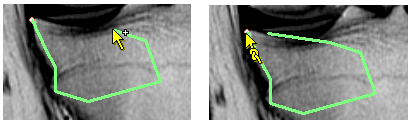
When the freehand contour drawing process is complete, the contour closes with a straight line between the starting point and the ending point.

10.8.2 Polygon drawing tool

The Polygon drawing tool is a manual tool for defining the points of a freely shaped polygon contour of the currently selected ROI in TomoCon.

To use the Polygon drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to edit a contour.
2. Select the adding contour mode (see Figure 247). To add a drawn contour to the ROI, check the **Add** radio button. To remove a drawn contour from the ROI, check the **Remove** radio button.
3. Click the **Polygon** button in the **ROI drawing** tool.
4. Click in the view to define the starting point (the first vertex) of the polygon.
5. Move the cursor and click to define the other polygon vertex or vertices (see Figure 249a).
6. To close the polygon, move the cursor towards the starting point until the mouse pointer changes to the closing symbol () and click (see Figure 249b).



(a) **(b)**

Figure 249 – Drawing a polygon contour (a), clicking the end point of the polygon contour (b)

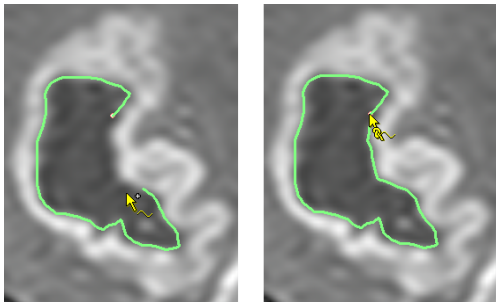
10.8.3 Snake drawing tool

The Snake drawing tool is a semi-automatic, edge detection tool for defining the contour parts of the currently selected ROI in TomoCon. The edges are detected in the image according to the current window and level values in the view (see 7.1 Window and level manipulations).

To use the Snake drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to edit a contour.
2. Select the adding contour mode (see Figure 247). To add a drawn contour to the ROI, check the **Add** radio button. To remove a drawn contour from the ROI, check the **Remove** radio button.
3. Click the **Snake** button in the **ROI drawing** tool.
4. Click in the view to define the starting point (the first vertex) of the contour.
5. Move the cursor (it can be seen that a part of the current curve is attracted to the edges in the image) and click when the curve shape is suitable. Next, define the other parts of the contour (see Figure 250a).

6. If a defined part of the contour is not desired, the last part of the contour can be deleted by pressing the Backspace key.
7. To close the contour, move the cursor towards the starting point until the mouse pointer changes to the closing symbol ( ) and click (see Figure 250b).



(a) **(b)**

Figure 250 – Drawing a polygon contour (a), clicking the end point of the polygon contour (b)

10.8.4 Magic wand drawing tool

The Magic wand drawing tool is used to draw a contour of the currently selected ROI around a consistently colored area (including any off-color areas surrounded by the chosen area). Select the range of color shades (the grayscale scope) for the contour.

To use the Magic wand drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to edit a contour.
2. Select the adding contour mode (see Figure 247). To add a drawn contour to the ROI, check the **Add** radio button. To remove a drawn contour from the ROI, check the **Remove** radio button.
3. Click the **Magic wand** button in the **ROI drawing** tool.
4. Select the 2D or 3D mode:
    - To create a contour in the current view only, uncheck the **3D** check box.
    - To create contours within the entire volume for which the original image (non-reconstructed) is displayed in the current view, check the **3D** check box.
5. If only one polygon from the contoured region is to be selected as the final contoured area, check the **Single polygon** check box.

6. To accept holes in the contours, check the **Holes** check box. This excludes any off-color areas enclosed within the area of the defined color range and creates holes in the contour instead.
7. Press and hold down the left mouse button to define the starting point and from there, drag the cursor to demarcate the area what you want to define. The further you drag the cursor away from the starting point, the wider the color range will be (see Figure 251).
8. Release the mouse button.
9. To check that the contours have been properly created, scroll through the slices and/or rotating ROIs in the 3D view.

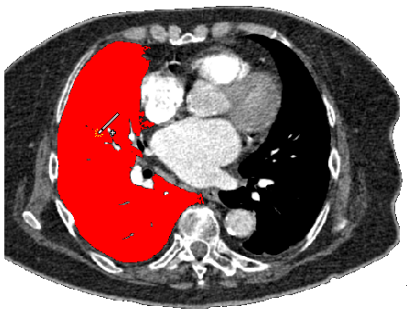


Figure 251 – Defining an area using the Magic wand drawing tool

10.8.5 Brush drawing tool

Using the Brush drawing tool, you can move the circular cursor with the defined size to project contour lines into the currently selected ROI. The Brush has the color of the currently selected ROI.

To use the Brush drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to edit a contour.
2. Select the contour adding mode (see Figure 247). To add a drawn contour to the ROI, check the **Add** radio button. To remove a drawn contour from the ROI, check the **Remove** radio button.
3. Click the **Brush** button in the **ROI drawing** tool.
4. If necessary, adjust the size of the brush tool by defining the **Radius** value in the box below the **Brush** button.

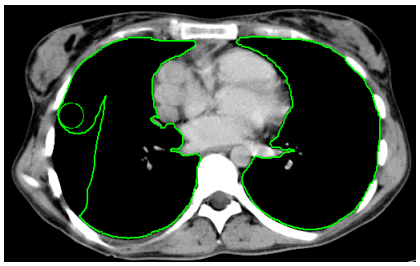
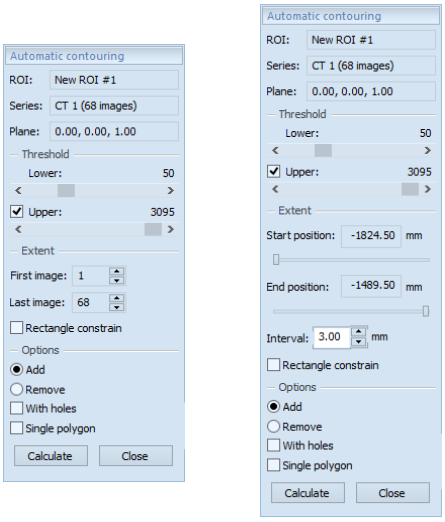


Figure 252 – Adding an area to a contour using the Brush drawing tool

5. To add/remove a contour, press and hold down the left mouse button and move the brush cursor to create the desired shape (see Figure 252).
6. To complete the contour creation process, release the mouse button.

10.8.6 Automatic contouring drawing tool

This ROI definition tool automatically generates contours in adjacent images at the same time. It is especially suitable for defining an outline of a patient (such as the skin surface). The image area (the entire image or a limited rectangle) and the image set (all images or a subset of images selected by defining the base image and extent) can be specified prior to contour creation.



(a) **(b)**

Figure 253 – Auto ROI tool for original images (a), for reconstructed images (b)

To use the Automatic contouring drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to edit a contour.
2. Click the **Automatic contouring...** button in the **ROI drawing** tool.

3. The **Auto ROI** tool is then automatically displayed as a new tab in the tools panel where you can define the parameters for automatic contouring (see Figure 253).
4. Select the **Lower** and **Upper** grayscale values for the search process. All grayscale values within the selected threshold value range will be considered as matching. This can be seen in the current view – the matching regions are displayed in red while the remainder appears in black (see Figure 254).

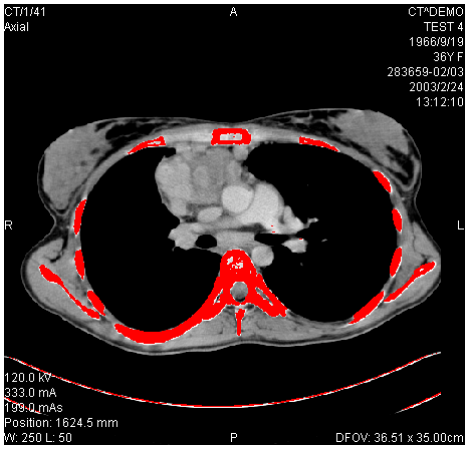


Figure 254 – Segmented image with threshold selection, contouring bones

5. Select the range of images (in the **Extent** section of the tool) to be used for automatic contour search, choosing the appropriate **First image** and **Last image** values or the **First position** and **Last position** for the reconstructed images.
6. Define which part of the image is to be used (a limited rectangle or the whole image).
   - Whole image – it creates an outline based on the entire image (the default setting).
   - Rectangle – only a limited area of the image will be used. To select the area, proceed as follows:
     - Check the **Rectangle constraint** check box.
     - Move the rectangle or drag the sides to change its size until the desired area is demarcated (see Figure 255).
     - To check that the desired area is properly demarcated in all slices, scroll through them in the current view.

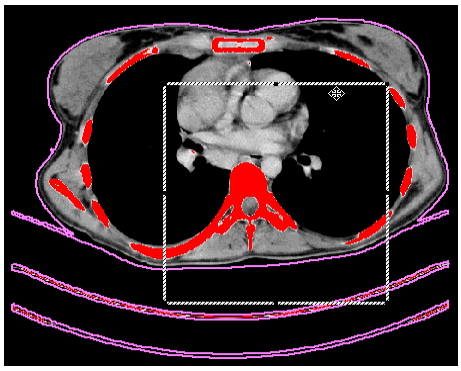


Figure 255 – Moving the rectangle constraint

7. Select the contour adding mode. To add all created contours to the currently selected ROI, check the **Add** radio button; to remove them, check the **Remove** radio button.
8. Select the advanced option for automatic contouring as follows:
   - **With holes** – this option is used to search for holes in each image according to the setting of the minimal and maximal threshold value.
   - **Single polygon** – this option specifies the use of only one polygon in each image without holes according to the setting of the minimal and maximal threshold value.
9. Click the **Calculate** button.

10.8.7 ROI margin drawing tool

This functionality is available only if the Advanced Contouring license is installed in the TomoCon Workstation.

The ROI margin tool is used to automatically create a margin around the source ROI with the defined dimensions and constraints of selected risk ROIs.

To generate an ROI margin using the margin drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to create a margin.
2. Click the **ROI margin...** button in the **ROI drawing** tool.
3. The **ROI margin** tool is then automatically displayed as a new tab in the tools panel where you can define parameters for the ROI margin (see Figure 256).
4. Set the margin size as desired along the x-axis, z-axis and y-axis. The sizes can be set individually for the minus and plus directions on each axis or jointly for all directions at the same time using the **Grow** scrollbar (from -1cm to 10cm).

5. If desired, select one **Risk ROI** or several Risk ROIs (typically an organ at risk) and set the **Border** of its safety margin. The margin of the risk ROI will not be created but its extension in space will be considered when calculating the ROI margin. The risk ROI and its safety margin then take precedence over the margin you are creating.

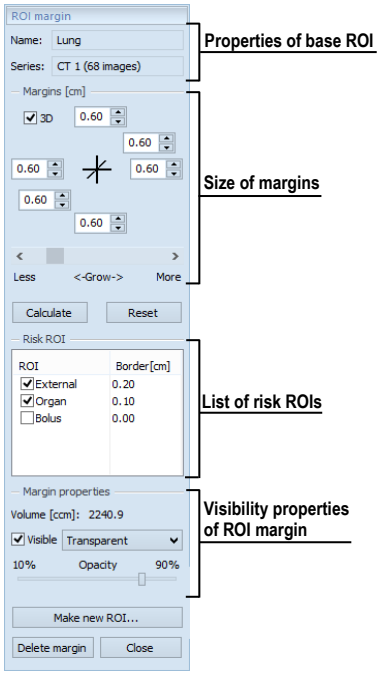
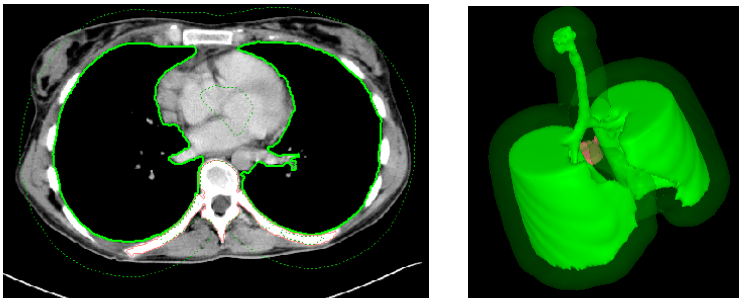


Figure 256 – ROI margin tool

6. Click the **Calculate** button. The created margin will be displayed as a dashed line (see Figure 257).



(a) **(b)**

Figure 257 – Created ROI margin in 2D (a), in 3D (b)

7. Check the result in the images and the 3D view and adjust the margin properties if necessary. If the result is unsatisfactory, adjust the settings in the ROI margin tool and recreate the margin.
8. To create a new ROI from the generated margin, click the **Make new ROI...** button. The **Create structure from margin** dialog (see Figure 258) is then displayed in which you proceed as follows:

- Select the image series if one other than the default series is to be used (this is only possible if registration has been carried out).
- If you do not wish to resample to original images, uncheck the **Original images** check box and enter a value into the **Number of contours** box.
- To create the ROI, click the **Create** button.

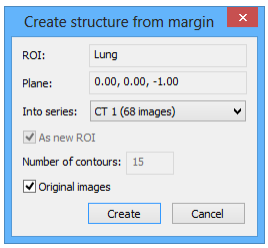


Figure 258 – Create structure from margin dialog

You can then assign a new color to the margin ROI, resize it and carry out all operations with it that you can carry out with a manually drawn ROI. The margin ROI is no longer connected to the source ROI it was based on.

10.8.8 Bolus ROI defining drawing tool

This functionality is available only if the Advanced Contouring license is installed in the TomoCon Workstation.

The Bolus ROI defining tool allows you to define a rectangular ROI of a certain thickness. The bolus ROI must be located on the surface of a previously defined ROI. The basic parameters for ROI bolus calculation are the four markers in the current view. The first two (the left and right) must be located on an image in which the source ROI is drawn. The other two markers (the top and bottom) can be located in any image (original or reconstructed).

To generate a bolus ROI using the bolus drawing tool, proceed as follows:

1. Select the ROI (as the currently selected ROI) for which you want to create a bolus.
2. Click the **Bolus ROI...** button in the **ROI drawing** tool.
3. The **Define bolus** dialog (see Figure 259) is then displayed in which you carry out the following:
   - Enter the name of the bolus ROI and its color.
   - Define the height of bolus in cm in the **Height** box.
   - When finished making the settings, click the **OK** button to continue.

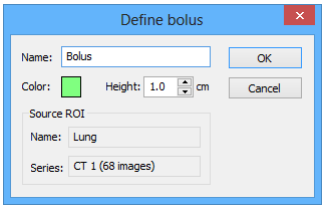


Figure 259 – Define bolus dialog

4. Define the left, right, top and bottom points of the bolus by clicking in the current view:

   - Define the leftmost point of the bolus by clicking the contour. The cursor marked as **L** will also be displayed with a green tick when it reaches the contour line of the currently selected ROI (see Figure 260).

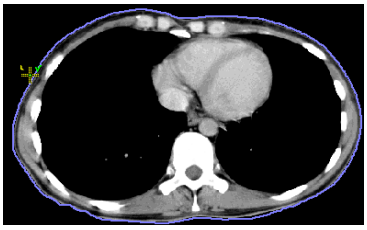


Figure 260 – Defining the left point of the bolus

   - The cursor is now marked as **R**. Click the rightmost point of the bolus, as described above for the leftmost point (see Figure 261).

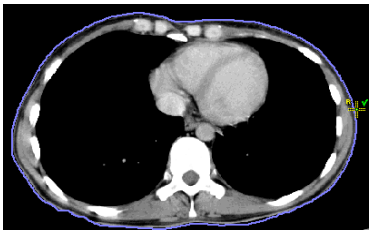


Figure 261 – Defining the right point of the bolus

   - The top point and the bottom point (the cursor is marked as **T** and **B** respectively) can be selected in any image in the current view. It is not necessary that these points are located on the contour line but simply in a view displaying the same image series (see Figure 262). The cursor will not be displayed as a green tick for **T** and **B**.

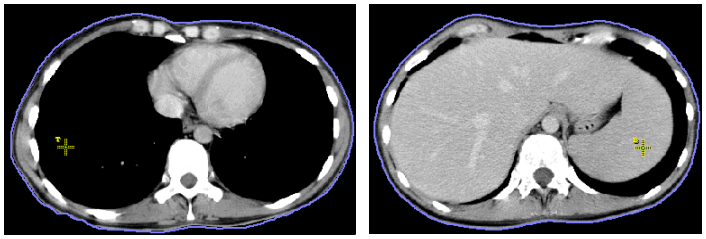


Figure 262 – Defining the top point and bottom point of the bolus

5. After the fourth point is defined in the current view, the bolus calculation process starts automatically. The bolus is generated and displayed as contours in the image series and as volume in the 3D view (see Figure 263).

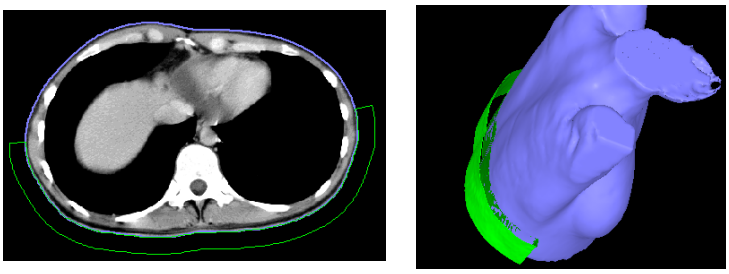


Figure 263 – Generated bolus ROI around the skin surface

11 MPR - Multi Planar Reformatting

Multiplanar reformatting (MPR) allows the display of sections of a patient's body according to a defined plane. MPR offers a particular way of examining medical imaging data that differs from that of the original imaging. MPR allows you to view three-dimensional volume in a plane direction other than the plane direction of the original imaging. MPR can be started quickly and easily for any suitable study selected in the current view using the **MPR** tool in the tools panel.

NOTE! Users responsible for diagnosis should be aware that MPR views display **calculated data**. Calculated data, although based on the original data set, may incorrectly (due to differences in dimensions) give the appearance of healthy tissues in situations where pathology may be present. Occasionally, calculated data may also include image artifacts that should not be interpreted as actual pathology.

The **MPR** tool (see Figure 264) is initially docked in the tools panel (on the fourth tab). You can access it at any time by clicking the tab with the icon. To start using this tool, select the image of the series you would like to view with MPR in the desired view of the work area and click the required MPR type in the tool.

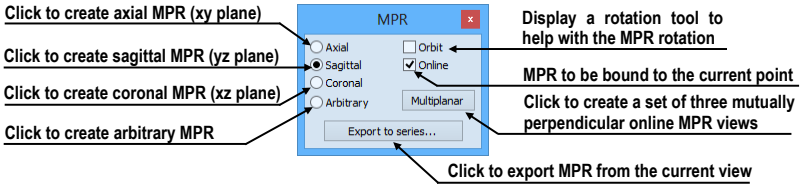


Figure 264 – MPR tool

For enhanced spatial orientation, a small box-like indicator in the upper left-hand corner of the MPR view displays the approximate position and orientation of the MPR plane in the patient image data (see Figure 265). Additionally, the plane position of each displayed MPR is indicated by a colored line (see 4.4 Color options) in all views that are intersected by this plane.

Figure 265 – Indicator of MPR plane position and orientation

11.1 Arbitrary MPR

MPR is not necessarily oriented parallel to the main patient axes and can be rotated into any orientation. This can be done by clicking the **MPR rotate** icon (in the

context menu or in the **Context** toolbar), holding down the left mouse button and moving the cursor directly in the current view. The base MPR plane (axial, sagittal or coronal) will change to the **Arbitrary** plane in the **MPR** tool.

To make image rotation use easier, check the **Orbit** check box. The MPR view will be overlaid with a set of blue circles that mark the image areas with different rotation functionality. When placed over these areas, the cursor can take various forms (, , ,) which indicate the rotation axis that will be used if the left mouse button is used to rotate the plane.

11.2 Online MPR

The **Online** check box in the **MPR** tool defines the online MPR to be bound to the current point (see Figure 266). All online planes are automatically shifted to intersect the current point. If the current point is changed by clicking in one of the views, all online planes will shift immediately.

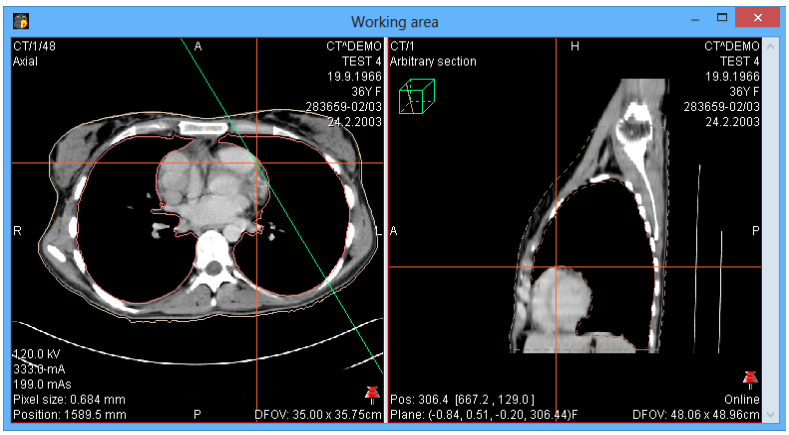


Figure 266 – Arbitrary MPR view and intersected axial MPR plane

11.3 Interactive moving and rotating

If you need to interactively rotate or move an MPR from another view, it is possible to use the intersection lines of planes, which are displayed automatically for each defined MPR in the work area (see Figure 267). Proceed as follows:

1. Display the required MPR in the current view.
2. Select the other view and in it, display the image or MPR in the other plane as in step 1 (the planes must intersect).
3. The intersection of the planes will be displayed in the current view.
4. If you move the cursor over this intersection line and press and hold down the left mouse button, you can move the plane of the MPR in the first view (its

frame is highlighted in blue). When finished moving the plane, release the mouse button.

5. If you move the cursor over the circles on the intersection line and press and hold down the left mouse button, you can rotate the plane of the MPR in the first view (its frame is highlighted in blue). When finished rotating the plane, release mouse button.

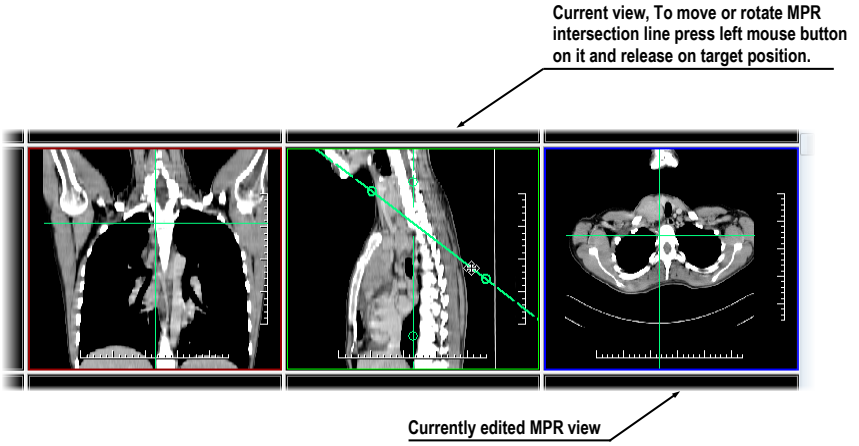


Figure 267 – Interactive moving of MPR

11.4 Exporting MPR to Series

TomoCon allows the saving of an MPR view as an additional series in a selected study. By setting the parameters for the exported MPR, it is possible to select the exact properties of the new series (the resolution, positioning of the first MPR, positioning of the last MPR). Once saved, the created MPR series can be sent to the PACS as a new series or reopened for viewing.

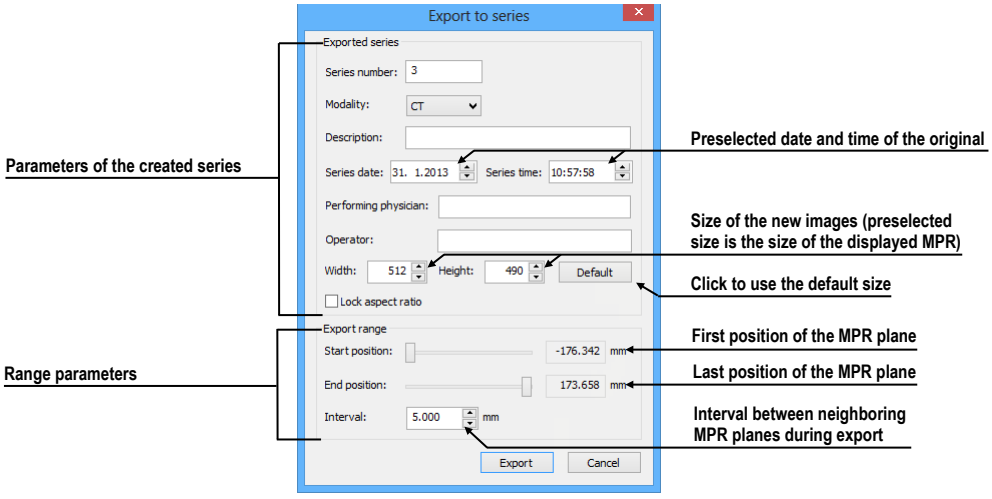


Figure 268 – Export to series dialog

To export an MPR view to a study, proceed as follows:

1. Display the required MPR in the current view.
2. Press the **Export to series…** button in the **MPR** tool.
3. The **Export to series** dialog will be displayed in which you can set the parameters for MPR export (see Figure 268).
4. After setting up the parameters, press the **OK** button.

12 MIP - Maximum Intensity Projection

MIP is a spatial method for displaying patient data. This method displays the projection of the maximum values from particular images to the 3D space. It searches for the maximum pixel values and displays them in a plane. The result of this projection is a multi-frame image with the frames creating the impression of an MIP object rotating in front of you. Although it usually displays MIP calculated from maximum values, the TomoCon application also allows you to create MIP calculated from minimum values; this is known as MinIP.

MIP display can be created quickly and easily for any suitable study selected in the current view using the **MIP** tool in the tools panel.

The **MIP** tool (see Figure 269) is docked in the tools panel (on the fourth tab) by default. You can access it by clicking the tab with the  icon.

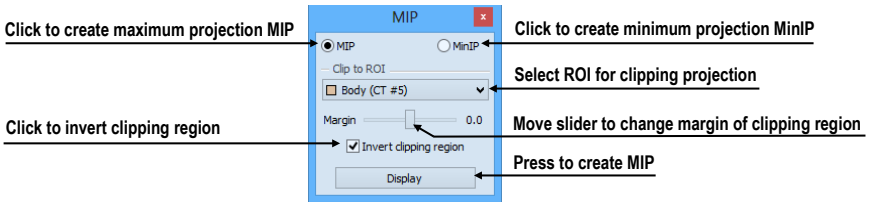


Figure 269 – MIP/MinIP dialog

To start using this tool, select the image of the series you would like to use for MIP visualization in any view in the work area. For standard projection (MIP), select the **MIP** option; for minimal projection (MinIP), select the **MinIP** option. To start the calculation process, press the **Apply** button. The calculated projection is then immediately displayed in the current view (see Figure 270).

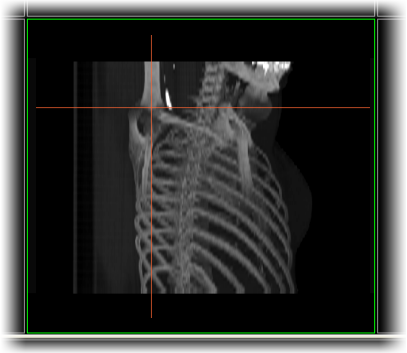


Figure 270 – MIP in the current view

13 DRR Reprojection

Digitally reconstructed radiograph (DRR) has become a valuable tool in clinical applications. It is a reprojection of a conventional 2D X-ray image, created from computed tomography data. TomoCon allows you to create a DRR by summing CT intensities along a ray from each pixel (**View**) to the simulated X-ray source (**Targed**).

To create **DRR** reprojection from patient image data, use the **DRR** tool (see Figure 271), which is initially docked in the tools panel (on the fourth tab). You can access it at any time by clicking the tab with the  icon.

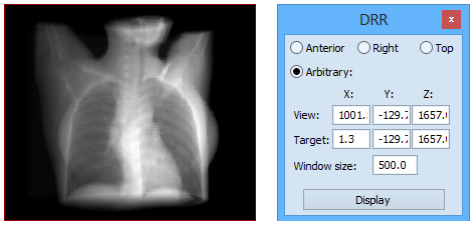


Figure 271 – DRR Reprojection image and tool

You can set the following parameters for DRR reprojection in the **DRR** tool:

- **Viewport settings** - setting up the DDR position to the patient's position: **Anterior**, **Right**, **Top** and **Arbitrary (**DDR position determined by the **View** and **Target** parameters)
- **Window size**

To start the process of DRR reprojection creation, press the **Display** button.

14 Multi-modality fusion

Multi-modality fusion makes it possible to display data from two registered series in combination or overlapping in one image view.

The ability to correlate 3D images (see 16 Registrations) from various common modalities (CT, MRI, PET) has become a valuable tool in radiology. TomoCon supports multi-modality fusion and provides users with the ability to identify structures in one imaging modality and then spatially locate the structures in the different modality (this includes CT-PET, CT scans with contrast media and without it, MRI series taken with different parameters and scans prior to treatment and following treatment, among others).

To create a fusion from a two-modality image series, use the **Fusion** tool in the tools panel. It provides the controls for fusion settings such as the base series, fusion series, color palettes, translucency, the fusion method, etc. The **Fusion** tool (see Figure 272) is initially docked in the tools panel (on the fifth tab). You can access it by clicking the tab with the  icon.

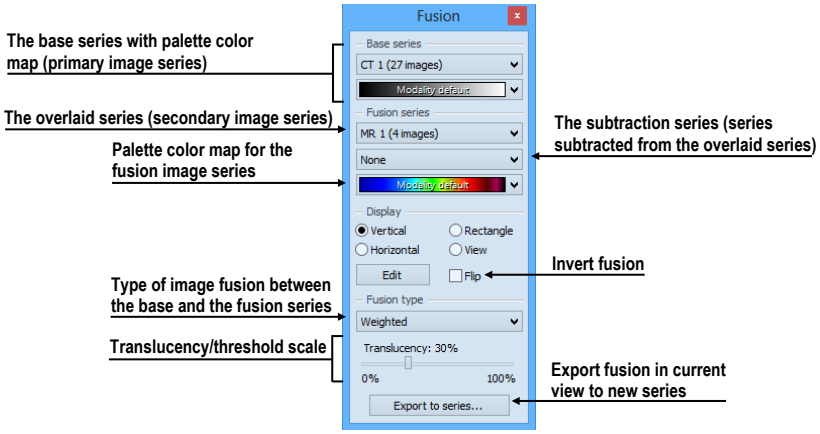


Figure 272 – Fusion tool

14.1 *Creating multi-modality Image Fusion*

To create fusion from a two-modality image series, use the **Fusion** tool (see Figure 272) as follows:

1. Click the **Base series** combo box to select the primary series (see Figure 273).
2. Click the **Base color map** to select the primary color map.
3. Click the **Fusion series** combo box to select the secondary series.
4. Click the **Fusion color map** to select the secondary color map.

5. The selected multi-modality fusion will be displayed in the current view. All other parameters will automatically be set up according to the most recently used fusion.

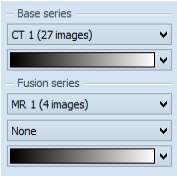


Figure 273 – Series and color map selection

To add a subtraction series to a multi-modality fusion, proceed as follows:

1. Click the subtraction series combo box to select the subtraction series.
2. The color palette will automatically change to the subtraction palette.
3. If you want to change the used subtraction palette, click the fusion color map to select it.
4. To remove a used subtraction series from a fusion, select the **None** item in the **Select subtraction series…** combo box.

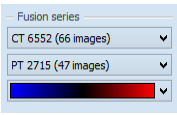


Figure 274 – Subtraction series and color map selection

To change the manner in which the fusion is displayed in the current view, click the desired type in the display section of the fusion tool (see Figure 275). TomoCon provides the following display options:

- **Vertical** - the view is divided with a vertical line; the image from the fusion series is displayed on the right (see Figure 276, right).
- **Horizontal** - the view is divided with a horizontal line; the image from the fusion series is displayed at the bottom.
- **Rectangle -** the image from the overlaying series is displayed inside the rectangle (see Figure 276, left).
- **View -** the image from the overlaying series is superimposed over the entire view.
- **Edit -** after choosing this option (or double-clicking the separation line or inside the rectangle) and holding down the left mouse button, drag the rectangle, its frame or border to modify the border position, the rectangle frame position and its size.

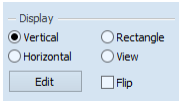


Figure 275 – Display section of the Fusion tool

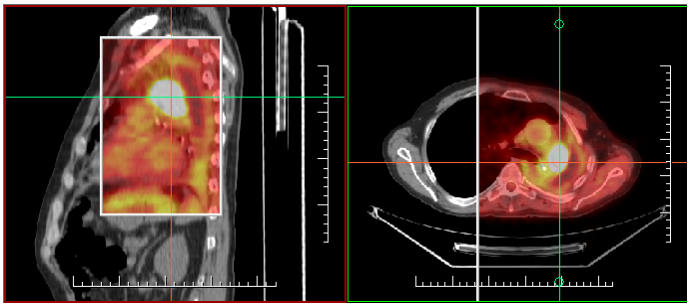


Figure 276 – Fusion images between MR and PET series

14.2 Fusion method

TomoCon provides five methods, which are listed below, for interfusing a primary and secondary series in a multi-modality fusion. For each fusion method, the scaling between the primary and secondary series can be changed using the fusion level (**Threshold/Translucency**).

- **Mask** – the image data of the secondary series with pixel values above the defined *Threshold* is displayed as *(primary + secondary color) / 2*.
- **Weighted** – the primary and secondary images are fused from the full primary image (*Translucency = 0%*) to the full secondary image (*Translucency = 100%*).
- **Merge** – it is calculated as *(primary + secondary color) / 2*.
- **Threshold** – the image data of the secondary series with pixel values above the defined *Threshold* is displayed in the defined color.
- **Contours** – it provides an anatomic image with contours of data from the secondary series corresponding to the threshold value.

To change the fusion method type, click the **Fusion type** combo box (see Figure 277) and select the method from the displayed list.

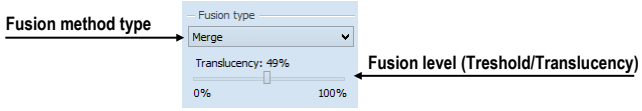


Figure 277 – Fusion type section of the Fusion tool

14.3 Exporting fusion to a series

TomoCon enables the saving of a fusion view as an additional series in a selected study. It is possible to select the particular properties of the new series by selecting the parameters for the exported fusion in the **Export to series** dialog (see Figure 278). Once saved, the created fusion series can be sent to the PACS as a new series or reopened for viewing.

To export a fusion view to a new series, proceed as follows:

1. Display the desired fusion in the current view.
2. Press the **Export to series…** button in the **Fusion** tool.
3. Set the parameters for fusion export in the displayed **Export to series** dialog.
4. After setting up the parameters, press the **OK** button.

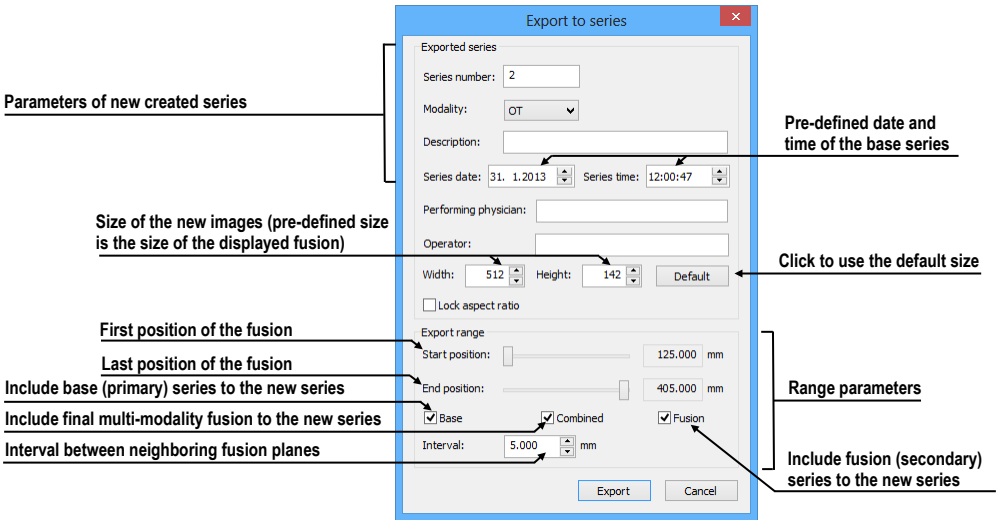


Figure 278 – Export to series dialog (parameters of the created series)

15 Three-dimensional visualization

Patient data is acquired as a set of two-dimensional (2D) images although the data can be interpreted as three-dimensional (3D) volume. The TomoCon application offers you the possibility to view and navigate through 3D patient data as follows.

- Displaying interactive MPRs in 3D.
- Displaying ROIs defined by segmentation in 3D (see 10 Contouring the patient – create ROIs).
- Using the automatic volume rendering tool for 3D visualization of volume data (see 15.4 Volume rendering).

To define the parameters of the 3D view, use the **3D** tool (see Figure 279) in the **Tools** panel. It is initially docked in tools panel (on the sixth tab). You can access it at any time by clicking the tab with the icon or by clicking the **3D View** item in the **Tools** menu of the TomoCon application.

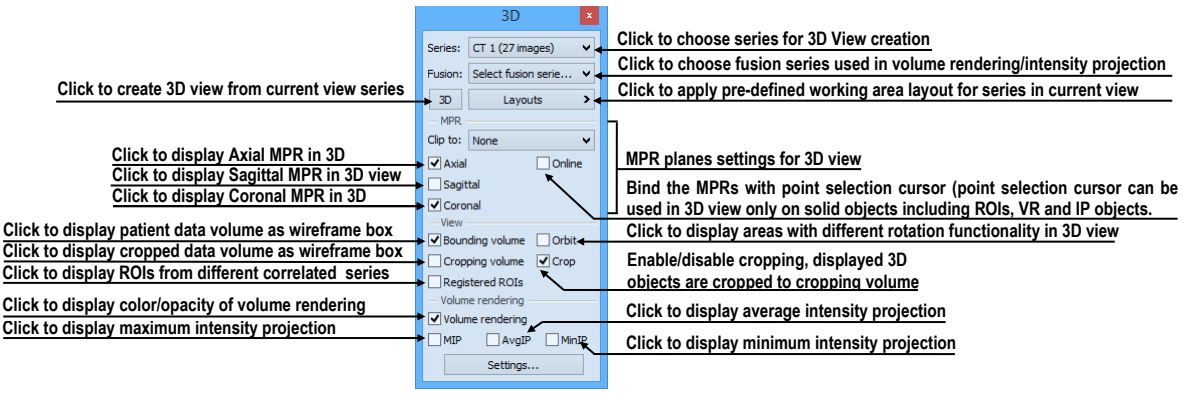


Figure 279 – 3D tool

To start using the tool, select the series you would like to view in 3D in the **Series** combo box or select any image of the series in the desired view. Next, in order to create the 3D view, click the required 3D visualization method in the tool:

- To display ROIs in 3D view (see Figure 280), click the **3D** button.
- To create 3D visualization of volume data using Volume rendering, select the **Volume rendering** check box.
- For the angiographic display of volume data in 3D, check the **MIP** (maximum projection) check box, the **AvgIP** (average projection) check box or the **MinIP** (minimum projection) check box.

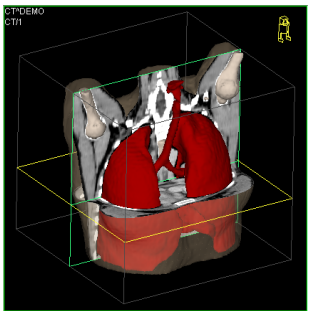


Figure 280 – 3D view

15.1 Rotation, spatial orientation

To activate the rotation action, click the **Rotate** item in the context menu of the 3D view. The cursor will take the form of . The 3D view can be rotated by pressing and holding down the left mouse button.

The **Orbit** item in the context menu of the 3D view provides visual assistance for image rotation. After selecting the item, the 3D view is overlaid by a set of blue translucent spheres (see Figure 281). This marks the image areas with different rotation functionality; when placed over these areas, the cursor takes various forms (, ,) which describe the rotation axis to be used for rotation.

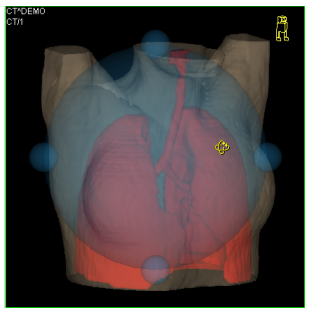


Figure 281 – 3D view with the Orbit function

To return to the initial viewing angle and zoom, select the **Reset view** item in the context menu of the 3D view.

For better spatial orientation, a small robot-like icon (called Enrico) is displayed in a selected corner of the 3D view. In properly oriented studies, its orientation corresponds to the patient's orientation. If you prefer that the icon is not displayed, it can be hidden in the **TomoCon setup** dialog (see 4.3 View texts).

To rotate objects in the 3D view, use the **Rotate** tool in the tools panel. Two rotation modes are available:

- rotation in screen coordinates (see Figure 282)

- rotation in patient coordinates (see Figure 283)

The screen coordinate rotation mode uses buttons is similar to the rotation in the 3D view. The patient rotation mode uses buttons to rotate volume around the patient coordinate system axes. The patient coordinate system axes are differentiated by color: x-red, y-green, z-blue. Rotation control with Enrico works in the same manner as rotation in the 3D view; for enhanced orientation, the orbit is always displayed.

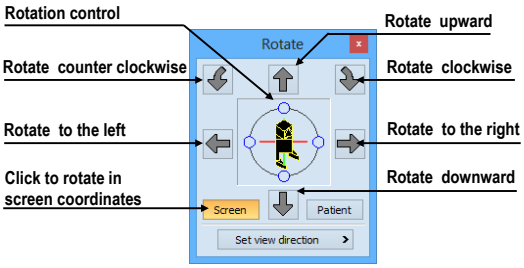


Figure 282 – Rotate tool (Screen mode)

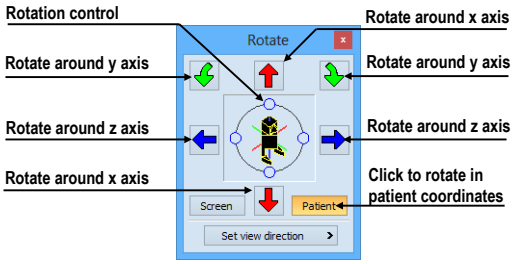


Figure 283 – Rotate tool (Patient mode)

15.2 Cropping volume of interest

Initially, the 3D view displays the entire bounding volume of the selected series. It is however possible, in order to speed up rendering and to increase efficiency, to display only partial series volume. Volume cropping (see Figure 284) can be used for the 3D view as well as a linked image, fusion or section view.

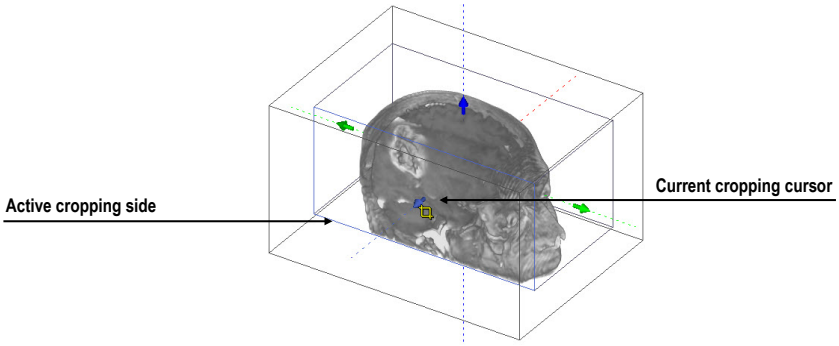


Figure 284 – Active cropping mode

In order to begin cropping, select the cropping tool in the context menu of the 3D view (see Figure 285). Next, drag selected object (the cropping arrow or cropping cube edge) in the view and move it to desired position (see Figure 284).

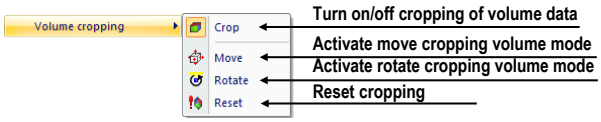


Figure 285 – Cropping menu

Volume cropping can be used in the linked 2D views (the 2D views of the same series). In a 2D view, drag the edge of the cropping volume polygon - an intersection of cropping volume and current image plane.

15.3 Moving an MPR plane

It is possible in the TomoCon application to move an MPR plane interactively in a view (see Figure 286). When the cursor is placed at an MPR edge of the MPR plane, the cursor takes the form of  and the border of the MPR plane is highlighted in yellow. You can then press and hold down the left mouse button to move the MPR plane.

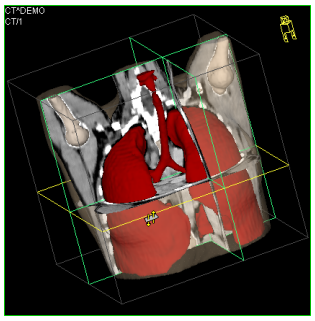


Figure 286 – 3D view with highlighted MPR plane

Movement of MPRs can be used in the linked 2D views (the 2D views of the same series). In a 2D view, drag the intersection line of given MPR - an intersection of the MPR and current image plane.

15.4 Volume rendering

This functionality is available only in TomoCon Workstation.

To display volume rendering visualization, you can use one of the following methods:

- Select the series of interest for volume rendering in the **Series** combo box of the **3D** tool and check the **Volume rendering** check box (see Figure 287a).

- Select the image from the series that is to be viewed using volume rendering in the required view and check the **Volume rendering** check box in the **3D** tool.
- Select the image from the series that is to be viewed using volume rendering in the required view, select the pre-defined layout in the **3D** tool (see Figure 287b) and then check the **Volume rendering** check box.

(a) **(b)**

Figure 287 – Selecting series for volume rendering, a) selecting series via combo box, b) using pre-defined layout

The volume rendering visualization (see Figure 288) with the default or most recent color preset for the given modality is automatically calculated and displayed in the current view. Applying intensity projections (MIP, MinIP, and AvgIP) is similar to that of volume rendering described above.

To change the parameters of volume rendering visualization, you can use the following tools and dialog in TomoCon:

- The **Rotate** tool enables spatial manipulation of the current 3D view (see 15.1 Rotation, spatial orientation).
- The **Color and opacity** tool is used for defining and using pre-defined color presets (see 15.4.3 Creating and using color presets).
- The **Volume rendering settings** dialog allows you to change the basic parameters of volume rendering visualization in the current view (see 15.4.2 Volume rendering settings).

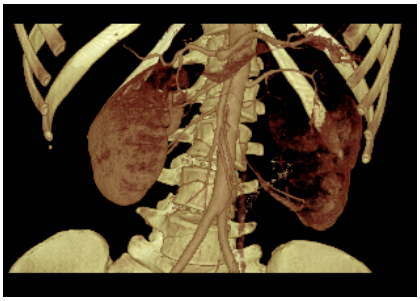
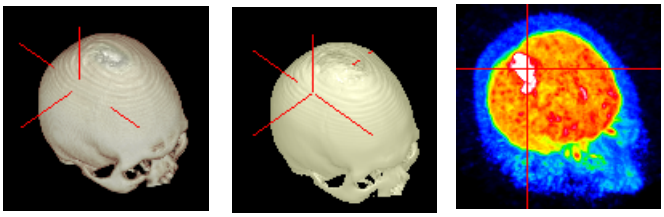


Figure 288 – Volume rendering 3D view

15.4.1 Point selection in volume rendering and intensity projections

The point selection in volume rendering is set to the 3D point in the cropped data volume, where the summed opacity is opaque. This is dependent on the opacity defined for the data values. For example, for the CT modality, this may be inside the bone because the transfer function used in common presets does not define the whole interval for solid bones (see Figure 289). When solid isosurface is used, the point selection is applied on the isosurface. If it is not possible to apply point selection within the cropped volume, the point selection is set to the back face of the cropped volume.



(a) (b) (c)

Figure 289 – Point selection, (a) inside, (b) on surface, (c) in MIP

The point selection in MIP and MinIP is set to the point in 3D data volume where the value along the ray is maximum in MIP or minimum in MinIP. The point selection for AvgIP in the 3D view is not defined and is therefore set to the back face of the cropped volume.

The point selection cursor for MIP, MinIP and AvgIP is displayed as a 2D cross (as it is in image views). The point selection cursor for volume rendering is displayed as a 3D cross.

15.4.2 Volume rendering settings

This dialog allows you to define adjustments of volume rendering quality and lighting in the current view. The following parameters can be set:

- basic volume rendering quality on the first tab (see Figure 290)

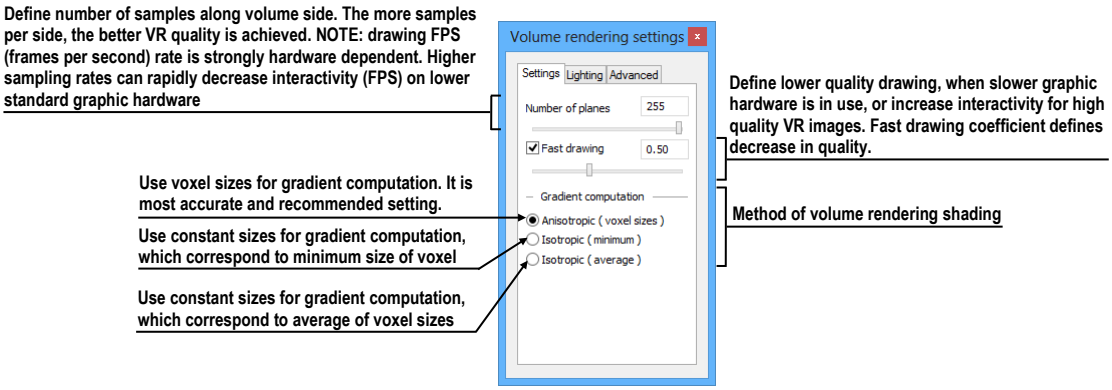


Figure 290 - Volume rendering settings, the first tab

- lighting settings used in volume rendering on the second tab (see Figure 291)

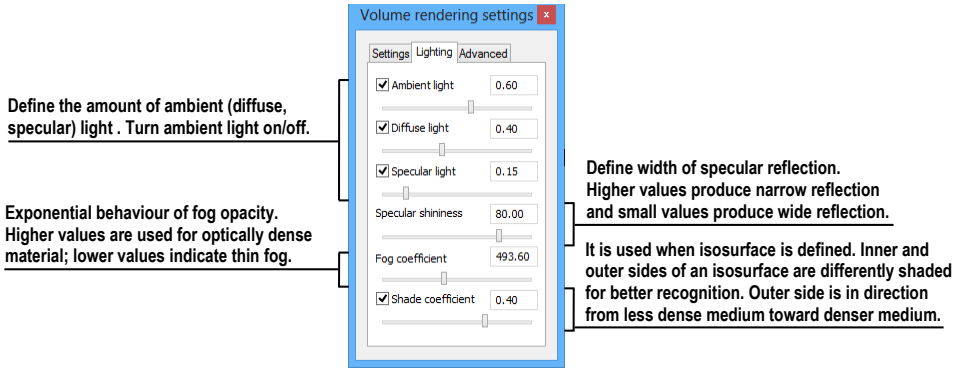


Figure 291 – Volume rendering settings, the second tab

- settings for color corrections and advanced ray casting settings on the third tab (see Figure 292)

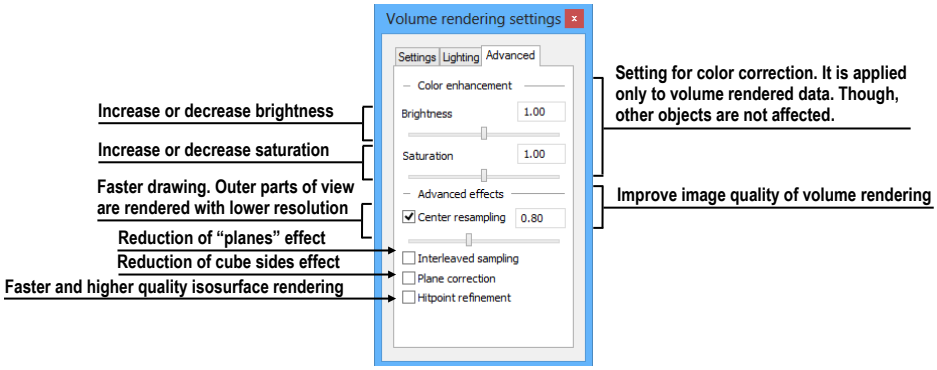


Figure 292 – Volume rendering settings, the third tab

15.4.3 Creating and using color presets

The TomoCon application allows you to change the color, opacity and lighting of the volume rendering in the current 3D view using the saved color presets. TomoCon supplies a gallery of predefined color presets that makes it possible to define customized color presets for special volume rendering visualization in a 3D view.

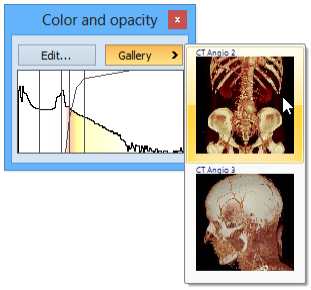


Figure 293 – Gallery of presets

To apply a color preset, click the **Gallery** button in the tools panel of the **Color and opacity** tool (see Figure 293). Next, select the desired preset in the displayed gallery list. The gallery contains the default presets included in the TomoCon installation (the default presets cannot be modified) as well as all of your customized presets.

To create a new color preset, click the **Edit…** button in the tools panel of the **Color and opacity** tool. The **Color/opacity settings** dialog (see Figure 294) is then displayed. Define the color, the opacity and the interval parameters for the new preset in the **LUT** control of the **Color/opacity settings** dialog (see Figure 294).

To modify the effects, use the **Effects** menu.

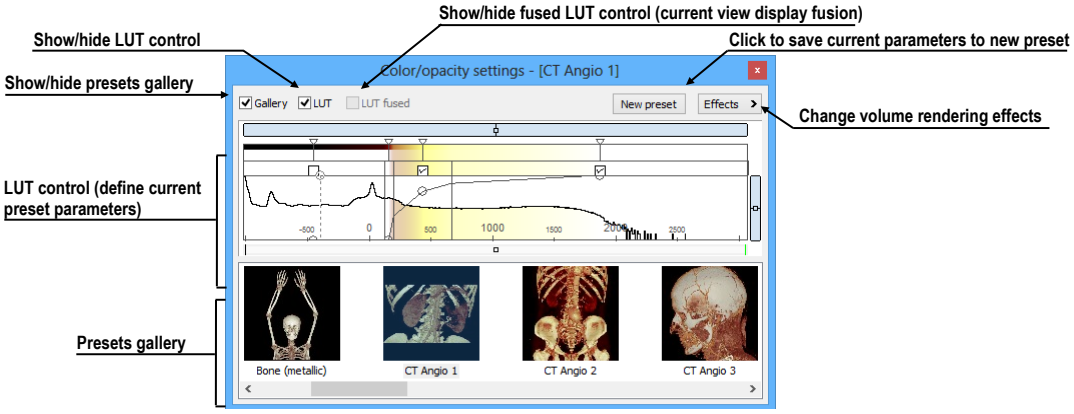


Figure 294 – Color/opacity settings dialog

To save the color parameters for the new preset, click the **New preset** button. The new preset is then added to the end of the gallery of presets (in the lower part of the dialog) and you can enter a name for it (see Figure 295).

Figure 295 – New saved preset

To rename or delete a (non-predefined) preset, select the preset in the gallery of presets, right-click to display the preset context menu and then select the **Rename** or **Delete** item (see Figure 296).

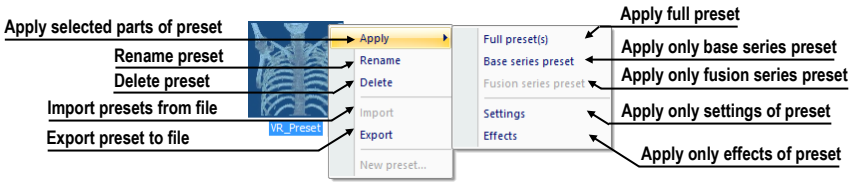


Figure 296 – Context menu of the gallery of presets

To set the color parameters for the preset, use the **LUT** control of the **Color/opacity settings** dialog (see Figure 297). This control defines the lookup table (LUT) and/or isosurfaces used in volume rendering. The **LUT** control can be used in the simple mode or in the advanced mode.

In the simple mode, the color positions and the opacity curve are fixed to the interval bands. The advanced mode provides more flexibility in defining the custom color table, enabling the modification of the opacity curve and the color table independently from the interval bands.

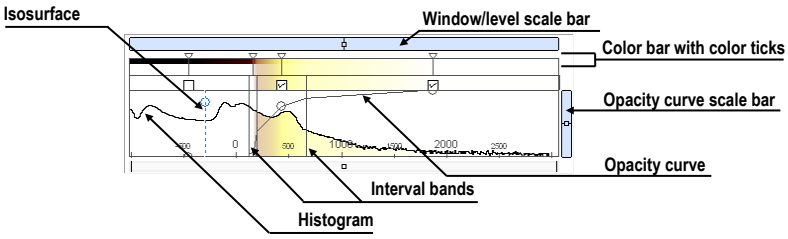


Figure 297 – LUT control part

The **Window/level scale bar** is used to change the window and level values of the color table. To change the level value, place the cursor over the **Window/level scale bar** and press and hold down the left mouse button while moving the **Window/level scale bar**. To change the window value, proceed as described above for the level value while additionally holding down the **Ctrl** key.

To display the **Window/level scale bar** menu, right-click the **Window/level scale bar**. In the displayed menu, you can select the objects to be moved along with the **Window/level scale bar** – the **Color, Opacity, Check, Isosurface** items.

The **Color bar** shows the current color palette. The following operation is available for modifying the color properties in the *simple mode*:

- To change the color in the color palette, move the cursor over the color position marker until it changes to ◇ and then:

- double-click, or
- right-click to display the context menu and select the **Edit** item.

The color dialog is then displayed.

The following operations are available for modifying the color properties in the *advanced mode*:

- To change the color in the color palette, move the cursor over the color position marker until it changes to ⇿ and then:
  - double-click, or
  - right-click to display the context menu and select the **Edit** item. The color dialog is then displayed.
- To move a color in the **Color bar** by moving the color position marker, move the cursor over the color position marker until it changes to ⇿ and press and hold down the left mouse button while moving it.
- To insert a new color position marker in the **Color bar**, place the cursor at the desired location for the insertion of the new color position marker and then:
  - double-click, or
  - right-click to display the context menu and select the **Insert** item.
- To set the interpolation mode between color position markers, right-click the **Color bar** to display the context menu and select the **Interpolation** sub-menu. Next, choose from among the **Box**, **Linear** and **Cosine** items.
- To delete a color position marker, move the cursor over the color position marker until it changes to ⇿, right-click to display the context menu and select the **Delete** item.

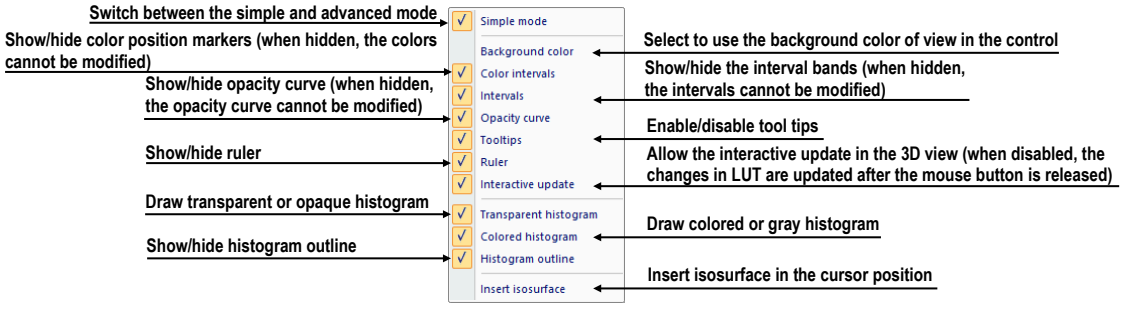


Figure 298 – LUT context menu

The **LUT** context menu (see Figure 298) contains the basic properties of the **LUT** control. To display the **LUT** context menu, right-click the **LUT** control.

The interval bands define the custom boundary intervals. The color palette within the interval is displayed along with the defined transparency. If the interval display is turned off, the opacity for the given interval is considered to be zero.

The following operations are available for modifying the interval bands:

- To change an interval band, move the cursor over the interval band until it changes to ⇹ and press and hold down the left mouse button while moving the band. Release the band at the desired position.
- To add an interval band, double-click inside the interval or select the **Insert** item in the context menu of the interval band color scale. To display the context menu of the interval band color scale, move the cursor to the interval band color scale and right-click.
- To delete an interval band, select the **Delete** item in the interval band context menu.
- To display the interval band context menu, move the cursor over the interval band until it changes to ⇹ and right-click.

The opacity curve defines the opacity used in volume rendering. Unlike in the *advanced mode*, the opacity curve in the *simple mode* is fixed to the center of the interval and automatically moves along with the interval band.

The following operations are available for modifying the opacity properties:

- To modify the opacity, move the cursor over the opacity curve point until it changes to ⇕ or ✣ and press and hold down the left mouse button while moving it.
- To change the curve slope (tangent) in the intersection point with the closest interval band, press the **Alt** key, move the cursor over the opacity curve until it changes to ⇜ and press and hold down the left mouse button while changing the curve slope.
- The opacity curve can be moved/scaled using the opacity curve scale bar.
- In the *advanced mode*, you can move the opacity curve. To move the opacity curve, press the **Alt** + **Shift** key combination and move the cursor over the opacity curve until it changes to ⇝.

The **Isosurface** is displayed in the histogram area. To insert an isosurface, right-click the desired position and select the **Insert isosurface** item in the displayed context menu. The isosurface transparency is defined by the circle position.

The following operations are available for modifying the isosurface properties:

- To move an isosurface, move the cursor over the isosurface line until it changes to ⇿ and press and hold down the left mouse button while moving it horizontally.
- To change the isosurface transparency, move the cursor over the isosurface line until it changes to ⇳ and press and hold down the left mouse button while moving it vertically.

16 Registrations

In order to map one series to another and to define a relation between them, they have to be registered (matched to one another). It is then possible to transfer coordinates between the series bi-directionally, to coordinate the same position in both series and to display the data overlaid from both series in the **Image fusion** mode (see 14 Multi-modality fusion).

TomoCon allows you to define your own registration between selected series by the group of registration tools described in chapter 16.1 Defining registration. Using the **Registrations** dialog (see Figure 299), you can define a new, edit or remove exist registration. Each created registration can be saved with images in DICOM format and be sent to PACS.

Except your own registrations, TomoCon supports also frame of reference registrations, which are stored with original patient data. The frame of reference registrations are not displayed in the **Registration** dialog, because they can not be changed or removed. When opening a patient study (with the frame of reference), registration between the two series is created automatically.

To open the **Registrations** dialog (see Figure 299), click the **Registrations…** item in the **Tools** menu.

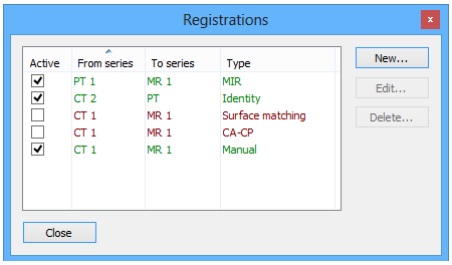


Figure 299 – Registrations dialog

The following operations are available in the **Registrations** dialog:

- **New…** - defining a new registration between two series (see 16.1 Defining registration).
- **Edit...** - editing a selected registration.
- **Delete… -** deleting a selected registration from the list of registrations.

It is possible to define multiple registrations between two series. In this case, only one of them can be active (highlighted in green and checked). Other registrations between the series are inactive (highlighted in red and unchecked). Using the check box, it is

possible to temporarily undefine a registration or to select one of the registrations defined for the series pair.

16.1 Defining registration

In order to define a relation between two series, press the **New…** button in the **Registrations** dialog (see Figure 299). The **Define registration** dialog opens (see Figure 300).

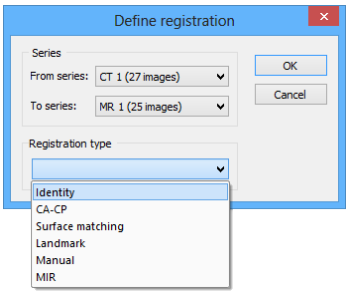


Figure 300 – Define registration dialog, selecting the Registration type

The **Define registration** dialog (see Figure 300) specifies the following:

- **Series** – the two series and the registration type between them:
  - **From series**
  - **To series**
- **Registration types**:
  - **Identity** (see 16.1.1 Identity)
  - **CA-CP** (see 16.1.2 Patient-related (CA-CP))
  - **Surface matching** (see 16.1.3 Surface matching)
  - **Landmark** (see 16.1.4 Landmark)
  - **Manual** (see 16.1.5 Manual)
  - **MIR** (see 16.1.6 MIR)

16.1.1 Identity

For **Identity registration**, it is assumed that the coordinate systems of the two image series are identical. This option is used if patient coordinate systems have been established in both image series (a frame of reference has been defined) or if the coordinate systems have remained identical through other means.

16.1.2 Patient-related (CA-CP)

CA-CP registration (see Figure 301) uses the coordinates of a patient's CA, CP and Median points to establish series registration.

The distance between the **CA** and **CP** points must fall within the range of 21.0 and 28.5 mm.

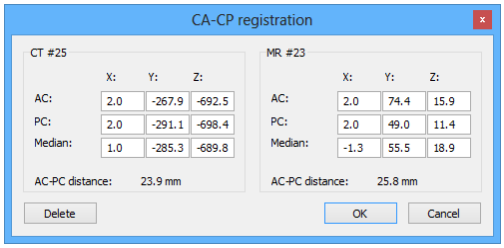


Figure 301 – CA-CP Registration dialog

16.1.3 Surface matching

Surface matching registration (see Figure 302) uses ROIs to establish series registration. This is suitable for cases in which the same ROI structure was defined in both image series. These two ROIs are then matched.

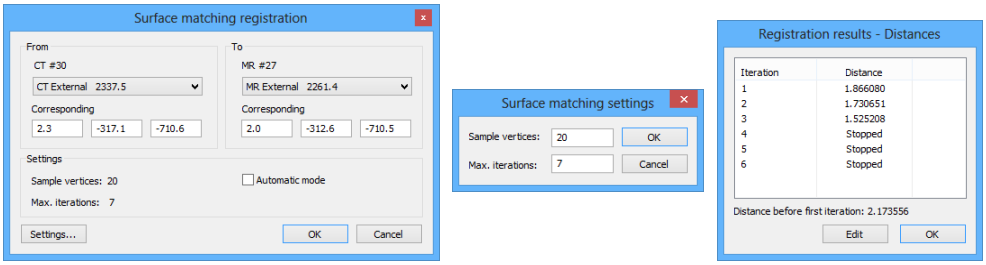


Figure 302 – Surface Matching Registration dialog, Surface matching settings dialog, Registration results - Distances dialog

16.1.4 Landmark

Landmark registration (see Figure 303) uses the coordinates of multiple landmarks to establish series registration.

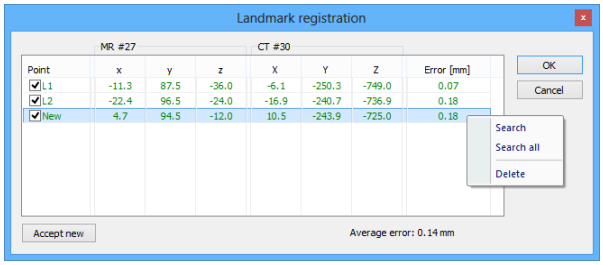


Figure 303 – Landmark Registration dialog

An erroneous landmark pair with an error exceeding the acceptable value can be disabled without deleting the pair from the list by removing the in the check box.

Landmarks can be renamed according to the names of the marked orientation points. To do so, click the landmark name (the default names are **L1**, **L2**, etc.) and overwrite it to match the marked structure or pin (e.g. **Marker2**). Each enabled landmark is displayed in the image Marker2 with its respective name.

16.1.5 Manual

Manual registration concerns the mutual manual movement of the three base planes in two registered series. After selecting manual registration in the **Define registration** dialog, the **Manual registration initialization** dialog is displayed (see Figure 304) in which the initial settings of manual registration are defined. In this dialog, you can define the initial relation between the series:

- **Use existing registration** (selecting an existing registration from the list)
- **Automatic** (the centers of the 3D coordinate systems of the two series are assumed identical)

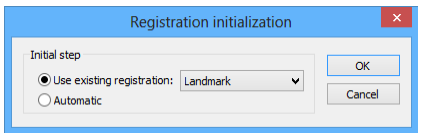


Figure 304 – Manual registration initialization dialog

After confirming the initial step with **OK** button, three views for manual registration are displayed in the workspace (see Figure 305) along with the **Manual registration** dialog (see Figure 306).

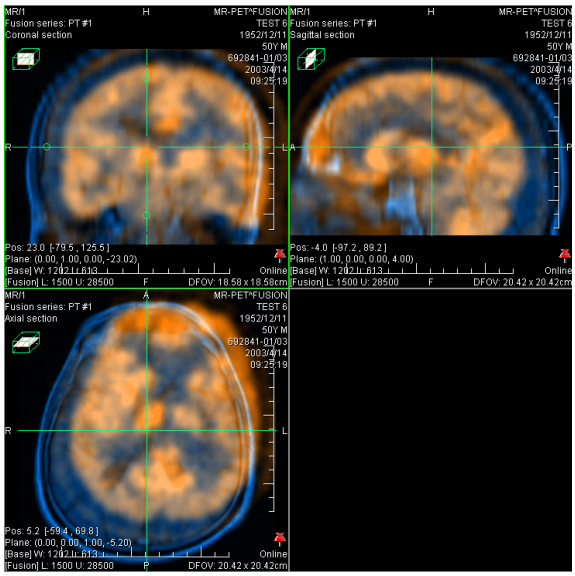


Figure 305 – Manual registration working area layout

The registration layout contains three separate views with each view displaying a pair of MPRs (each MPR is for a different series) in one base plane (axial, sagittal, coronal). The MPRs of the registered series have different colors and are transparent. The color of the MPR of each series is displayed in the **Manual registration** dialog and can be changed at any time (see Figure 306).

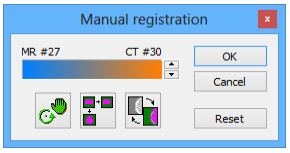
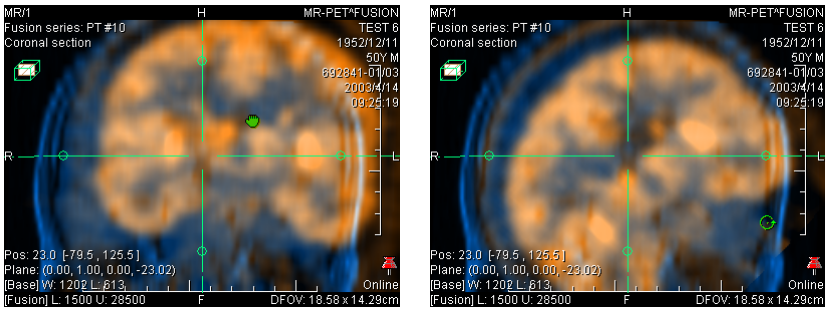


Figure 306 – Manual registration dialog

Activate the first view. A circle for moving and rotating the MPR will be displayed in this view. When the mouse cursor is placed inside the circle, the MPR can be moved (the cursor is displayed as). Press and hold down the left mouse button, move the MPR to the required position in the view and release the mouse button (see Figure 307a). Outside of the circle, the MPR can be rotated around the center of the view (the cursor is displayed as). Press and hold down the left mouse button, rotate the MPR to the required orientation in the view and release the mouse button (see Figure 307b). MPRs of one only series can be moved/rotated. The MPRs of the other series (called Base MPR) remain unchanged in the view. After releasing the mouse button, the registration is automatically recalculated and the other views are redrawn automatically.

When editing manual registration, it is possible at any time to enter the move and rotate mode by pressing the button (e.g. if another selected operation type is used in the view).



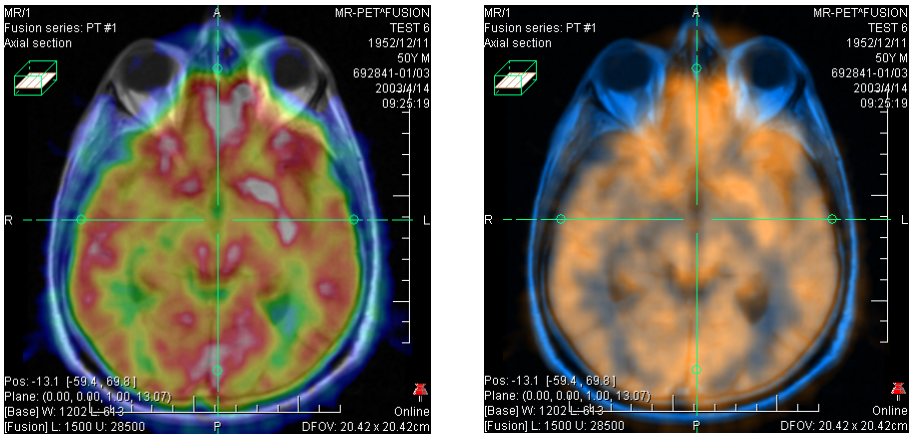
(a) **(b)**

Figure 307 – Panning (a) and rotating (b) an MPR during manual registration

If necessary, it is possible to modify the plane of the Base MPR in any view. To do so, activate the view in which the MPR plane is to be changed and press the button in the **Manual Registration** dialog. The MPR, which can be moved and rotated (standard MPR display; see 11 MPR - Multi Planar Reformatting), is displayed in the current view (see Figure 308a). After pressing the button again, it is possible to continue editing the manual registration view (see Figure 308b).

When editing manual registration, it is possible at any time to revert to the initial registration settings by pressing the **Reset** button in the **Manual Registration** dialog.

After manual registration is successfully defined, press the **OK** button to add the registration to the list of existing registrations. Alternatively, after pressing the **Cancel** button, the registration will be discarded and will not be used.



(a) **(b)**

Figure 308 – Moving the Base MPR's plane (a), manual registration with shifted plane of the Base MPR (b)

16.1.6 MIR

This functionality is available only with MIR license in TomoCon Workstation.

MIR (**M**utual **I**nformation **R**egistration) is a probability method for the calculation of the registration between two series for which final registration is calculated automatically.

After selecting MIR registration in the **Define registration** dialog, the **Registration Initialization** dialog is displayed (see Figure 309). This dialog is displayed only when the registration between series is already defined. The initial transformation can be defined as:

- **Use existing registration** (selecting an existing registration from the list)
- **Automatic** (the centers of the 3D coordinate systems of the two series are assumed identical)

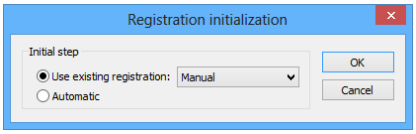


Figure 309 – MIR registration initialization dialog

After confirming the initial step with the **OK** button, the MIR dialog is displayed (see Figure 310). The calculation of the registration starts automatically and the progress is displayed in the log window. To stop the registration process, click the **Stop** button. If you check the **Close when finished** check box, the registration dialog will close automatically as soon as the calculation is completed.

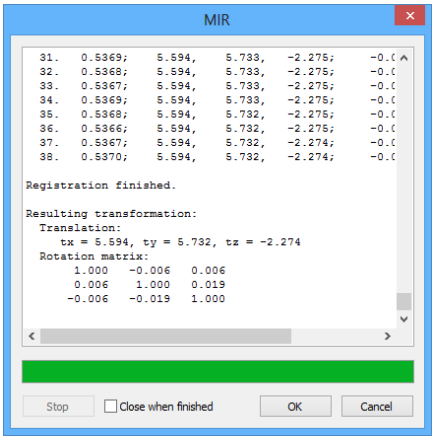


Figure 310 – MIR dialog

17 Print images

The TomoCon application provides printing capabilities that offer you more printing functions than other MS Windows applications. With TomoCon, you can print any selected images from the opened series on monochrome, on a color MS Windows printer or on any DICOM printer. The printing interface of TomoCon can be configured to work with a number of printers. The printing area can be divided according to your required layout and TomoCon allows you to monitor and control the printing process and review everything that has already been printed.

Printing in TomoCon is carried out in the background and will not impede your system operation and thus you can continue viewing while your print jobs are running.

TomoCon allows you to combine various images on virtual print films which you can then print out through the special TomoCon print interface (see 17.1 TomoCon print window) that is displayed by selecting the **Print...** item in the TomoCon main menu. This selection provides you with a high degree of flexibility for combining images from different studies or series on the same virtual print film or process images (such as zoom, filter, window/level, etc.) before they are printed.

17.1 TomoCon print window

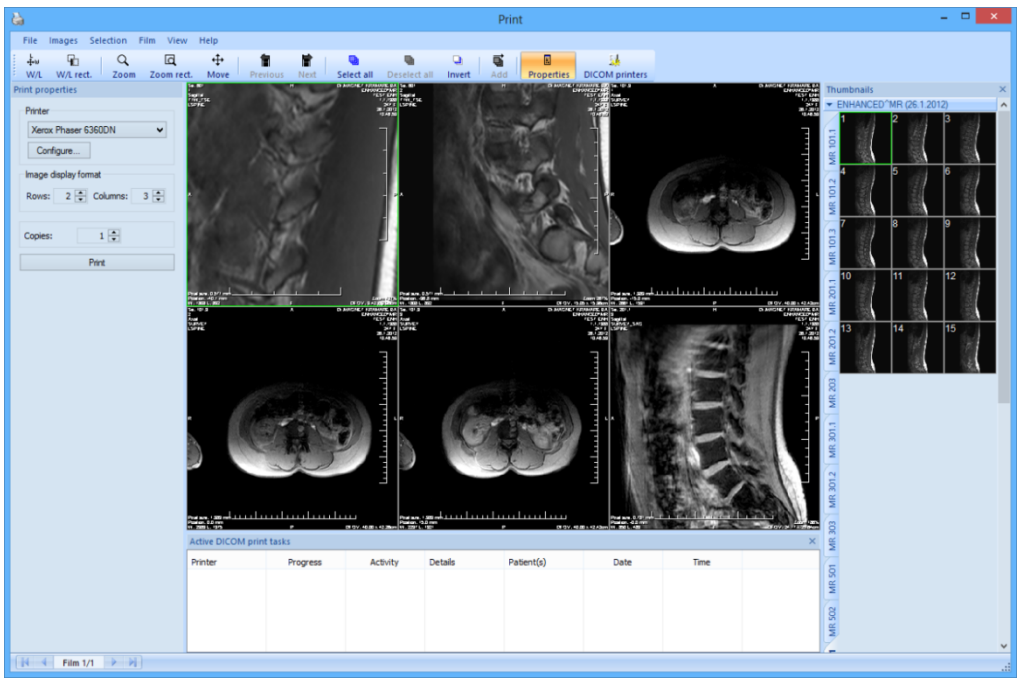


Figure 311 – TomoCon print interface

The TomoCon print interface window (see Figure 311) consists of the following main parts:

- Print working area (see 17.1.1 Print working area)
- Thumbnail palette (see 17.1.2 Main menu)
- Print queue (see 17.4 Start printing)
- Menu (see 17.1.2 Main menu)
- Standard toolbar (see 17.1.3 Toolbar)
- Status bar (see 17.1.4 Status bar)

17.1.1 Print working area

The print working area is a large black area representing one print film and is similar to the TomoCon working area. It is divided into smaller windows (views with displayed images) depending on the row and column settings in the **Image Display Format** item of the **Print properties** dialog (see Figure 312).

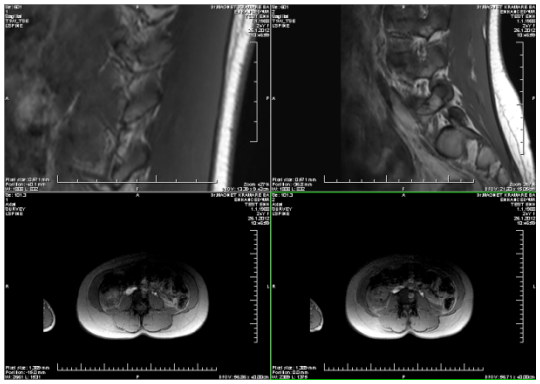


Figure 312 – Working area with 2 rows and 2 columns

When you have large number of images to print, you can compose and print a number of films at the same time. When you insert more images than can be placed on the current film, TomoCon automatically creates a new film into which it inserts the remaining images.

The print working area displays only one print film at one time. If you have more than one print film, you can move between the films using the scroll bar in the status bar of the print window (see 17.1.4 Status bar) or by clicking the **Prev**/**Next** button in the toolbar (see 17.1.3 Toolbar).

When composing a print film on the current print working area, you can view and modify the images using the usual tools (window/level, pan, zoom, etc.). Right-click the image you want to modify and select the desired option from the displayed context menu (see Figure 313). Additionally, you can show/hide the additionally displayed

objects (ruler, overlays, texts, etc.) in all views using the **View** menu in the print window.

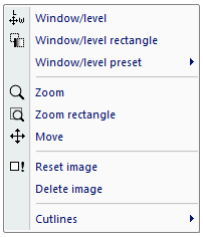


Figure 313 – Context menu in the current view

17.1.2 Main menu

The main menu takes the form of a system menu in the print window (see 3.4 Main menu) and provides you with direct access to all functions for printing images. As with a typical Microsoft Windows application, the items in the main menu are logically grouped into submenus. The main menu consists of the following submenus:

- **File -** for DICOM printer installation (the **Printers…** item, see 17.5.2 Configuring a DICOM printer) and completing work in the print window (the **Exit** item).
- **Images -** for image modification (window/level, zoom, move, etc.) in the current view (see 17.3 Manipulating image for print).
- **Selection -** for selecting images from the thumbnail palette to be displayed in the print working area (see 17.1.6 Select images for print).
- **Film -** for editing and moving between films (see 17.2 Editing and moving films).
- **View -** for hiding/displaying sub-windows (toolbar, status bar, etc.) in the print window and additional objects in views.
- **Help -** for browsing the electronic version of the user's manual.

17.1.3 Toolbar

The print window of the TomoCon application allows you to use the **Standard** toolbar buttons for frequently performed tasks in the printing preparation process. This toolbar (see Figure 314) is located above the print menu by default and its visibility can be changed by checking/unchecking the **Toolbar** item in the **View** menu. The **Standard** toolbar in the print window contains two groups of buttons. The first contains the buttons for activating the standard TomoCon tools for image

viewing while the second contains the special printing buttons for inserting images into the working area and the buttons for moving between the print films

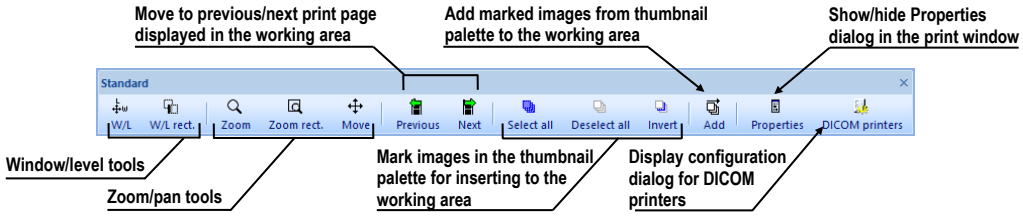


Figure 314 – Print Standard toolbar

17.1.4 Status bar

The Status bar (see Figure 315) is a horizontal bar in the lower part of the print window that displays the move panel which is used for moving between the print films displayed in the working area and for displaying the progress of the current printing tasks. It is visible by default although TomoCon allows you to hide/show it by the unchecking/checking the **Status bar** option in the **View** main menu.

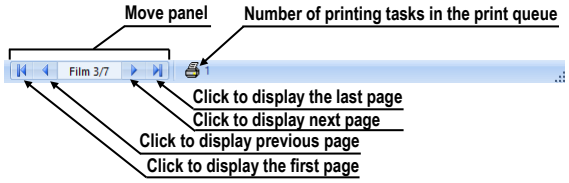


Figure 315 – Print Status bar

17.1.5 Thumbnail palette

The thumbnail palette, which is located on the right-hand side of the print window, enables you to select and add images to the print films (see Figure 316). All series of opened studies in the TomoCon application are also displayed in this palette and the work with it is identical to the work with the main thumbnail palette in TomoCon (see 3.3 Thumbnails palette).

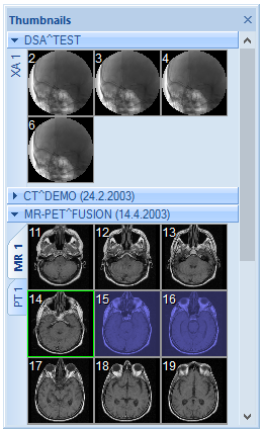
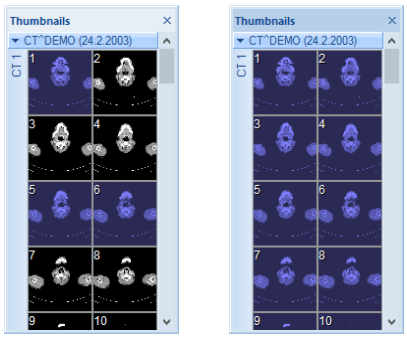


Figure 316 – Thumbnail palette in the print window

17.1.6 Select images for print

To select and add a group of images from the thumbnail palette to the films, proceed as follows:

1. Display the appropriate series tab in the thumbnail palette.
2. Click the required images. The images will be highlighted in blue (see Figure 317a).
3. Click the **Add** button (the icon) in the **Standard** toolbar. The selected images will automatically be added following the last image in the working area.



(a) **(b)**

Figure 317 – Selected images in the thumbnail palette, a) three selected images, b) all selected images

To select and add all images of a displayed series from the thumbnail palette to a film, proceed as follows:

1. Click the **Select all** button (the icon) in the **Standard** toolbar. All of the images displayed in the thumbnail palette will be highlighted in blue (see Figure 317b).
2. Click the **Add** button (the icon) in the **Standard** toolbar. The selected images will automatically be added following the last image in the working area.

To clear all of the selected images in the thumbnail palette, click the **Deselect all** button (the icon) in the **Standard** toolbar in the print window.

17.2 Editing and moving films

When launching the TomoCon print interface, one empty film without images becomes available. After adding the images, they are placed, one after another, into the required number of films. The print working area represents one film. The number

of images on the film is specified by the number of rows and columns in the **Image display format** item of the **Print properties** dialog.
If you are working with more than one film, you can move between them using the move panel in the status bar (see Figure 318a) or you can use the **Previous** ( )/ **Next** ( ) buttons in the **Standard** toolbar (see Figure 318b).

(a) **(b)**

Figure 318 – a) Move panel, b) Previous/Next buttons

To delete an image in the current view in the working area, select the **Delete image** item in the **Film** main menu (see Figure 319). The images following the deleted image will be shifted by one position.

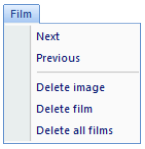


Figure 319 – Film menu

To delete an entire film that you have created, select any view in the film to be deleted and select the **Delete film** item in the **Film** main menu. Similarly, to delete all films, select the **Delete all films** item.

17.3 Manipulating image for print

While composing a film, you can view and modify the images in the same manner you do in TomoCon (zoom, pan, window/level, etc.). To modify the image data in the current view, use the **Images** menu (see Figure 320) that contains the following tools:

- **Window/Level** and **Window/Level rectangle**
- **Zoom** and **Zoom rectangle**
- **Move**

The activation/use of the modifications is the same as those of the options of the TomoCon **Image** menu (see Figure 320).

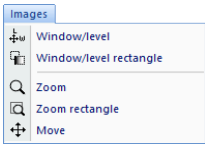


Figure 320 – Images menu

17.4 Start printing

Once you have finished composing your films, use the options in the **Printer properties** dialog to change the printer, the print orientation and the film or paper size (see 17.5 Print properties). Once you have configured the printer properties, click the **Print** button to submit the print job.

After printing starts on any DICOM printer, the current status of the printing process is displayed in the **Preparing data** dialog (see Figure 321). Once the process is complete, a new print task is then added to the DICOM print queue. During the DICOM print process, you can at any time check in detail which studies are being printing in the **Active DICOM print tasks** list located above the working area (see 17.4.1 Monitoring and controlling the print process).

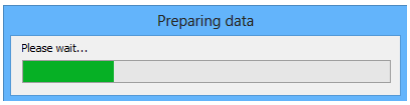


Figure 321 – DICOM printing…

17.4.1 Monitoring and controlling the print process

Using the list of **Active DICOM print tasks** (see Figure 322), which can be displayed/hidden by selecting the **Print queue** item in the **View** menu, you can see if and how many studies are awaiting print (pending), whether any are currently being printed and whether any errors have occurred. In addition to the current status of each task displayed in the **Activity** column, information is displayed concerning each task, such as the name of the printer (the **Printer** column), the progress of the status of the current task (the **Progress** column), the task **Details**, etc.

The context menu of each task displayed in the list allows you to restart, remove, stop or delete your print jobs. To carry out these actions for a job in the printer queue, you first need to select the job in the list and right-click to display the context menu and then select the required action.

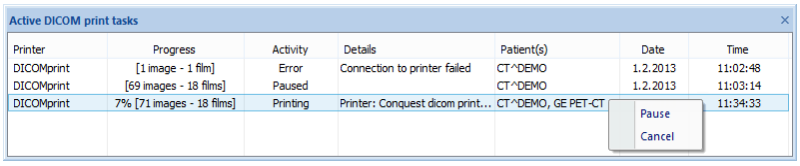


Figure 322 – List of active DICOM print tasks

17.5 Print properties

The **Print properties** dialog, which is docked in the left-hand side of the print window, allows you to configure the print options of the currently selected printer in

the printer combo box. This box contains the list of all available MS Windows printers installed on your computer and all of your configured DICOM printers (see Figure 323).

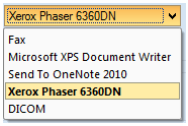


Figure 323 – The list of printers in print window

For the currently selected printer, you can configure the following (see Figure 324):

- The settings for the print process through the **Printer** option dialog. To display the **Printer** option dialog, click the **Configure** button in the **Print properties** dialog. For a MS Windows printer, you can configure the settings as described in chapter 17.5.3 Configuring a MS Window printer; for a DICOM printer, you can configure the settings as described in chapter 17.5.2 Configuring a DICOM printer.
- The number of rows and columns that define the number of images displayed on each film (**Image display format**).
- The number of copies of the printed films (**Copies**).
- The film settings (size, orientation, etc.) used only for DICOM printers.

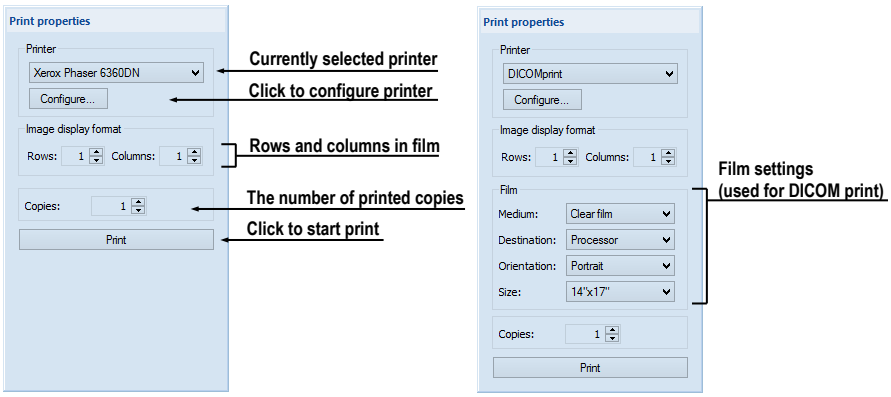


Figure 324 – Print properties dialog

17.5.1 Installing a printer

The TomoCon application allows you to print on standard MS Windows printers or on DICOM printers. While the MS Windows printer comes installed as part of the MS Windows operating system, it is necessary to install DICOM printers in TomoCon manually.

To install and configure a DICOM printer in the TomoCon print interface, select the **DICOM Printers...** item in the **File** menu of the print window (see Figure 325) and

define the printer parameters in the displayed **DICOM printers** dialog (see Figure 326).

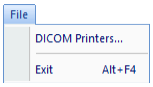


Figure 325 – File menu

The **DICOM printers** dialog contains the list of the installed DICOM printers. Here it is possible to configure previously installed printers, to install new printers and to verify DICOM connection to a printer (see Figure 325).

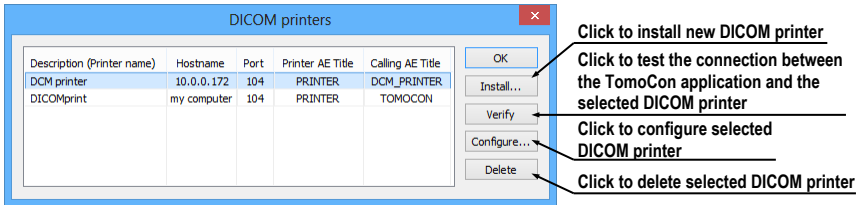


Figure 326 – Printers dialog

To install a new DICOM printer, click the **Install...** button to open the **Printer installation** dialog (see Figure 327) in which you can set the properties of the new printer (**Printer name**, **Hostname**, **Port**, **Printer AE title**, **Calling AE title**).

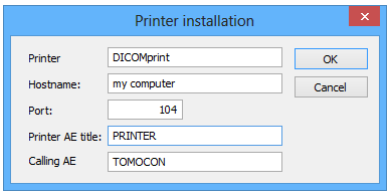


Figure 327 – Printer installation dialog

To configure the printing settings of the selected DICOM printer in the **DICOM Printers** dialog, click the **Configure...** button and adjust the printer settings in the displayed configuration dialog (see 17.5.2 Configuring a DICOM printer).

17.5.2 Configuring a DICOM printer

To configure the settings of a DICOM printer, select the corresponding printer in the printer combo box and click the **Configure**… button in the **Printer properties** dialog. The configuration dialog then opens (see Figure 328) in which you can define the following DICOM printer settings:

- **Trim** and printing **Priority**
- **Resolution** defined in DPI units
- **Monochrome** (8/12 bit) or **Color print**

- **Density** of printing with defined color for **Border**, **Empty image** and **Min/Max** gray values on film
- **Image display format** (**Rows, Columns**) – the number of rows and columns in the working area that correspond to the image layout in the film.
- **Film** (**Medium**, **Destination**, **Orientation**, **Size**) – the film properties.

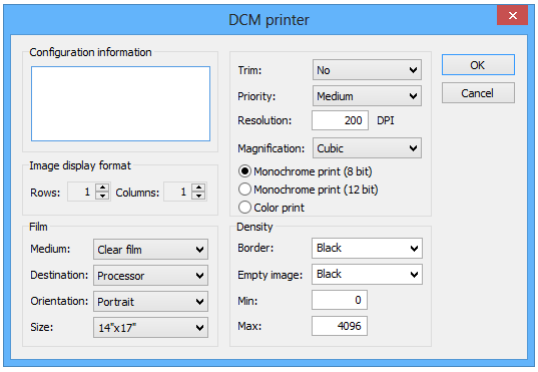


Figure 328 – Configuration dialog

17.5.3 Configuring a MS Window printer

To configure the settings of a MS Windows printer, select the corresponding printer in the printer combo box and click the **Configure**… button in the **Printer properties** dialog. The **Print** configuration dialog then opens (see Figure 329).

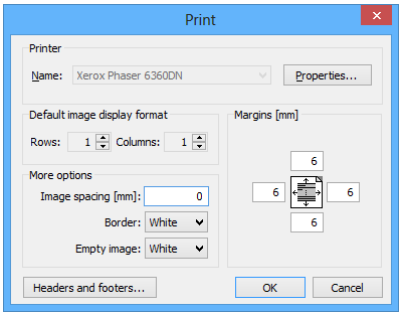


Figure 329 – Print dialog

The **Print** configuration dialog allows you to define the following settings of the MS Windows printer:

- MS Windows **Properties** of the printer such as the appropriate paper size and orientation, layout, color management and other preferences.
- **Default image display format** (**Rows, Columns**) – the default number of rows and columns in the working area that correspond to the image layout in the film.
- **Image spacing** between images on film

- Color of **Border** and **Empty image** on film
- **Margins** (top, left, right, bottom) defined in millimeters
- The header and footer to be inserted into each printed page: To define the header and footer, click the **Headers and footers** button. In the **Page headers and footers** dialog, which is then displayed, you can define the following types of texts for the page header and footer:

For print	Type
Horizontal line after header or before footer	**&h**
Version of TomoCon	**&v**
Date in short type	**&d**
Date in extended type	**&D**
Time	**&t**
Time in 24 format	**&T**
Current page number	**&p**
Total pages count	**&P**
Right alignment of text	**&b [aligned text]**
Center of text	**&b [centered text] &b**
One type &	**&&**

These types format the text to be printed. An example is depicted in Figure 330 where the header contains the name of the organization in the middle and the name of the doctor on the right. Once you have completed the definition, click the **OK** button to confirm.

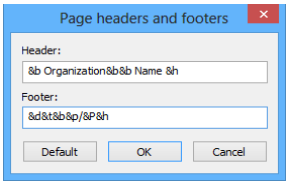


Figure 330 – Page headers and footers dialog

18 ECG/HD

The TomoCon application offers the possibility to review and enter measurements and diagnoses for ECG waveforms stored in patient DICOM data. As a result, it is very simple to analyze diagnostic patient images along with ECG diagnostic waveforms. The clinician has full access to comprehensive ECG/HD information in TomoCon using the **Waveforms** workspace that is automatically displayed when opening patient data with stored ECG/HD information, or manually by selecting the **ECG/HD...** item in the **Tools** menu.

The **Waveforms** workspace consists of the following three parts (see Figure 331):

- a toolbar with all applicable tools for ECG/HD diagnostics (in the upper left-hand corner)
- a list of all opened ECG/HD waveforms in TomoCon (on the left)
- a preview window for viewing and diagnosing a selected waveform

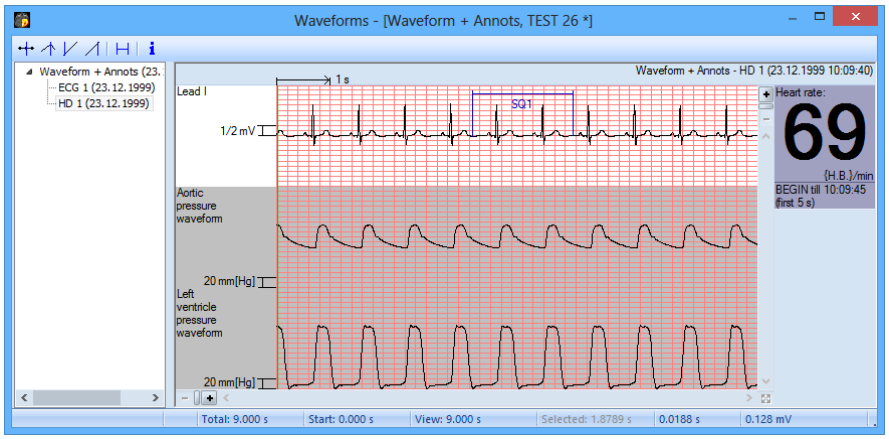


Figure 331 – Waveform workspace

18.1 Navigating through opened ECG/HD waveforms

All opened ECG/HD waveforms are listed on the left side of the **Waveforms** workspace in the TomoCon application. All waveforms are grouped according to the studies to which they belong.

To display a preview of a waveform, proceed as follows:

1. Look through the study groups in the list on the left side of the workspace.

   To find out which waveforms belongs to a particular study, click the [+] symbol in front of the study name. The complete list of all waveforms of the selected study will be displayed.

To collapse the list of study waveforms, click the [–] symbol in front of the study name.

2. After finding the required waveform in the list, select it by clicking.
3. The selected waveform will be displayed in the preview window on the right side of the workspace.

18.2 Viewing and diagnostics of ECG/HD

After opening the waveform workspace, you can immediately display a desired ECG/HD waveform (see Figure 332). Simply click the name of the waveform in the list on the left side and the selected waveform will be displayed in the preview window on the right side. Work with the preview window is simple and intuitive. The window provides a set of comprehensive and flexible tools for the viewing and diagnosis of ECG/HD waveforms in TomoCon.

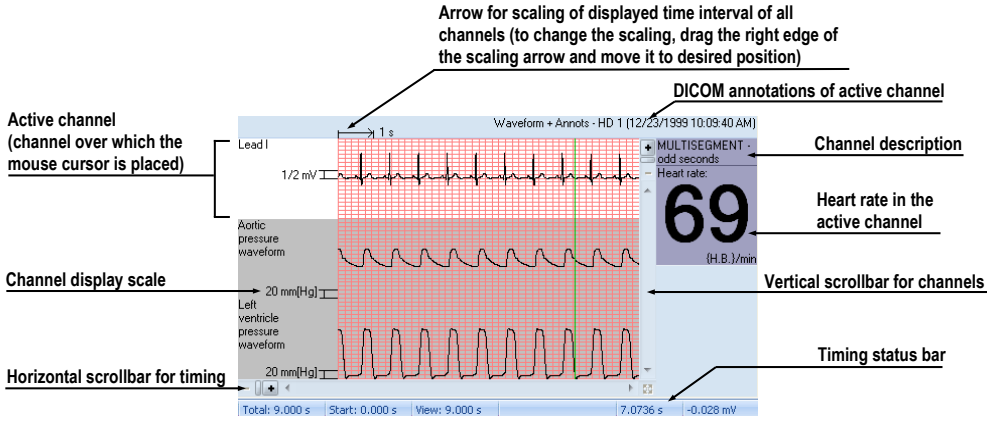


Figure 332 – Preview window for viewing and diagnosis of ECG/ HD

18.2.1 Status bar

The **Timing status** bar (see Figure 333) is the bar at the bottom of the waveform workspace. It displays the main time and value parameters from the displayed ECG/HD channels.

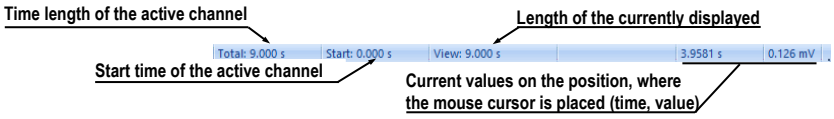


Figure 333 – Timing status bar

18.2.2 Customizing displayed channels and time interval

To customize the displayed time of all channels, use the horizontal timing scrollbar under the channels grid view (see Figure 334).

To customize the number of displayed channels, use the vertical scrollbar on the right side of the channels grid view (see Figure 334).

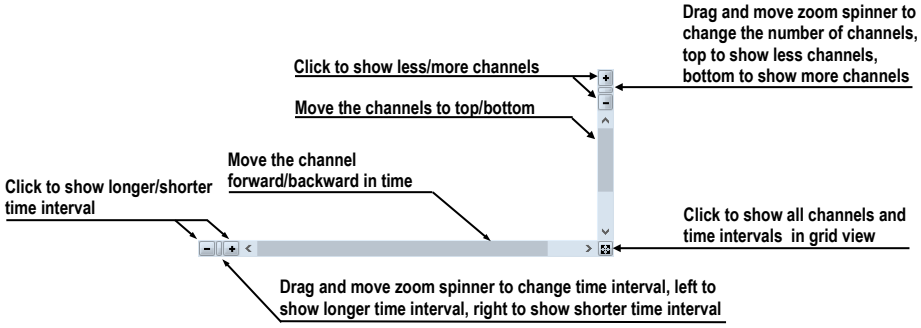


Figure 334 – Waveform workspace scrollbars

To customize the value scaling only for the active channel (the channel where the cursor is placed), use the vertical arrow in front of the active channel. Drag the top edge of the scaling arrow and move it to the desired position. The active channel is automatically vertically adjusted to the selected scale position (see Figure 335).

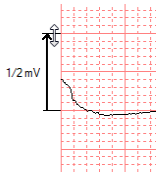


Figure 335 – Active channel value scaling

18.2.3 Time cursor in ECG/HD

When previewing ECG/HD waveforms, it is often necessary to identify the time and value for the active channel in a specific point. For this purpose, TomoCon offers the use of a time cursor tool (see Figure 336).

Figure 336 – Time cursor

This is a special cursor that is activated when the cursor hovers over the grid view. When moving the mouse, the Status bar automatically displays the time and value from the current cursor position. Moreover, it is also possible to find the minimum and maximum values in the active channel using the channel cursor. Simply select the active cursor mode in the toolbar (in the upper left-hand corner of the waveform workspace) and move the mouse cursor over the desired channel.

To activate cursor snapping:

- to the nearest sample around the cursor, click the button.
- to the nearest extreme around the cursor, click the button.
- to the minimum in the range around the cursor, click the button.
- to the maximum in the range around the cursor, click the button.

18.2.4 Marker measurement in ECG/HD

When diagnosing an ECG/HD examination, it is often necessary to measure or mark only a particular range of a selected channel. For this purpose, TomoCon offers a manual measurement tool of the **Marker** type (see Figure 337). Using this tool, it is possible to graphically write the measured time interval into the examination along with the description. Moreover, the TomoCon application enables its subsequent modification and removal. All defined measurements are available for subsequent use. It is possible to store them along with the patient data or even store it to a PACS.

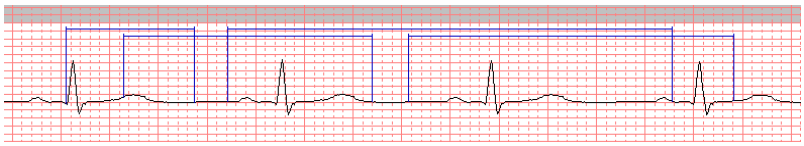


Figure 337 – Markers in selected channel

To create a new range measurement, proceed as follows:

1. Click the button on the toolbar in the waveform workspace or the context menu.
2. Move the cursor to the desired start location in a channel.
3. Press and hold down the left mouse button at the start location and move the cursor to the other location where you want the measurement to end.
4. Release the left mouse button. The **Marker properties** dialog is automatically displayed (see Figure 338).
5. Fill in the **Marker properties** dialog and click the **OK** button. A newly defined range measurement is then automatically created and displayed in the active channel highlighted in blue and labeled with a specified name.

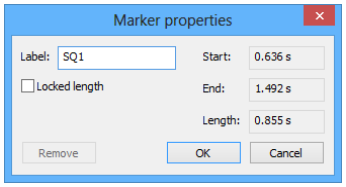


Figure 338 – Marker properties dialog

To edit the start or end location of a defined range measurement, proceed as follows:

1. Move the cursor over the vertical start or end line (the measurement will be highlighted).
2. Press and hold down the left mouse button and move the cursor to the new location (see Figure 339). The measurement border will move along with the cursor.
3. Release the left mouse button.

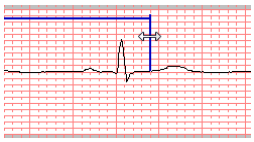


Figure 339 – Editing a defined Marker

To edit the measurement properties or to remove a defined measurement, proceed as follows:

1. Move the cursor over the vertical start or end line (the measurement will be highlighted).
2. Press the right mouse button.
3. To edit the measurement properties, select the **Properties…** item in the displayed context menu (see Figure 340).

To remove a measurement, select the **Remove** menu item in the displayed context menu.

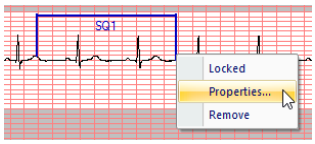


Figure 340 – Marker context menu

19 Touch screen mode

The TomoCon application offers the special touch screen mode for touch screens used in operating rooms. The touch screen mode is activated when starting TomoCon (see 3 Using TomoCon) or during work with the application by selecting the **Touch screen mode** item in the **Tools** menu. The mode offers selected application functions that are operated using enlarged control buttons.

The touch screen mode window consists of the following two parts (see Figure 341):

- Working area (on the left)
- Panel with control buttons (on the right)

When the mode is started, the working area has only one view – the current view. Click the  button to change the layout of the working area (see 19.5 Working area layout). If there are multiple views in the working area, select the view that is to be the current view. If patient studies were opened in TomoCon before switching to the touch screen mode and the current view was empty, the working area is filled with the image sequence. The first image is then the first image from the last series of the most recently opened study in TomoCon. If an image was selected in the current view, the working area is then filled with the image sequence from the current image series beginning with this image. If no patient study was open, the working area is empty.

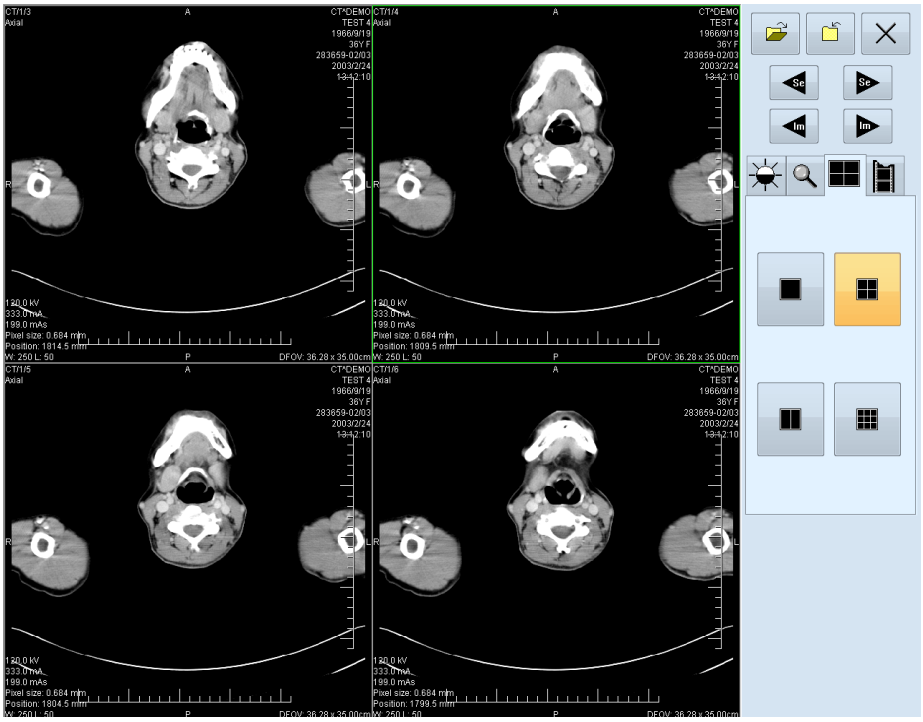


Figure 341 – Touch screen mode – layout

The panel of control buttons is divided into three parts:

1. The upper part of the panel contains the following buttons:
   - Open a patient study  (see 19.1 Opening a patient study)
   - Close a patient study  (see 19.2 Closing a patient study)
   - Exit the touch screen mode 
   - Select image series:  - Move to the previous series,  - Move to the next series (the series are in the same order in which they were opened in TomoCon)
   - Move images within the series:  - Move to the previous image,  - Move to the next image
2. The middle part of the panel contains the following tabs for operation selection:
   -  - Window, level, shape settings (see 19.3 Window, level, shape settings)
   -  - Move and zoom images (see 19.4 Move and zoom images)
   -  - Working area layout settings (see 19.5 Working area layout)
   -  - Switch to the Cine mode (see 19.6 Playing multi-frame images)
3. The lower part of the panel contains buttons that depend on the selected operation.

19.1 Opening a patient study

A patient study is opened in the Touch screen mode by clicking the  button. The **Search studies** dialog is then displayed (see 5 Studies management).

19.2 Closing a patient study

All studies opened in TomoCon can be closed by clicking the  button. If the Touch screen mode was activated when working with the application and changes were made (e.g. to ROIs, registrations, annotations), a dialog is then displayed allowing the changes to be saved before the studies are closed (see 5.5 Closing and saving a study).

19.3 Window, level, shape settings

After selecting the tab, the following buttons are displayed in the lower part of the panel (see Figure 342):

- - accelerating level increase
- - accelerating level decrease

Clicking the buttons changes the level of the following in the all images of the working area:

- **Window** -
- **Level** -
- **Shape** -

The level changing process is indicated by the slider and the numerical values under the sliders.

The buttons for the following operations are located in the lower part of the panel:

- - inverting the colors in the image
- - resetting the default values of the window, level and shape in the series
- - applying new values of the window, level and shape to the series

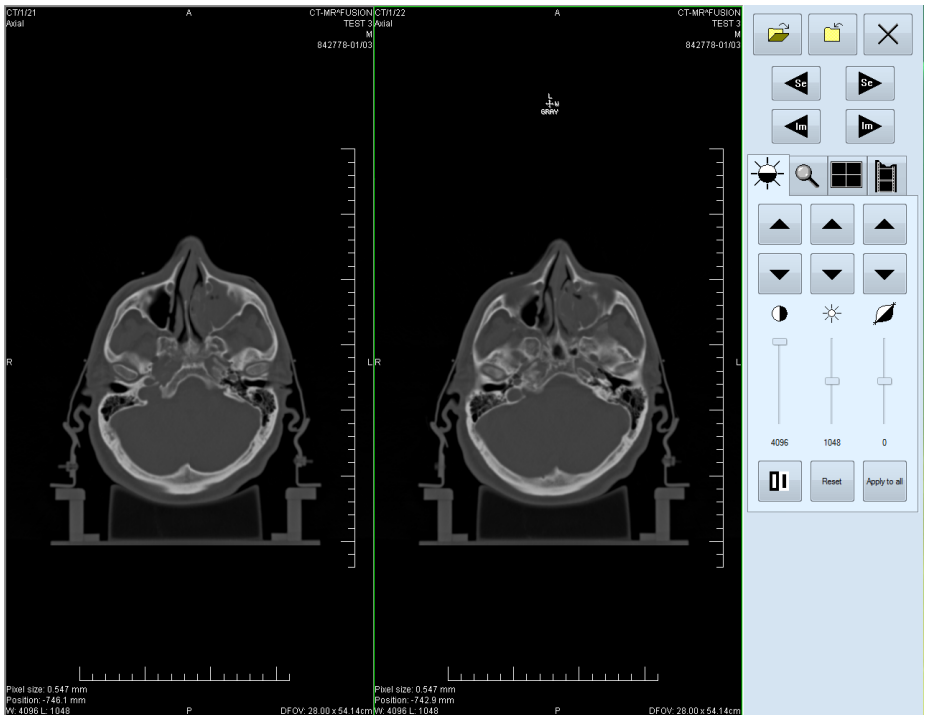


Figure 342 – Touch screen mode - gray, W&L settings

19.4 Move and zoom images

After selecting the tab, the following buttons are displayed in the lower part of the panel (see Figure 343):

- Zooming the image in the working area from 50% to 800%: - zoom out, - zoom in (the current image size is displayed under the zooming buttons)
- Moving the image: - up, - down, - left, - right
- Resetting the default size and position - Reset

Figure 343 – Touch screen mode - move and zoom images

19.5 Working area layout

After selecting the tab, the buttons representing the working area layout are displayed in the lower part of the panel (see Figure 341).

19.6 Playing multi-frame images

After selecting the tab, the following buttons are displayed in the lower part of the panel (see Figure 344):

- Playing back images: ◄ - play backward, ► - play forward, ■ - stop image playback. (When playing back images, only one view is displayed in the working area in which the images starting with the current image are played back; the slider and the numerical value under the buttons indicate the position of the displayed image in the series).
- Play mode: - looping, - sweeping
- Changing the frame per second (fps) from 0 to 50 fps in intervals of 2.5: + - increase fps, − - decrease fps (the current speed value is displayed between the buttons).

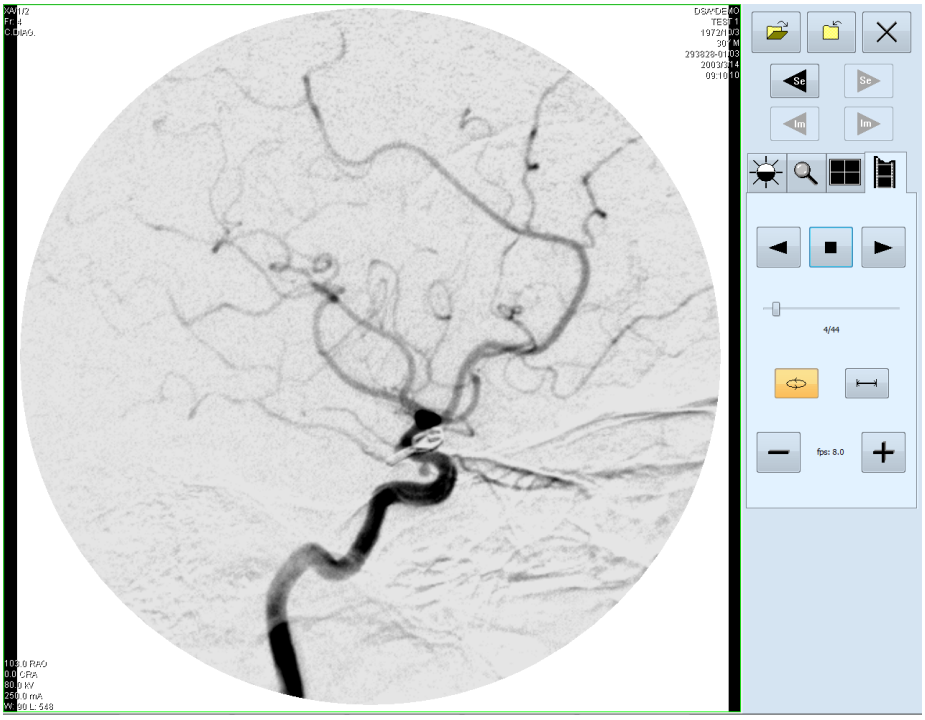


Figure 344 – Touch screen mode - playback of multi-frame images

20 Structured reports

A structured report is widely used as a standard mechanism for presenting the gathering, transmitting and exchanging of information in diagnostic medical imaging. It provides the framework for collecting the clinical questions and responses for a patient (medical reports, findings, annotations, etc.). All the information of a structured report is stored in a single object with SR modality and the TomoCon application provides you with the functionality for creating new reports and viewing previously written reports. Each structured report can be stored in the PACS system and TomoCon allows you to download/send it directly from/to the PACS system.

All structured reports in TomoCon are accessed through the **Reports** dialog (see Figure 345), which displays the list of all currently loaded or created reports. When you open a study with a previously created structured report, the **Reports...** dialog automatically opens in which you can view the reports. If the dialog is hidden, you can display it at any time by clicking the **Report** button in the main toolbar of the TomoCon application (or by selecting the **Reports…** item in the **Study** menu).

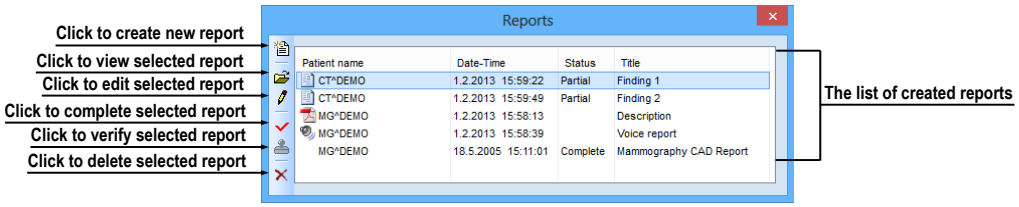


Figure 345 – Reports dialog

TomoCon supports several types of structured reports, which you can open and view using the **Reports** dialog in TomoCon. The main type is a Text report, which is composed of structured text blocks (see 20.1 Viewing a text report) and which allows you to write text information concerning a patient study.

20.1 Viewing a text report

To view a structured report displayed in the **Reports** dialog, select the report in the list and click the **View report** icon in the **Reports** dialog or double-click the report. The preview of the report heading and body content is then displayed (see Figure 346).

The report heading contains the following information:

- **Patient -** the name and date of birth of the patient along with other predefined identification data

- **Completion flag -** the report status (partial, complete, verified)
- **Predecessor Docs** - the link to the original document
- **Verification Flag -** the report verification (verified, unverified)
- **Content Date/Time** - the date and time of document creation; when editing an incomplete document, the time data does not change (the date/time of the original document is retained)

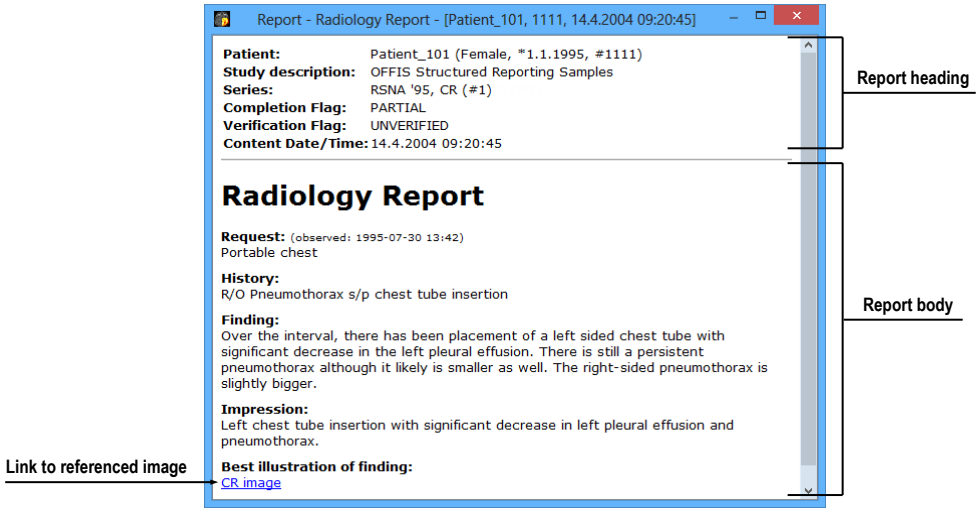


Figure 346 – Report content

If the report body contains a link to a patient image, clicking the link displays the image in the current view. If the study with this image is not opened in TomoCon, a dialog is displayed informing you that the referenced image cannot be found.

It is also possible to copy the report text to the clipboard or to a text file (e.g. MS Word). Using the mouse or the **Ctrl+A** keyboard shortcut, select the text and press the **Ctrl+C** keys to copy the text and the **Ctrl+V** keys to insert the text into the document.

To print a report, open it and press the **Ctrl+P** keys. The standard Microsoft Windows dialog for printing then opens. Using the **Print** dialog, the report can be printed on a standard Microsoft Windows printer.

A report you can close by clicking the button in the upper right-hand corner of the report dialog.

20.2 Viewing a Mammo CAD report

A Mammo CAD report is the special structured report containing findings identified by a computed-aided detection system on mammography images. Each identified finding can be described in text form and represented graphically (CAD markers) on the corresponding mammography image (see Figure 347).

After opening a Mammo CAD report in the TomoCon application, the report is then added to the list of all reports in the **Reports** dialog and all of its CAD markers are automatically displayed on the corresponding mammography images as special annotations with tooltips.

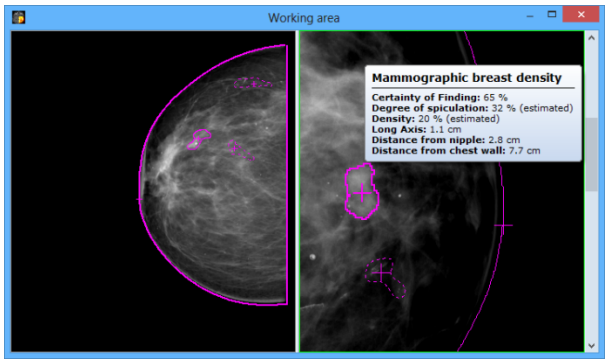


Figure 347 – Displayed CAD markers

To view a Mammo CAD report displayed in the **Reports** dialog, select the report in the list and click the **View report** icon in the **Reports** dialog or double-click the report. The preview of the report heading and body content is then displayed (see Figure 348).

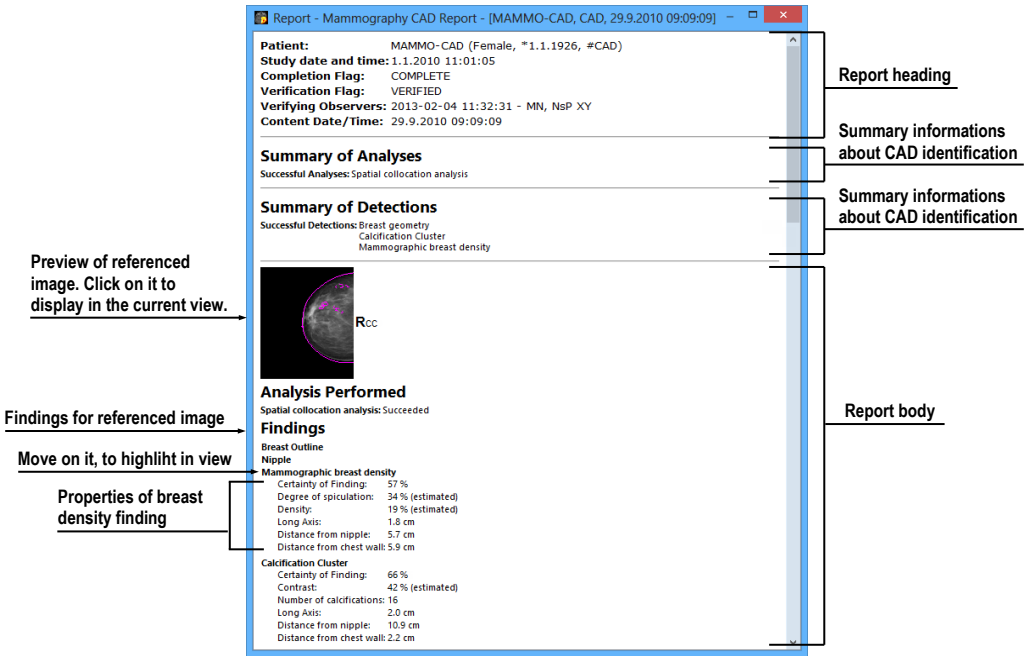


Figure 348 – Report content

The report content is composed of findings grouped by images with each image being represented by its preview. If you go to the image preview and click in the report, you can display this image directly in the current view of TomoCon. If you move to a certain finding in the report and the referenced image is displayed in any view in TomoCon, this finding is then highlighted.

20.3 Creating a new report

The TomoCon application offers you the possibility of creating three types of structured reports. To create a new report, click the **Create new report** item (the icon) in the left toolbar of the **Reports** dialog. A new report can be created only if a study is open in TomoCon. The **New report** dialog is then displayed in which you can select the template for the new report (see Figure 349) by double-clicking the template icon.

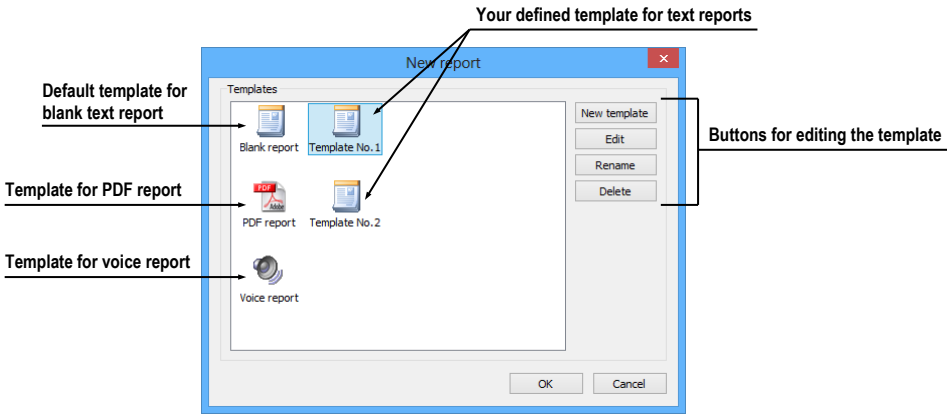


Figure 349 – Template choice dialog

The template defines the type of new report; you can select one of the following:

- Voice report - after double-clicking the **Voice report** icon, you can verbally record your report in the recording dialog that is displayed.
- PDF report - after double-clicking the **PDF report** icon, you can create a report from an existing PDF document stored on the disk.
- Text report - after double-clicking the text type report icon, you can write a text report in the **Report** dialog that is displayed (see 20.3.2 Report editor). You can select the **Blank report** template or another one of your prepared text templates (Template No.1, see Figure 349). Your text template can define the predefined structure of the new text report.

20.3.1 Report template

The TomoCon application offers you the possibility of using a template to create a new structured report. The template defines the structure of the report and can also contain your predefined texts that are the same in each of your reports. All defined report templates in TomoCon are listed in the **New report** dialog, which you can display by clicking the **Create new report** icon in the left toolbar of the **Reports** dialog.

To create a new template, click the **New template** button (see Figure 350) and enter the name of the report in the displayed dialog. The **Report** editor dialog (see 20.3.2 Report editor) is then displayed for writing the new template. After you have finished, the newly created template will automatically be inserted into the list of previously defined templates in the **New report** dialog.

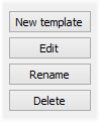


Figure 350 –Buttons for editing templates

To make changes to an existing template, select the template in the list and click the **Edit** button. The **Report** editor dialog (see 20.3.2 Report editor) is then displayed for editing the selected template.

To rename an existing template, select the template in the list, click the **Rename** button and enter the new name for the template (see Figure 351).

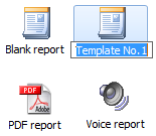


Figure 351 – Entering a new name for a template

To delete an existing template, select the template in the list and click the **Delete** button.

20.3.2 Report editor

The TomoCon application offers you the possibility to create your own text structure report using the report editor. This concerns a special dialog window (see Figure 352) in which you can write a structured text. The heading of the newly created report is filled in automatically from the patient study properties.

To create a new text structure report using the report editor, double-click the template icon in the **New report** dialog. If only one set of patient data is opened in TomoCon, the report editor opens with the patient's name in the heading. If multiple studies are opened in TomoCon, the **Select study...** dialog opens in which you can select the patient study for which the report is to be created.

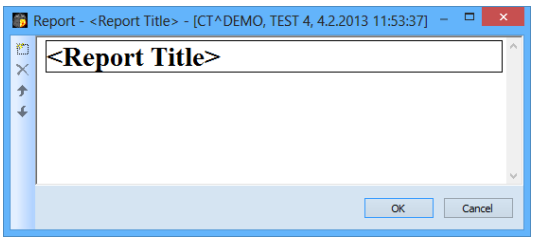


Figure 352 – Report dialog

The report editor allows you to insert texts into the text report through the text sections. A section is a separated part of texts, usually a group of sentences with the same meaning. Sections can be hierarchically arranged into a tree structure, thus allowing you to write any structured information into the report.

To insert a new section into the report editor, click the **Add new section** icon in the left toolbar of the dialog or select the **Add new section** item in the context menu of the **Report** dialog (the context menu opens by right-clicking in the dialog). A menu is then displayed with the section types that can be added to the text of the edit dialog (see Figure 353):

- **Text -** subtitle, report text
- **Container** - containing text or another container (maximum of 64 characters)
- **Concept modifier** - specification of the report heading
- **Observation context** - report information (writer, examining surgeon, etc.)
- **Property** - the physical properties of the medical findings

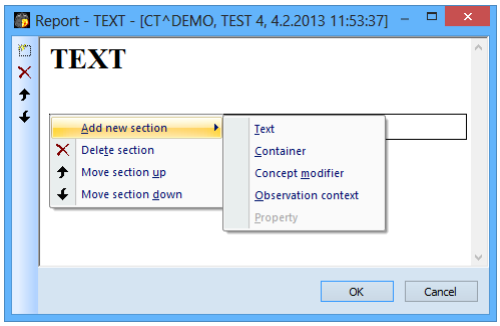


Figure 353 – Report dialog – context menu

It is possible to move sections up and down in the report editor dialog using the and **Move section up/down** arrows (container, text, etc.).

20.4 Report status

Each structured report has its own status, which is selected by the writer or reviewer of the report. The current report status is displayed with the report main properties in the **Reports** dialog (see Figure 354). Reports can take the following three statuses:

- **Partial** – the report is open for editing. This status allows you to edit the content of the report.

- **Complete –** the report is closed for editing. A report in this status cannot be edited; only a revised version of the report with the same content can be edited.
- **Verified** – the report has been verified by the verifying person (+ organization).

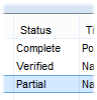


Figure 354 – Status of reports in the Reports dialog

To finish editing a report, select the report and click the **Complete report** icon in the left toolbar of the **Reports** dialog (see Figure 355). The **Complete report** dialog (see Figure 356) is then displayed in which you can add a note to the report concerning the completion process.

Figure 355 – Complete and Verify buttons in the Reports dialog

In order to verify a report, select the report and click the **Verify report** icon in the left toolbar of the **Reports** dialog (see Figure 355). The **Verify report** dialog is then displayed (see Figure 356) in which you can fill in the name and organization of the verifying person. Reports can be verified by more than one person. The data concerning the verifying person(s) is displayed when the corresponding report is opened for viewing.

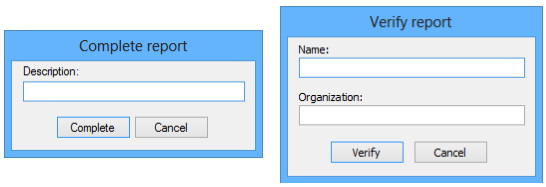


Figure 356 – Complete report and Verify report dialog

20.5 Editing a report

To edit an existing report, select it from the **Reports** list and click the **Edit report** icon in the left toolbar. The **Report** editor is then displayed in which you can change the content of the report.

Partially created reports can be edited at any time. When editing a completed and verified report, a new document is created with the same contents for editing. The original document will not change and the link to the original document (Predecessor Docs) will be added to the heading of the revised version. If the original report was not loaded into the application, it is not possible to open it.

20.6 Saving a report

If any changes have been made to structured reports (a newly created report, a changed report status, etc.) in the opened studies in TomoCon, an asterisk (*) is displayed after the study time in the TomoCon title bar at the top of the window (see Figure 357).

Figure 357 – TomoCon title bar with asterix

If any changes to structured reports exist in opened studies when attempting to close them, you are asked whether or not you wish to save the changes. If you want to save changes when a study is still open, press the **Ctrl+S** key combination on the keyboard or select the **Save** item in the **Study** menu of the main application menu. The changes to the structured reports will automatically be saved in the Local studies storage of TomoCon. To send these changes from TomoCon to a PACS, select the **Send...** item in the same menu.

21 Study anonymization

The TomoCon application allows you to save the series of all opened studies as a new anonymized study to the Local studies. This is carried out in the **Anonymize study** dialog (see Figure 358), which is opened by selecting the **Anonymize study...** item in the **Study** menu.

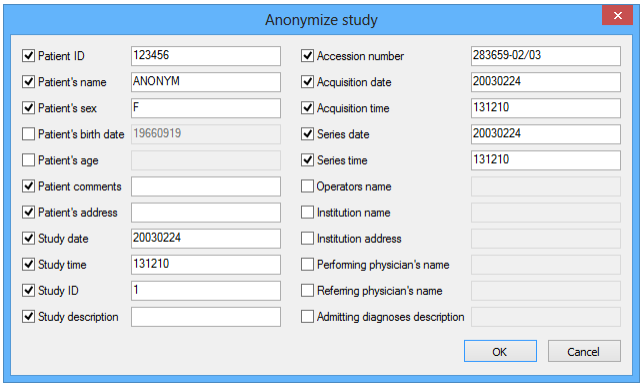


Figure 358 – Anonymize study dialog

The items in the dialog are filled with DICOM data obtained from the first opened study. Check the check box next to the item you want to change. This provides you access to the text box of the item. Click the **OK** button to save the new anonymized study. You can monitor the saving process in the **Saving anonymized study...** dialog (see Figure 359).

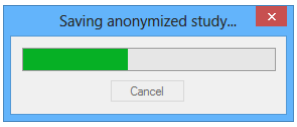


Figure 359 – Saving anonymized study… dialog

22 Creating a new patient study/series

A new study or new series can be added by means of the **Select study** dialog, which is displayed by selecting the **Create new series…** item in the **Study** submenu of the **TomoCon** menu (see 3.4 Main menu).

To create a new series in an existing study, proceed as follows:

1. Select the existing study for the insertion of the new series from the studies list in the **Select study** dialog (see Figure 360).
2. Click the **OK** button in the **Select study** dialog. The **New series** dialog then opens.
3. Fill the information concerning the new series into the **New series** dialog (see Figure 361) and click the **OK** button.
4. The new series is then automatically added to the selected study.

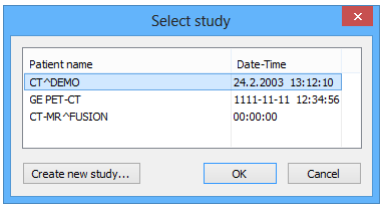


Figure 360 – Select study dialog

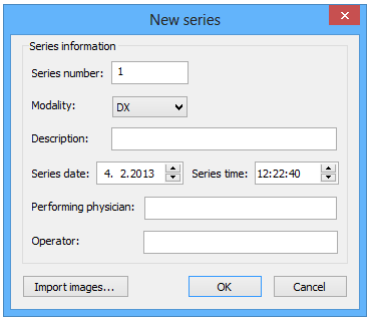


Figure 361 – New series dialog

To create a new series in a new study, proceed as follows:

1. Click the **Create new study…** button in the **Select study** dialog. The **New study** dialog then opens.
2. Fill the information concerning the new study into the **New study** dialog (see Figure 362) and click the **OK** button. The **New series** dialog then opens.
3. Fill the information concerning the new series into the **New series** dialog (see Figure 361).

4. To import the images that will automatically be inserted into the newly created series, click the **Import images...** button. Next, select the graphical files in your computer (bitmap, JPEG or TIFF files) in the displayed **Open** dialog and click the **Open** button.
5. Click the **OK** button in the **New series** dialog.
6. The new study along with the new series will automatically be added.

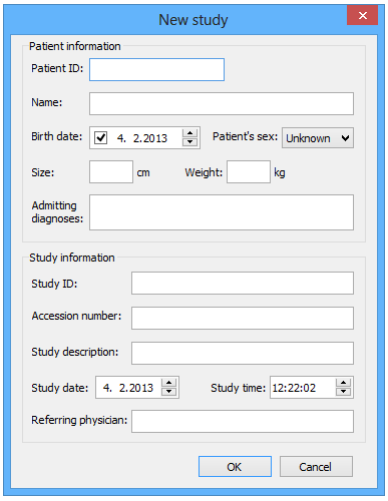


Figure 362 – New study dialog

23 Archiving images on a CD

Patient studies in the TomoCon application can be archived on the CD medium by means of the **Create CD** dialog. In order to burn such data on a CD, it is necessary that one of the following requirements is met:

- Microsoft Windows XP operating system (at the minimum) with launched "`Windows IMAPI`" or "`Windows IMAPI2`" service.
- Installed Nero Burning ROM 6.3 or higher.

If your system does not meet either of these requirements, the data can be archived to a selected directory on the disk.

The **Create CD…** dialog (see Figure 363) is opened by selecting the **Create CD…** item in the **Study** menu. The **Create CD…** dialog displays the set of patient data prepared for CD backup. To add the currently opened studies to the prepared data set, click the **Add** button. To remove a study, a series or an image from the set, click the **Remove** button or press the **Delete** key on the keyboard. Clicking the **Remove all** button removes all studies from the prepared data set.

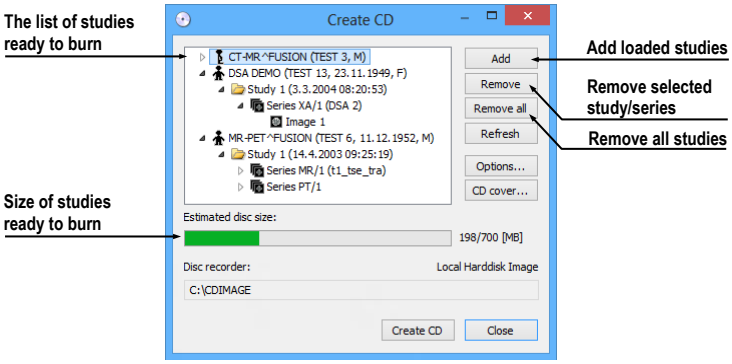


Figure 363 – Create CD dialog

Click the **Create CD** button to place the prepared data set on a CD or the selected directory on the disc (depending on the **Disc recorder** settings).

The **Create CD** dialog closes by clicking the **Close** button; the created data set will be retained for archiving. When the dialog is reopened (e.g. when loading new patient data to the application), the set will be available and new studies can be added by clicking the **Add** button.

It is possible to add patient studies to a CD with previously archived patient data. The **Create CD** dialog displays the newly added studies/series along with the previously archived studies (see Figure 364); it is not possible to remove them from the list.

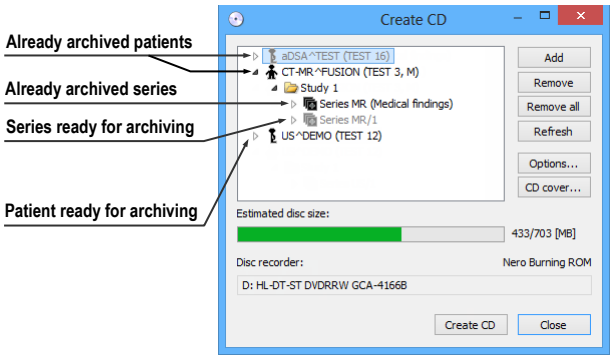
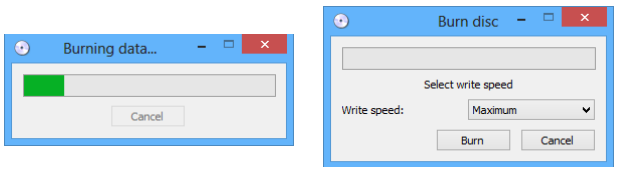


Figure 364 – Create CD dialog (adding a study/series to a CD)

Clicking the **Create CD** button starts the archiving process. You can monitor the burning process in the dialog (see Figure 365).



(a) **(b)**

Figure 365 – Archiving of patient image data in progress, IMAPI CD-Burning COM (a), Nero Burning ROM (b)

To set the archiving settings, click the **Options…** button. The **Create CD options** dialog then opens (see Figure 366).

The following settings can be made in the dialog:

- **Disc recorders** - selection of the burning type and of the **Disc recorders** to be used for archiving.
- **Maximal CD capacity** - user-specified CD capacity.
- **Temp directory** - an auxiliary directory for the temporary storage of studies prepared for archiving.
- **Export directory** - the directory for exporting the image of the prepared CD if the disk recorder is set as Local Hard Disk Image.
- **Template directory** - the directory that will be copied to the CD during the burning process.
- **Clear temp directory after burning** - if this option is checked, the temp dictionary serving for the temporary storage of studies prepared for archiving will be deleted after burning.
- **TomoCon Lite** - if this option is checked, the TomoCon Lite viewer will be added to the archive. The viewer has all TomoCon functionality except for

data import. Only the DICOM image archive on the given CD can be viewed with the viewer.

- **Template** - if this option is checked, the **Template directory** will be copied to the archive.

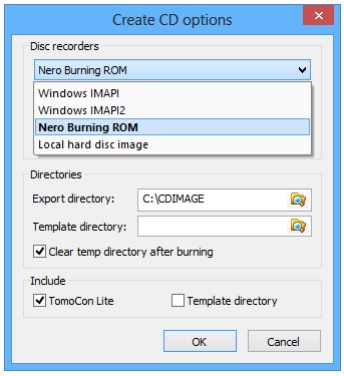
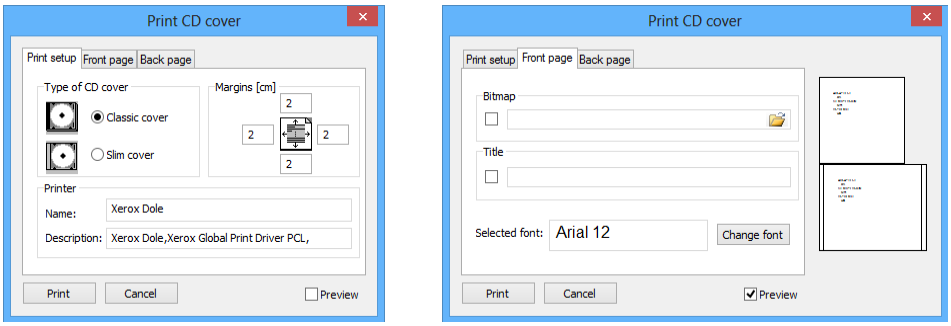


Figure 366 – Create CD options dialog

To create and print a cover for the created CD, use the **CD cover** dialog (see Figure 367), which is opened by clicking the **CD cover…** button. The list of patients from the **Create CD** dialog is then automatically placed on the front page and the back page of the cover.



(a) **(b)**

Figure 367 – CD Cover dialog, Print setup tab (a), Front page tab (b)

The following settings are available in the **CD cover** dialog:

- **Print setup** tab:
  - Type of CD cover (**Classic cover**, **Slim cover**)
  - Margins
- **Front page** tab:
  - Selecting a picture to accompany the text on the front page (**Bitmap**): Click the button with the icon to select the picture and click the check box to print the picture on the front page.

- Setting up the **Title**: Use the **Change font** button to change the font size and type for the title. Click the check box to print the title on the front page.

- **Back page** tab - the settings are the same as the front page settings.

In order to print the CD cover, click the **Print** button, which opens the standard Microsoft Windows print dialog (the **Print** dialog). Select the printer, specify the print parameters and click the **OK** button to initiate printing.

24 Mammography mode

The TomoCon application provides you with a powerful diagnostic mode for digital mammography. Its user interface and workflow have been optimized to support experienced mammography reviewers in high-volume reading. The mammography mode offers flexible and interactive diagnostic tools that radiologists require for clarity and efficiency in their work. In particular, it provides advanced workflow and image manipulation tools with customizable and flexible hanging protocols for diagnostic images from any vendor. It is of course also possible to access the other standard diagnostic tools, such as the magnifying glass, annotations and the window/level, in this mode. In combination with the predefined views for the single, double and quadruple tiling of the display, you get immediately access to all spatial information in digital mammograms.

24.1 Starting the mammography mode

You can activate the mammography mode in the following ways:

- Manually
  - by selecting the **Tools/Mammography mode** item in the main menu in TomoCon.
  - by defining and using the custom shortcut in TomoCon (see 4.5 Keyboard shortcuts).
- Automatically
  - by using the **/m** or **–m** command line parameter when launching TomoCon; it is recommended to use this feature when you want to create a desktop shortcut for quick access to the mammography mode in TomoCon.
  - by checking the **Start Mammography automatically when mammography study is loaded** check box on the **Mammography** tab of the **TomoCon options** dialog (see 4.8 Mammography) so that the mammography mode is activated when a mammography study is opened.

It is assumed when activating the mammography mode that the resolution of the monitors connected to your workstation is at least 3Mpx. If you have only one monitor, you should use the landscape monitor orientation. That stated, it is strongly recommended to use two portrait-oriented mammography monitors, both with the same resolution (3Mpx or higher). In order to use all zooming modes, you have to

calibrate your monitors before beginning the diagnosing process. For an explanation about how to calibrate your monitors, see 4.7 Monitors.

24.2 Mammography workspace

The standard diagnostic workstation for digital mammography consists of two high-resolution monitors designated for mammography and optionally a third standard monitor for multi-modality images (MRI, US) and patient data management.

The TomoCon mammography mode offers a specially designed workspace allowing you to take advantage of the maximal level of your available high-resolution display monitors connected to your workstation in the dual-portrait mode (see Figure 368).

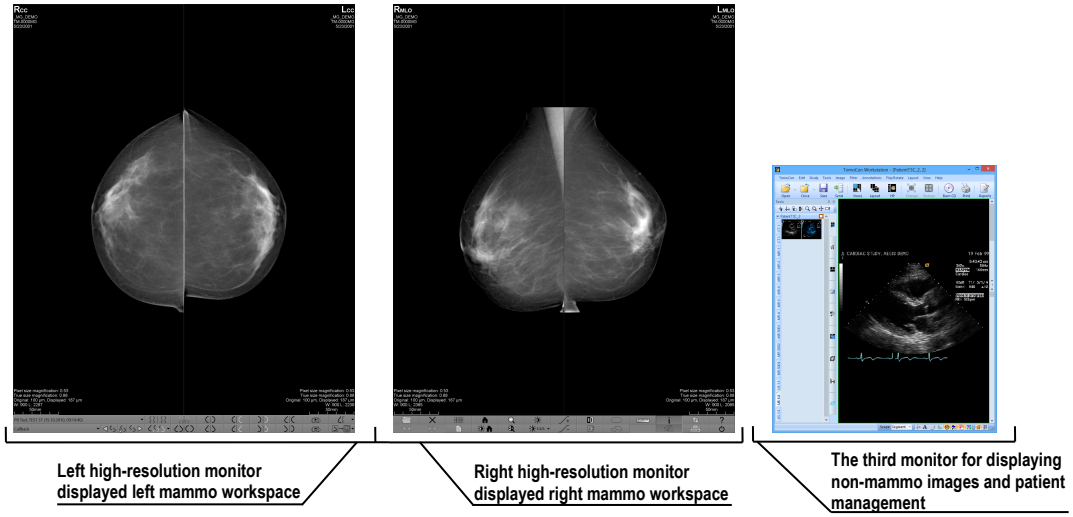


Figure 368 – TomoCon's mammography workspace

The TomoCon mammography workspace consists of two full-screen working areas, along with the mammography toolbars, that cover the entire display area of each high-resolution monitor. The toolbars are designed mainly for accelerated work with mammography image diagnosis, hangings, workflows and mammo-patient management. The two rows of toolbar buttons contain the most frequently used mammography tools. The toolbar on the left monitor offers the workflow and hanging functions (see Figure 369) while the toolbar on the right monitor contains the mammo-patient management and diagnosis tools (see Figure 370).

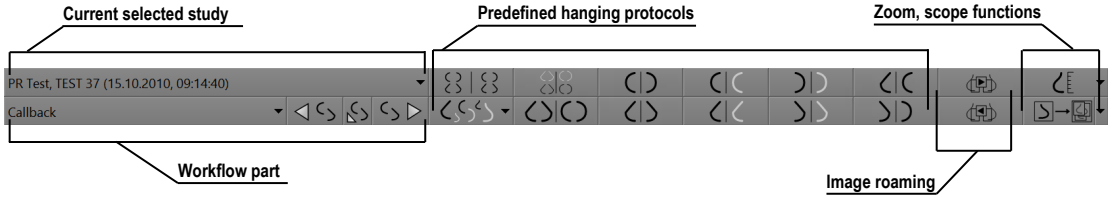


Figure 369 – Mammo toolbar on the left monitor

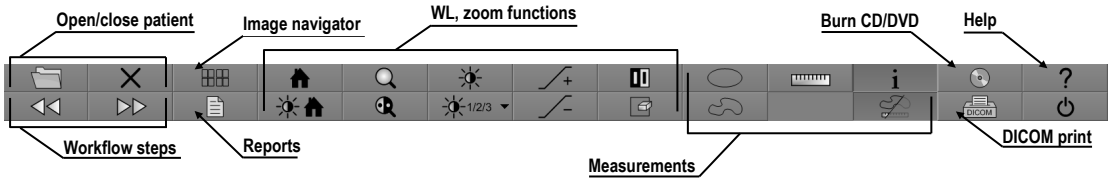


Figure 370 – Mammo toolbar on the right monitor

All TomoCon mammography functionalities are accessible in the main mammography application menu. The menu is located at the top of each monitor and is hidden by default. To display the main menu in the TomoCon mammography mode, move the cursor to the top of the monitor (see Figure 371). When you move the cursor out of the main menu area, the main menu is hidden again.

For a full description of all the items in the main menu, see 3.4 Main menu.

Figure 371 – Main mammography menu displayed on the left monitor

24.2.1 Working area

The working area is the visualization area of the workspace for displaying and diagnosing mammography images in the TomoCon mammography mode. The size of the mammography working area cannot be customized; it is adjusted according to the resolution of your monitor.

In the mammography mode, TomoCon offers you three predefined working areas with different mammography layouts that can be applied to the workspace on each monitor separately. By default, the working area consists of two non-resizable segments (layout 2x1), each with one view (see Figure 372) in which you can view and diagnose the mammography images.

To change the current working area layout in the mammography mode, you can proceed in one of the following manners:

- Manually, using the mammo image navigator (see 24.9 Image navigator) through which you can change the division of each working area.
- Automatically, using the currently selected hanging protocol (see 24.7 Hanging protocols) through which the current layout of each working area is defined according to the hanging protocol layout.
- Automatically, using the hanging protocol defined in the current step of the selected workflow (see 24.8 Workflows).

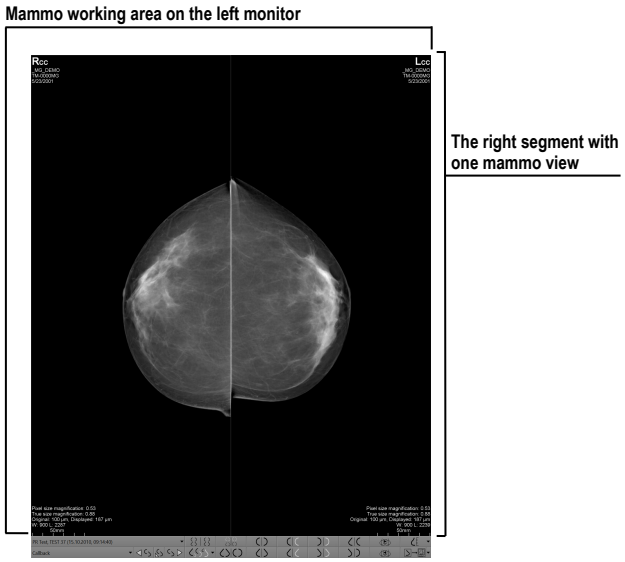


Figure 372 – Initial layout of the left workspace

24.3 Opening a patient study

The TomoCon application provides you with everything required for patient study management in the mammography mode using the **Search studies** dialog. The dialog offers all of the functions you need to manage patient studies (e.g. search, open, send, receive and open patient images), to manage the worklist and to burn patient data to a CD/DVD.

To open a mammography study in the mammography mode, click the **Open study** button in the mammography toolbar on the left monitor. The **Search studies** dialog then opens from where you can carry out the following:

- Finding and opening a required study stored in the local studies of TomoCon (see Figure 373) by taking the following steps:

    1. Activate the **Local studies** tab of the **Search studies** vertical tab.

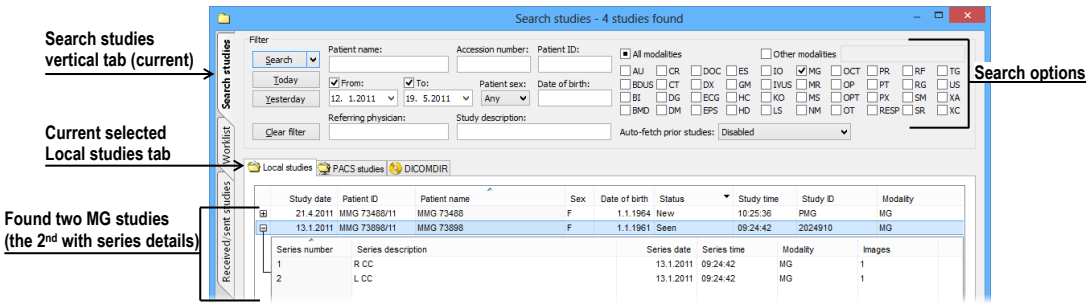


Figure 373 – Opened patient study from the Local studies

    2. Define the search criteria in the **Filter** section.

3. Click the **Search** button. The list of matched studies is then displayed in the studies list.
4. Select the patient data and click the **Open study** button.

- Finding and opening a required study stored in a remote DICOM device (see Figure 374) by taking the following steps:
  1. Activate the remote DICOM device tab (for example, the **PACS studies** tab) of the **Search studies** vertical tab.
  2. Define the search criteria in the **Filter** section.
  3. Click the **Search** button. The list of matched studies is then displayed in the studies list.
  4. Select the patient data and click the **Open study** button.

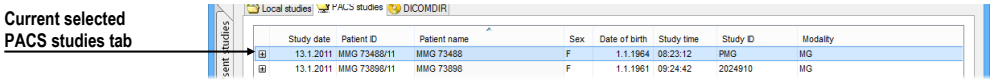


Figure 374 – Opened patient study from PACS

- Managing a worklist and opening patient data from a defined worklist (see 5.8 Patients worklist) by taking the following steps:
  1. Activate the **Worklist** vertical tab of the **Search studies** dialog.
  2. Select the patient data from the worklist and click the **Open study** button.

For a full description of the **Search studies** dialog, see 5 Studies management.

24.3.1 Currently selected patient study

The currently selected patient study is the currently selected mammography study for which you actually apply hanging protocols and workflows in the TomoCon mammography mode. When a certain hanging protocol or workflow is selected, the images of this study are displayed in the mammography workspaces according to the rules defined in the hanging protocol or workflow. The currently selected study is indicated by the study selector in the toolbar on the left monitor (see Figure 375) in the TomoCon mammography mode.

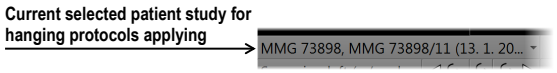


Figure 375 – Selector of current study

When you open an MG patient study suitable for display in the TomoCon mammography mode, it immediately becomes the currently selected study in the mammography mode. If a hanging protocol or workflow is subsequently selected, the

images of this new study are displayed in the mammography workspace according to the rules defined in the respective hanging protocol or workflow.

To change the currently selected patient study, click the study selector in the left mammography workspace. Doing so opens the list of all opened mammography studies (see Figure 376) in which you can select a new current study.

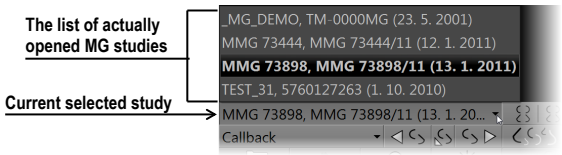


Figure 376 – Changing of the currently selected study

24.4 Closing and saving a patient study

As in the general TomoCon mode, you can finish working with opened studies in the mammography mode at any time by saving and closing them. In order to save and close opened studies in the mammography mode, use one of the following methods:

- Select the **Close** menu item in the **Study** menu of the main menu.
- Click the **Close currently open studies** button in the mammography toolbar on the right monitor.
- You can also close opened studies as long as the currently selected work process contains the close study function. For further information about using workflow, see 24.8 Workflows.

For mammography images, TomoCon provides you with a special confirmation dialog (the **Close study** dialog; see Figure 377), which is displayed automatically after the close study operation is selected in the mammography mode. The dialog allows you to confirm the saving and closing of all opened studies along with the changing of their read status.

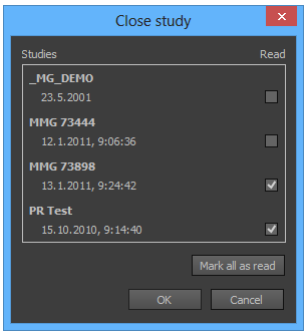


Figure 377 – Close study dialog

The **Close study** dialog contains the following:

- **Study list** – this list contains all the studies that are to be closed. The corresponding **Read** check box appears for each study. If all images of a study have been previewed, the **Read** check box is checked; otherwise, it is unchecked.
- **Mark all as read** check box – this check box serves as a shortcut for marking all studies as read.
- **Save study** check box – if studies are closed without this option activated, any potential changes will not be saved. This check box is not displayed if no study was changed during the previewing session.
- **OK** button – by clicking this button, you close all studies according to the selected options (the **Read** status and the potential saving of changes).
- **Cancel** button – clicking this button cancels the closing of the studies.

This dialog is not displayed if the **Close study dialog** check box on the **Mammography** tab of the **TomoCon options** dialog is not checked (see 4.8 Mammography). In this case, if any changes have been made to the studies designated for closing, the standard message box asking for confirmation to save the changes is displayed instead (see 5.5 Closing and saving a study).

24.5 Displaying images

The mammography mode allows you to display the images of all opened mammography studies in one of the following ways:

- The direct display of one or more image(s) using the mammography image navigator in any view of the mammography workspace (see Figure 380b). The image navigator is an additional image tool that displays the preview of all opened mammography images in the hierarchical tree and allows you to display an image of any opened mammography study in the workspace view in a very simple manner.

  To display an image in the current view of the mammography workspace using the mammo image navigator, proceed as follows:

  1. Click the image navigator button in the toolbar on the right monitor. The image navigator is then displayed.
  2. Expand the selected mammography study and click the required image preview in the image navigator (see Figure 378).

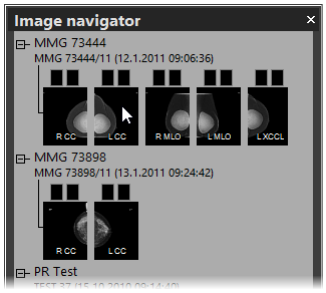


Figure 378 – Display image using the image navigator

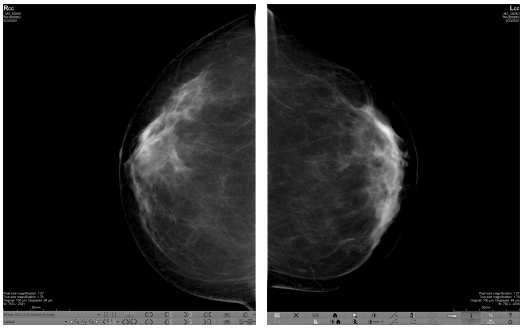
For a full description of mammo image navigator functionality, see 24.9 Image navigator.

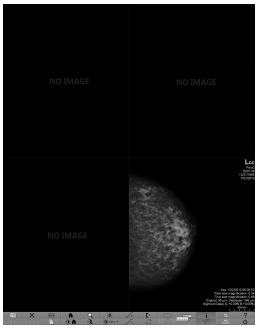
- Automatic image display adhering to defined hanging protocol rules (see Figure 380a). This option ensures that the images of the currently selected study are placed in the correct order and orientation according to your preferences in each view of the mammography workspace. A hanging strategy for the display of the mammography study images is defined for each hanging protocol.

  To apply a hanging protocol to the images of the current mammography study, click the button of the desired hanging protocol in the toolbar on the left monitor (see Figure 379).

Figure 379 – Apply hanging protocol section of the toolbar

A full description of how to use hanging protocols in the TomoCon mammography mode can be found in section 24.7 Hanging protocols.





(a) **(b)**

Figure 380 – Displayed images using a hanging protocol (a), using the image navigator (b)

TomoCon enables you to set numerous properties and parameters for image display in the mammography mode during the viewing and diagnosing process. When you display a mammography image in a view in the mammography mode, the initial settings of the following modifiable display parameters and properties are used:

- Zoom settings – defined by the image zoom factor stored with the image in the thumbnail palette
- Window/level settings – defined by the image Window/level settings stored with the image in the thumbnail palette
- Rotation and alignment settings.
- Air suppression type (see 24.6Air gap suppression in a view) – defined in the **TomoCon options** dialog (see 4.2 Modality options).

24.6 Air gap suppression in a view

When you change the window/level when examining an image, you may need to exclude all parts of the image which are not covered by tissue, i.e. the air gap contained in the image.

TomoCon provides you with support for automatic air gap suppression for images of all modalities using the settings on the **Modality** tab of the **TomoCon options** dialog (see Figure 381).

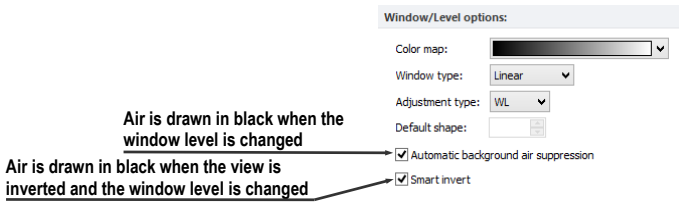


Figure 381 – Air gap suppression settings for the selected MG modality

If the **Automatic background air suppression** check box is checked, the air gaps in the image are always displayed in black, even when the window/level changes (see Figure 382).

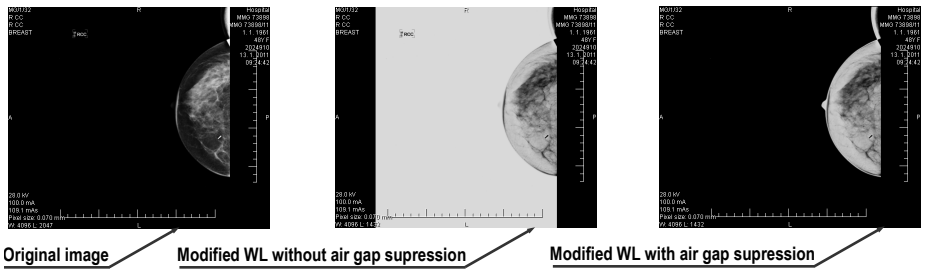


Figure 382 – Applying air gap suppression to an image

If the **Smart invert** check box is checked and the image is displayed in the inverted mode (the **Invert** option is checked in the context menu of the view), the gaps with air remain displayed in black (i.e. they are not inverted, see Figure 383).

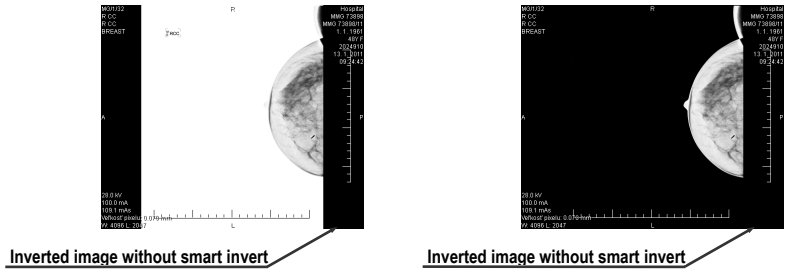


Figure 383 – Applying smart invert to an image

By default, air gap suppression with the smart invert option is set for all modalities although you can change this option for a selected modality at any time.

24.7 Hanging protocols

When a mammography study is opened in the mammography mode, it can be examined applying defined mammography hanging protocols. This manner of examination ensures that all study images with a specified set of images will be displayed in the correct order in the views in the mammography mode and that each image will be placed in the correct orientation according to the preference of the respective radiologist.

A mammography hanging protocol is a hanging strategy defining how a mammography image is rotated and placed in a view. The strategy is based on the view position, the laterality, the patient orientation and other characteristics of the view. You can specify your preferred image orientation for the right and left views and for the old and new images to be displayed in the mammography mode.

TomoCon provides you with a group of predefined hanging protocols that can be used at any time during the diagnosing process (see 24.7.2 Predefined hanging protocols). You can edit the rules of each hanging protocol or you can define your own protocols for displaying images with your own preferences (see 24.7.3 Customizing hanging protocols).

To apply a hanging protocol in the mammography mode, use the hanging protocol buttons in the mammography toolbar located on the left monitor (see 24.7.1 Applying a hanging protocol).

24.7.1 Applying a hanging protocol

For simple hanging protocol application, TomoCon provides you with the configurable hanging protocol toolbar in the mammography mode that allows you to quickly apply up to ten selected protocols. The selected protocols are mapped on the toolbar buttons, each with a preview of the corresponding protocol. The hanging

protocol toolbar is located in the mammography toolbar on the left monitor (see Figure 384).

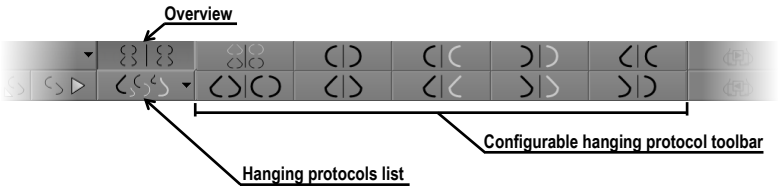


Figure 384 – Toolbar on the left monitor (hanging protocols section)

To apply a hanging protocol to the images of the current mammography study, click the button of the desired hanging protocol in the hanging protocol toolbar. The button remains pressed and the protocol mapped on the button applies to the current mammography study and workspace; each image that adheres to the protocol view rules (laterality, orientation) is rotated according to the protocol and is displayed in the relevant view (see Figure 385). The views without matching images remain empty.

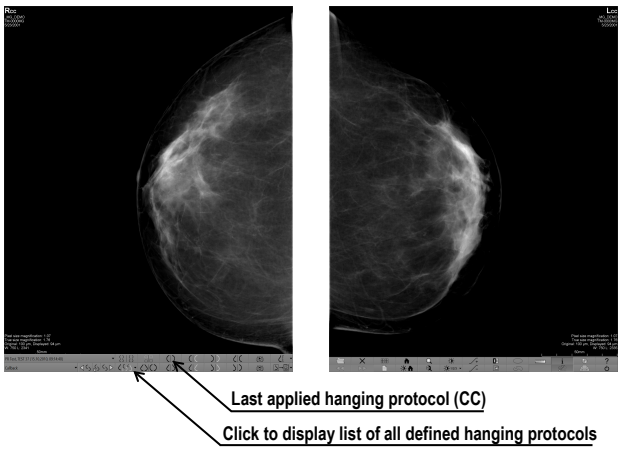


Figure 385 – Applied CC hanging protocol

The configuration of the hanging protocol toolbar depends on the currently selected workflow in the mammography mode. The workflows allow you to carry out all desired diagnostic steps using the predefined workflows and the corresponding hanging protocols. You can define your own configuration of the hanging protocols toolbar for each workflow in a very simple manner in the **TomoCon options** dialog (see 24.8 Workflows). The TomoCon application supplies you with seven predefined workflows, each with the same predefined hanging protocols. For a complete description of the workflow functionality, see 24.8 Workflows.

TomoCon also provides you with a list of all defined hanging protocols in the mammography mode. You can use it when you need to apply a hanging protocol that is not selectable in the hanging protocols toolbar. To display the hanging protocol list, click the button in the mammography toolbar on the left monitor. The drop-

down menu is then displayed (see Figure 386) containing all defined hanging protocols, each of which is represented by the name and the preview. To apply a hanging protocol from the displayed list, select the corresponding row in the list.

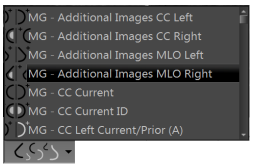


Figure 386 – Hanging protocols list

24.7.2 Predefined hanging protocols

The TomoCon application provides you with a group of predefined hanging protocols for mammography images in the mammography mode, allowing you to display images in the correct order and orientation. To manage all predefined hanging protocols for the mammography mode, use the **Hanging protocol manager** dialog, which is displayed by selecting the **Hanging protocol manager**… item in the **Layout** main menu in TomoCon (see 3.4 Main menu).

The ten most often used protocols of the group of predefined hanging protocols are initially selected in the configurable hanging protocol toolbar (see Figure 387), which is permanently located in the mammography toolbar on the left monitor. If a patient study contains only standard images (i.e. up to ten images with MLO and CC left and right, the prior and current images), you can use the protocols from this toolbar to display all lateralities at a glance or easily switch to different tailings. Otherwise, if the initially selected protocols in the hanging protocol toolbar do not meet your requirements, you can configure the toolbar content in the **TomoCon options** dialog (see 24.8.2 Workflow properties).

Figure 387 – Configurable hanging protocol toolbar (initial state)

By default, the hanging protocol toolbar offers the following buttons for displaying various combinations of mammography images:

-  – the CC and MLO images with priors
-  – the CC and MLO images
-  – the CC images
-  – the MLO images
-  – the right CC image with prior

-  – the right MLO image with prior
-  – the left CC image with prior
-  – the left MLO image with prior
-  – the right MLO image and the right CC image
-  – the left MLO image and the left CC image

24.7.3 Customizing hanging protocols

For the immediate display of mammography images in the mammography mode, you can use predefined or customized hanging protocols. For customized protocols, you can define your preferred properties using the simple editor of mammography hanging protocols (the **Hanging protocol properties** dialog for mammography) where you can define all the parameters of a selected protocol.

Each defined mammography hanging protocol must meet the following conditions:

- The hanging protocol contains two workspaces (for two monitors).
- Each working area can only be divided into 1x1, 2x1 or 2x2 segments with views.
- Each working area view can display only a mammography modality image (not reconstruction, 3D, etc.).

To create a new hanging protocol for mammography using the **Hanging protocol properties** dialog, choose from the following options:

- Click the **New** button on the **Mammography workflow** tab of the **TomoCon options** dialog,
- or proceed as follows:
    1. Select the **Layout**/**Hanging protocol manager** item in the main menu.
    2. Click the **New** button in the displayed **Hanging protocol manager** dialog and select the layout for the protocol in the displayed popup menu. The **Hanging protocol properties** dialog is then displayed in which you can set all properties of each protocol type, not only the one for mammography (see 8.3 Manually creating and modifying a hanging protocol).
    3. Click the **Mammography…** button to specify the particular mammography properties of the new protocol. The **Mammography** button is enabled only for layout with two monitors.

To edit an existing hanging protocol using the **Hanging protocol properties** dialog for mammography, proceed as follows:

- Select the hanging protocol in the list of all protocols on the **Mammography workflow** tab of the **TomoCon options** dialog and click the **Edit** button (see Figure 388).

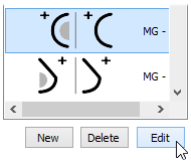


Figure 388 – Editing a selected hanging protocol

- Alternatively, select the **Hanging protocol manager…** item in the **Layout** menu to open the **Hanging protocol manager** dialog in which you select the protocol and click the **Edit…** button.

In the **Hanging protocol properties** dialog for mammography, you can set the following parameters for a mammography hanging protocol according to your own preferences:

- **Name** – the name of the hanging protocol.
- **Description** – a detailed description concerning the protocol functionality.
- **Screen previews** – clickable previews of the left and right working areas; for each selected preview, you can define differing properties that are graphically displayed in the preview.
- **Layout buttons** – buttons allowing you to divide each working area into one, two or four segments, each with one view.
- **Skip hanging protocol if view is empty –** if this check box is checked and no image from the study meets the conditions of the hanging protocol, the workflow skips this hanging protocol and the next step is applied.
- **Sorting of images** – this defines the order of the images selected from the study to the view.
- **Time criteria** – this defines whether the view displays only the current image or priors or both (current, all priors, 1st prior, 2nd prior, etc.).
- **Chest wall** – the chest orientation (left, right, undefined).
- **Icon** – the icon displayed in the hanging protocol list and in the toolbar.
- **View position** – the type of the image position displayed in the view.
- **View modifiers** – modifiers applied to the projection of the image.

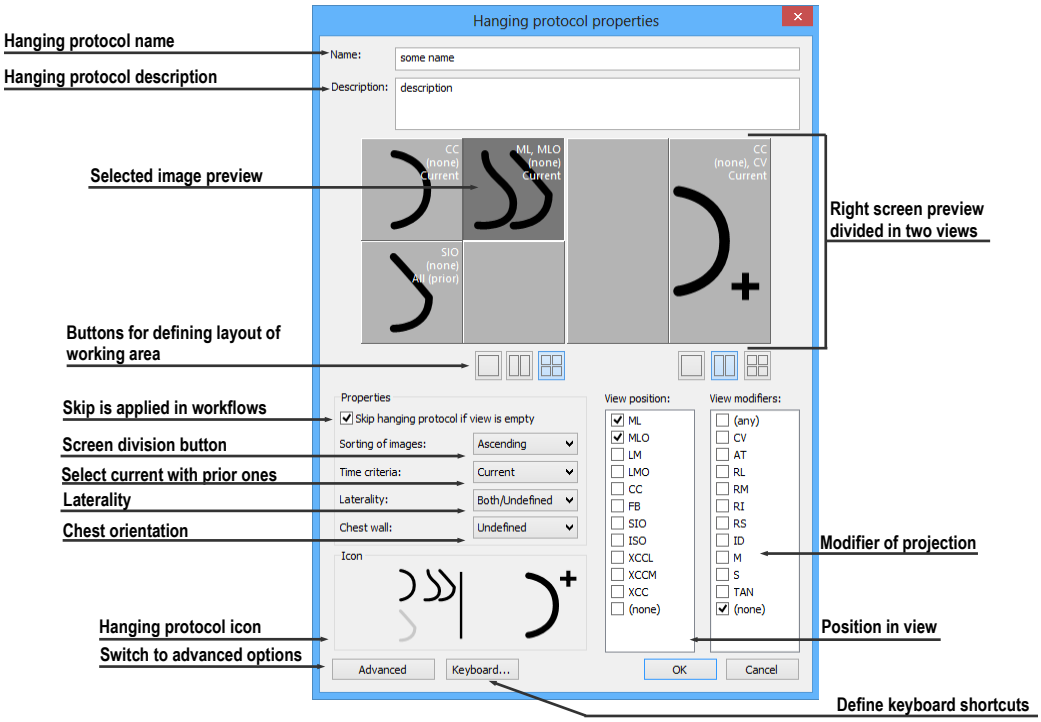


Figure 389 – Hanging protocol properties dialog for mammography

24.7.4 Overview

The arrangement showing all mammography images of a standard mammography study is called an overview. The images in an overview are displayed in the views on both monitors, from the upper left view on the left monitor to the lower right view on the right monitor (see Figure 390). Each workspace in an overview contains 1, 2 or 4 views, which depends on the number of images in the study. If a study contains more than 8 images, the image iterator is added to the last view (the lower right view on the right monitor). You can click the image iterator to view the next images in the study (see Figure 391).

To activate the overview in the mammography mode, click the **Overview** button in the toolbar on the left monitor.

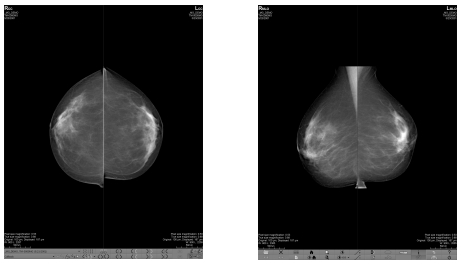


Figure 390 – Overview of a study containing 4 images

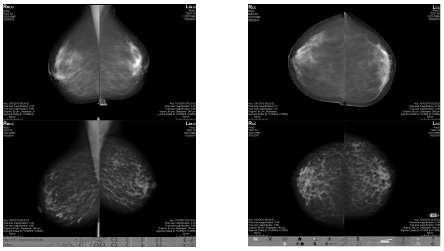


Figure 391 – Overview of a study containing more than 8 images

24.7.5 Image selector

When a hanging protocol is applied in the mammography mode and multiple images from the mammography study meet the criteria for view display, the image selector control is displayed in the lower left-hand corner of the view (see Figure 392). The image selector allows you to navigate within an entire image set and to display each image from this set in descending or ascending order as defined in the hanging protocol.

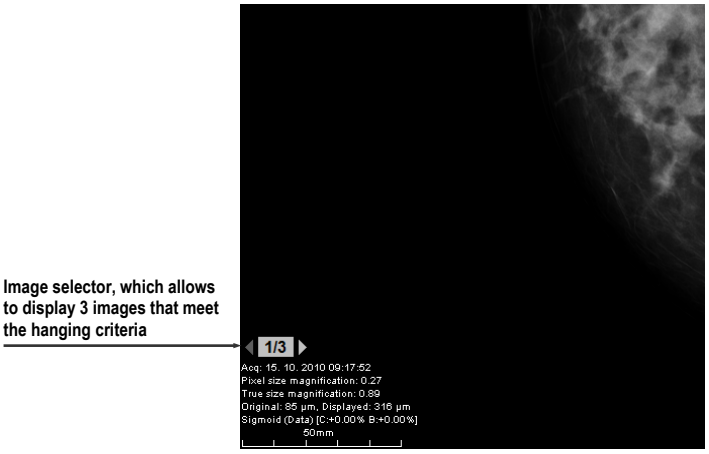


Figure 392 – Image view with image selector

The image selector is displayed in the view as a special information text, whose position or visibility can be set on the **View texts** tab of the **TomoCon options** dialog (see 4.3 View texts). It consists of the following:

- **Navigating arrows** ◀▶ – for navigating forward and backward within the image set.
- **Image order indicator** 1/3 – to indicate the part of the image set that is currently being displayed in the view.

24.8 Workflows

A workflow is a group of predefined hanging protocols and other functions (closing studies, closing the image navigator, etc.) which can be applied at any time during the diagnosing process to the currently opened study in the TomoCon mammography mode. A workflow allows you to fully automate the process of study viewing. Using a workflow, you can display all study mammography images step by step according to your viewing preferences. In addition to the possibility of creating your own customized workflows, TomoCon supplies you with a group of predefined (the most recently used) workflows that make your work with mammography studies easier immediately after the first launch of TomoCon. For easier management of all defined workflows, TomoCon offers a simple management system which is available on the **Mammography workflows** tab of the **TomoCon options** dialog (see Figure 393).

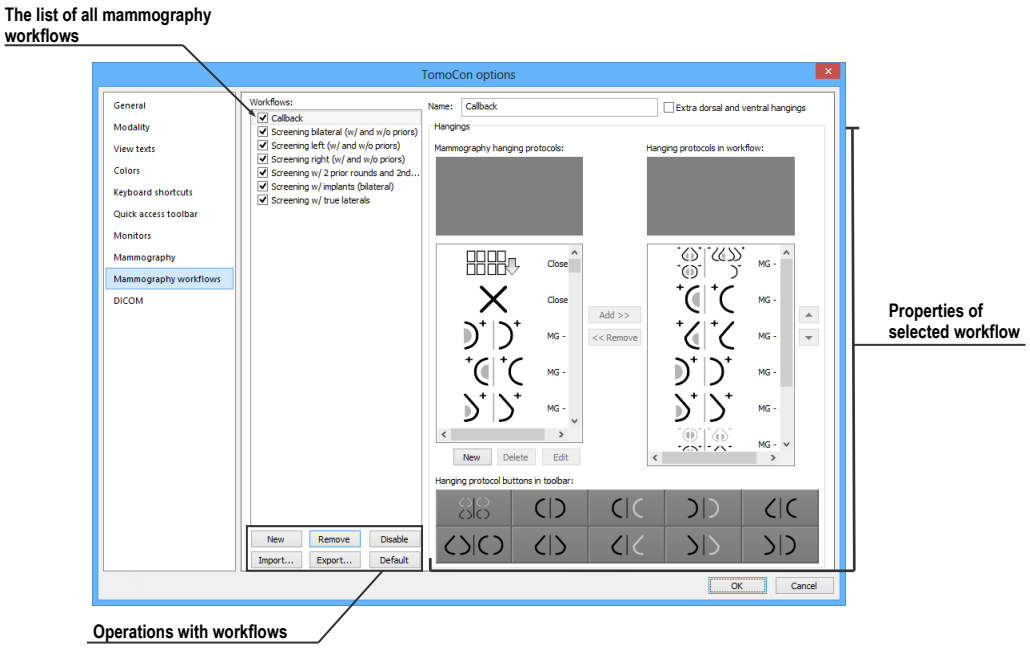


Figure 393 – Mammography workflows tab

24.8.1 Applying a workflow

Each selected workflow is applied step by step to the currently opened study in TomoCon. All predefined workflows remain available in the mammography mode through the combo box located in the mammography toolbar on the left monitor (see Figure 394). When you activate the mammography mode, the default selected workflow is the most recently selected workflow (or the first one if you are using workflows for the first time).

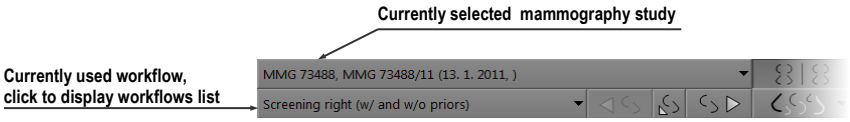


Figure 394 – Selecting the current study and workflow in the mammography mode

After you select a workflow in the mammography mode, you can apply all workflow hanging protocols and the subsequent functional steps simply by clicking the buttons for applying workflow (see Figure 395).

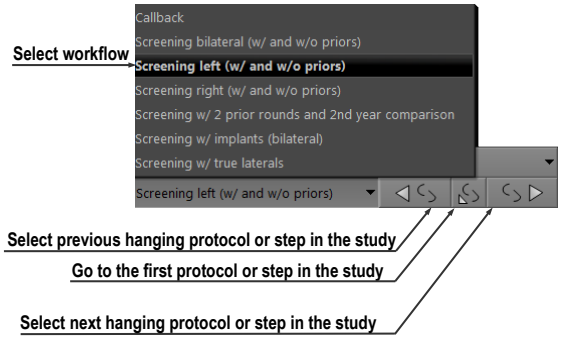


Figure 395 – Navigating in a selected workflow

To apply hanging protocols or functional steps of a mammography workflow to the currently selected study, proceed as follows:

1. Select the required mammography workflow in the combo box.
2. Navigate linearly step-by-step through the selected workflow as follows:
   - Proceed to the subsequent step in the selected workflow by clicking the **Select next hanging protocol in workflow** button ( ) until the last step of the workflow is carried out. If the workflow is selected for the first time, clicking this button sets the first protocol or functional step.
   - Click the **Select previous hanging protocol in workflow** button ( ) to return to the previous step until the first step of the workflow is carried out.
   - You can always return to the first step of a workflow by clicking the **Set first hanging protocol in workflow** button ( ).
   - You can deviate from the current workflow by initiating another function in TomoCon (e.g. another hanging protocol) at any time. TomoCon stores the current position and proceeds with the next step if you click the **Select next hanging protocol in workflow** button again.

If a hanging protocol in a workflow cannot be applied to the currently selected study (e.g. due to improper image orientation), then the corresponding view in the workspace remains empty. This default behavior can be changed by setting the **Skip hanging protocol if the view is empty** parameter in the **TomoCon options** dialog

(see 4.9 Mammography workflows). If the parameter is set, hanging protocols that display empty views are skipped.

24.8.2 Workflow properties

A workflow consists of a list of the hanging protocols and the subsequent operations which help you simplify your work. These protocols are applied and the operations are carried out in a strictly defined order in the workflow and are always applied to the currently opened study in the TomoCon mammography mode. TomoCon also allows you to define all workflow properties including the buttons of the configurable hanging protocol toolbar displayed on the left monitor.

To display or edit the workflow properties, select the mammography workflow from the list on the **Mammography workflows** tab of the **TomoCon options** dialog (see 4.9 Mammography workflows). The properties of the selected workflow are then displayed on the right-hand side of the tab (see Figure 396).

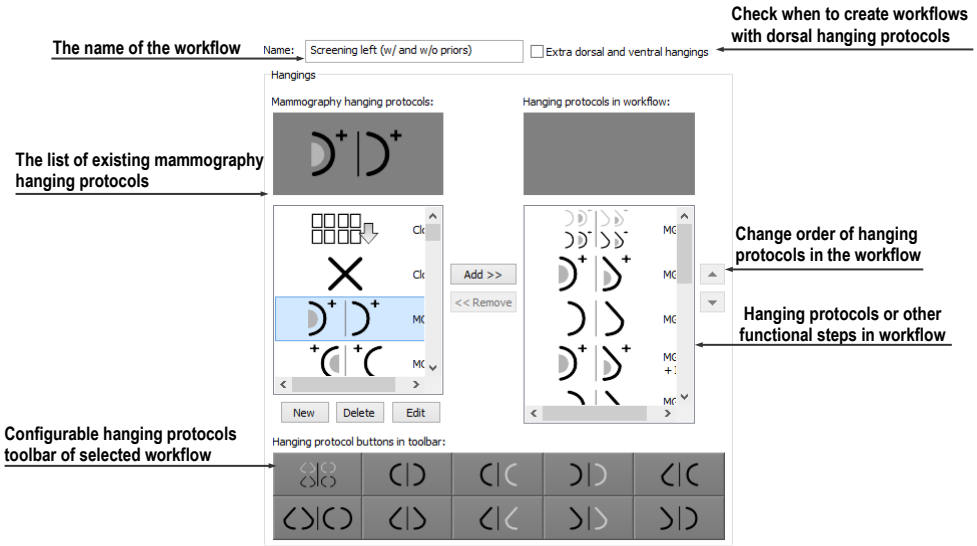


Figure 396 – Mammography workflow properties

The displayed workflow properties on the **Mammography workflows** tab allow you to carry out the following operations:

- Changing the workflow name in the **Name** text box.
- Creating dorsal workflows if the **Extra dorsal and ventral hangings** check box is checked. A new tab will be added and you can then define the workflows for the dorsal hanging protocols.
- Modifying a workflow. You can add and remove hanging protocols or other functional steps included in a workflow using the **Mammography hanging protocols** list (which contains the available protocols and functions) and the

Hanging protocols in workflow list (which contains the content of the workflow). To do so, use the **Add>>** and **Remove<<** buttons or the drag-and-drop technique to move items from one list to the other.

- Reordering the hanging protocols or other functional steps in the **Hanging protocols in workflow** list using the up and down arrow buttons.
- Modifying previously defined mammography hanging protocols displayed in the **Mammography hanging protocols** list. If you select a required protocol and then click the **New** or **Edit** button, the **Hanging protocol properties** dialog will then be displayed in which you can change the properties. Clicking the **Delete** button removes the selected hanging protocol. For detailed information concerning the hanging protocol properties, see 24.7.3 Customizing hanging protocols.
- Customizing the configurable hanging protocol toolbar. You can choose the hanging protocols to be used as shortcut buttons in the toolbar using the drag-and-drop technique between the **Mammography hanging protocols** list and the **Toolbars buttons** list. For a detailed description, see 24.7.1 Applying a hanging protocol.

24.9 Image navigator

Additional possibilities exist for displaying an image in the mammography mode. You can use the predefined or customized workflows and hanging protocols but you also can use another image tool called the Image navigator. This tool is integrated in the floating window in the mammography mode and is accessible by clicking the image navigator button in the mammography toolbar on the right screen (see Figure 397).

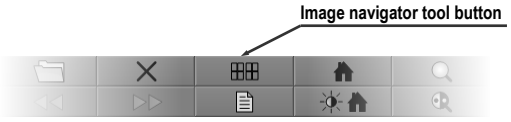


Figure 397 – Displaying the Image Navigator window

The basic functionality of the image navigator is to display a comprehensive list of the previews of all mammography images opened in TomoCon. Moreover, the image navigator provides you with the following advanced functionalities:

- Displaying an arbitrary mammography image in an arbitrary view in the mammography mode using the select and place method.
- Identifying the current placement of the mammography workspaces including the displayed images in the views.

- Changing the layout of the mammography working areas.
- Identifying the read status of each image in the mammography mode to check whether it has been displayed or not.

The image navigator window consists of two basic parts: the studies list (see 24.9.2 Studies list in the image navigator) and the screen layout (see 24.9.3 Screen layouts in the image navigator). The study overview displays the ordered list of all opened mammography images (a tree list containing the series and images) which can be displayed in the mammography views on the left and right screens of the monitors. It identifies the currently displayed images. The screen layout allows you to divide the layout of each workspace into one, two or four segments.

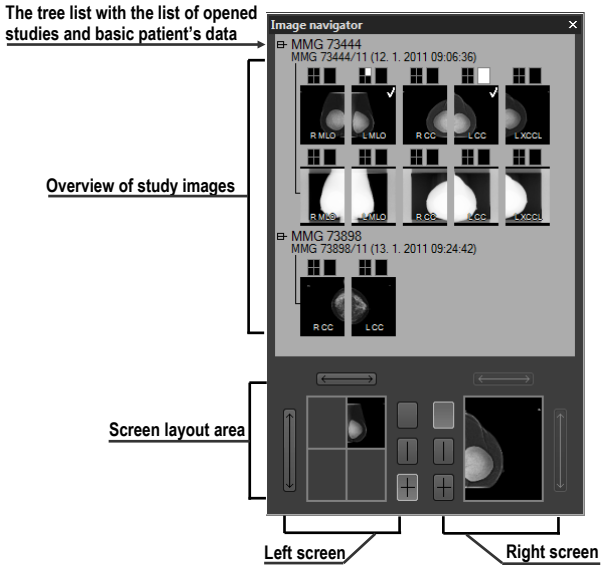


Figure 398 – Image navigator

24.9.1 Opening and closing the image navigator

To open the image navigator window, click the image navigator button in the mammography toolbar on the right monitor. The image navigator window (see Figure 398) is displayed in the same position where it was last closed. You can also schedule the displaying of the image navigator window as a separate workflow step.

To close the image navigator, click the close button or the image navigator button in the mammography toolbar.

24.9.2 Studies list in the image navigator

The studies list is the graphical tree list control in the image navigator containing the mammography images of all opened studies in TomoCon. Each opened

mammography study is displayed in a separate tree node which can be collapsed or expanded. To collapse a node, click the minus ▣ symbol; to expand it, click the plus ▣ symbol.

Each tree item (see Figure 399) consists of the following parts:

- **Screen position indicator** ▞ – it identifies the displayed image in the view in the workspace. Each workspace (on the left monitor and right monitor) is displayed as a rectangle, which is proportionally divided according to its current layout. The current placement of the image is highlighted in white.
- **Image preview** – the thumbnail of the image
- **Information text about image orientation** R MLO – it describes the laterality view code of the mammography image.
- **Read mark indicator** ☑ – it indicates whether the image has been displayed in any view in the mammography mode.

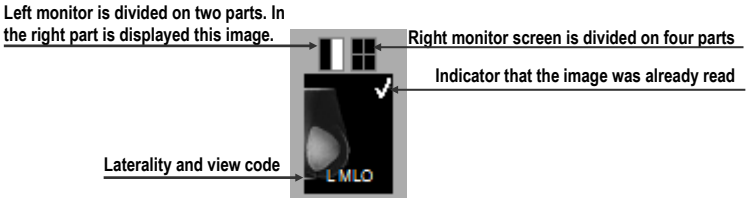


Figure 399 – The image preview item of the image navigator

In addition, you can place images directly into the views in the workspaces without applying a hanging protocol using the image navigator. To display a selected image in the studies list, proceed in one of the following ways:

- Use the drag-and-drop technique to drag the image from the study overview to the view in the mammography workspace on the left or right monitor (see Figure 400).

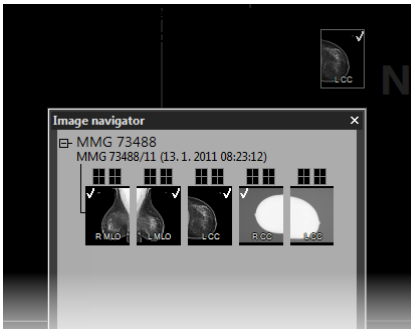


Figure 400 – Dragging an image from the study preview to the screen

or

- Use the drag-and-drop technique to drag the image to the screen preview in the screen layout area in the image navigator (see Figure 401). The image is displayed in the appropriate view in the mammography workspace on the left or right monitor.

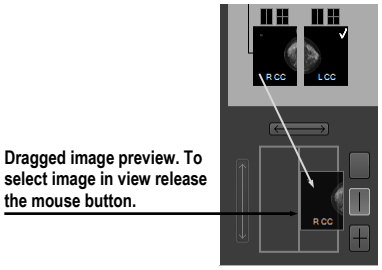


Figure 401 – Dragging an image from the study preview to the layout area

or

- Click the desired rectangle in the screen position indicator representing the view in the working area (see Figure 402). The image is displayed in the appropriate view in the mammography workspace on the left or right monitor.

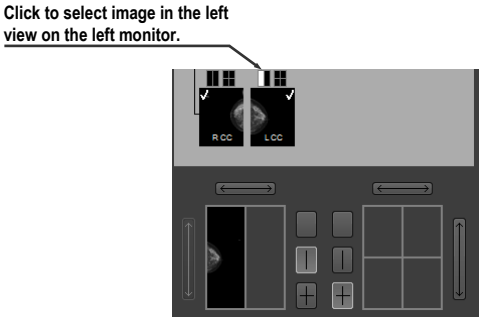


Figure 402 – Selecting an image to view using the rectangle indicator

24.9.3 Screen layouts in the image navigator

The screen layout area of the image navigator (see Figure 403) displays the screen previews of both monitors and allows you to set the workspaces on the left or right monitor to one view or to divide them into two or four equally sized views and toggle the views of the same workspace.

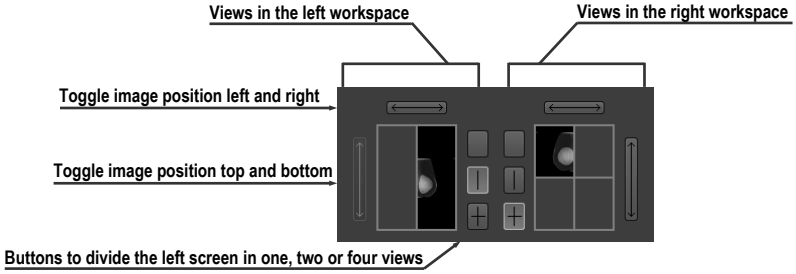


Figure 403 – Screen layout section of the image navigator

24.9.4 Image order

All displayed studies and their images are sorted in the image navigator according to predefined rules. The order of all items displayed in the studies list part is defined according to the following rules, from the lowest level to the highest level:

- By laterality and orientation of images – the images are ordered in groups by view position (default is CC) and by laterality (default is right) within the groups; from the left RCC, LCC, RML, LML, etc.
- By image type – the images designated for presentation are displayed prior to the images designated for processing. The image type is defined in the DICOM data.
- By study and study prior – the ordering is from the newest study to the oldest study. If a study does not contain the study date and time, it is moved to the end of list.

The default sorting order of the images in the image navigator can be changed (see Figure 404) by adjusting the **Reverse view order** parameter on the **Mammography** tab of the **TomoCon options** dialog. By adjusting the setting, you can change the order of the laterality and orientation (ML on the left and laterality left before right). You can also turn off the display of images of the "for processing" type. For a detailed description of the image navigator settings, see 4.8 Mammography.

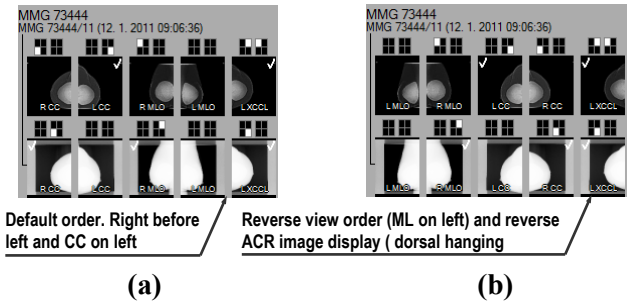


Figure 404 – Image order in the image navigator; standard order (a), reverse order (b)

24.10 Manipulating images

With respect to the nature of mammography, it is not possible to carry out operations related to volume, such as cutlines, DRR, MIP, MPR, 3D, ROIs, etc. However, it is possible in the mammography mode to carry out the main image operations that allow you to preform full mammography diagnosis using mammography studies.

Unlike the general mode, the mammography mode does not provide tool dialogs for such operations. All the operations are accessible in the main menu or the view context menu. On the other hand, the mammography mode provides you with the

possibility to quickly activate the most frequently used operations using the buttons in the mammography toolbar (see Figure 405).

Figure 405 – Image operations section in the mammography toolbar

The following image manipulation operations can be carried out using the buttons available in the mammography toolbar:

- changing the window/level settings
- applying the WL presets
- inverting a view
- applying gamma correction
- using the advanced magnifying glass

The character of the work in the mammography mode does not require the altering of various scope limits (segment, series or study). However, it is possible to apply the changes carried out using these operations (WL, invert, etc.) in the currently selected view to all images in the mammography mode. To apply all the changes, turn on the Scope all mode by clicking the **Scope all** button in the mammography toolbar. If you wish to limit the effects of the changes only to the selected view, turn off the Scope all mode by releasing the **Scope all** button.

All changes carried out in the view using these operations (window, level, invert, zoom, etc.) can be discarded at any time by clicking the **Reset window/level** button in the mammography toolbar.

24.10.1 Window and level manipulations

Any change made to the window/level settings is immediately applied to the selected view or to all views if the Scope all mode is turned on (the **Scope all** button in the mammography mode is pressed).

To change the window/level settings of displayed mammography images in the mammography mode, you can use one of the following methods:

- Adjusting the window/level values with the mouse.

  To activate the window level function, click the **Window/level** button in the mammography toolbar. Next, press and hold down the mouse button and move the cursor to change the window and level values (see 7.1.7 Adjusting window/level using the mouse).

- Applying a predefined window/level preset.

To select a preset, click the presets button. The drop-down menu (see Figure 406) of all predefined applicable window/level presets then opens in which you can select the desired preset. The preset is then immediately applied.

Figure 406 – Displayed window level presets drop-down menu

- Inverting the current color palette in the image.

  To apply inversion, click the **Invert** button in the mammography toolbar.

- Increasing or decreasing the gamma correction factor.

  It is not possible to change the palette graduation type or shape in the mammography mode. However, you can refine an image by adjusting the gamma correction factor, which can be increased or decreased by the 0.1 constant. Click the button to increase it or click the button to decrease it. The minimum value you can set for the gamma factor is 1/2.5; the maximum is 2.5. The current value of the gamma correction factor as part of the window/level string is displayed in the view text (see Figure 407).

Figure 407 – The gamma value in the view text

Any changes made to the window, level or contrast values can be discarded at any time by clicking the **Reset window/level** button in the mammography toolbar.

24.10.2 Zooming an image

The current view zoom factor in the mammography mode can be changed using the zoom function or the zoom rectangle function. Function activation is carried out by selecting the **Zoom** item or the **Zoom rectangle** item in the view context menu or in the **Image** submenu of the main menu. Next, move the cursor within the current view while holding down the action mouse button. Alternatively, the zoom factor can be

changed by scrolling the mouse wheel while holding down the **Ctrl** key. For a full description of image zooming, see 7.2 Zooming an image.

The mammography mode supports all four zoom modes available in TomoCon. The currently selected zoom mode (which alternates the interpretation of the zoom factor) can be changed by clicking the **Zoom mode** button in the mammography toolbar. The zoom mode menu then opens (see Figure 408) in which you can choose a new zoom mode (each menu item represents a different zoom mode).

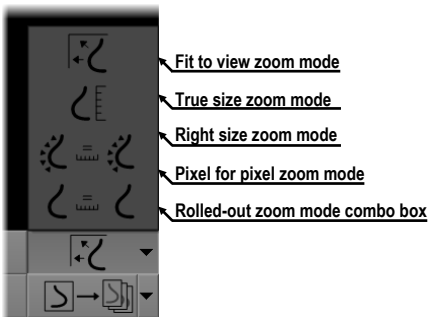


Figure 408 – Available zoom modes in the mammography mode

It can happen that after changing the current zoom mode or the zoom factor or moving the image, a certain part of the image will no longer be visible in the view. In the mammography mode, there are two different ways in which you can be informed about not viewing an entire mammography image:

- The appearance of a checkered border, which can be activated/deactivated by checking/unchecking the **Indicate that the image is not displayed entire in the view (checkered border)** check box on the **Mammography** tab of the **TomoCon options** dialog (see 4.8 Mammography). If the check box is checked, the part of the image that is not visible within the view is indicated by a checkered border on the corresponding edge of the view (see Figure 409).

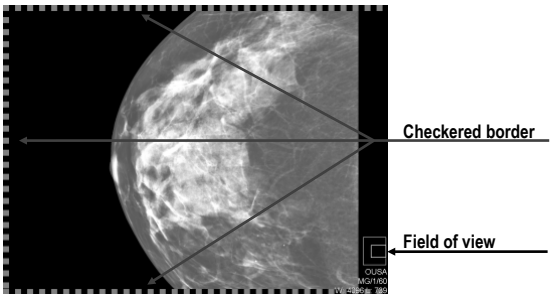


Figure 409 – Only part of the image is visible within the view

- The field of view indicator, which is a special view text item available only in the mammography mode. Two rectangular areas show the part of the mammography image displayed in the view. However, if you see the entire image, the field of view indicator is not displayed. You can change the default appearance of the field of view indicator (the **Colors** tab) and the position (the

View texts tab) within the view in the **TomoCon options** dialog (see 4.1 General options).

24.10.3 Applying window/level and zoom changes

The zoom and window/level changes in the current view can be applied automatically to a selected range of displayed images according to the limit selected in the **Scope** button in the mammography toolbar on the left monitor. You can make the changes applicable to a study or you can apply the changes to all views in all working areas by pressing the ▼ button (see Figure 410).

To apply the window/level and zoom changes according to the selected scope limit, click the **Scope** button (see Figure 410). To disable the application of these changes to other views in all working areas, deactivate the **Scope** button.

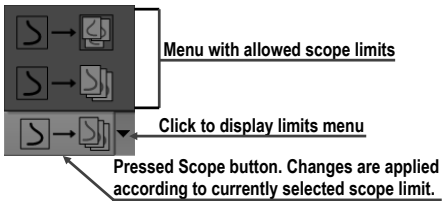


Figure 410 – Only part of the image is visible in the view

24.10.4 Magnifying glass

The magnifying glass allows you to zoom an area of interest within a small, separate magnification window. The current zoom factor of the magnifying glass defines how the selected image part is magnified compared to the image in the view. The position of the magnifying glass in the view defines the current magnified area. As a result, when you move the magnifying glass, the magnified image part displayed in the magnifying glass is automatically updated.

To display the magnifying glass in the view, click the **Magnifying glass** button in the mammography toolbar on the right monitor (or the **Magnifying glass – inverted** button). Next, click in the view to place the magnifying glass. When the mouse button is released, the magnifying glass remains displayed in the view and another magnifying glass can be set in another view.

A displayed magnifying glass behaves as part of the view (see Figure 411). As a result, any operation carried out in the view (zooming, moving, adjusting the WL, changing the measurement, etc.) is applied to the zoomed part of the image in the magnifying glass as well.

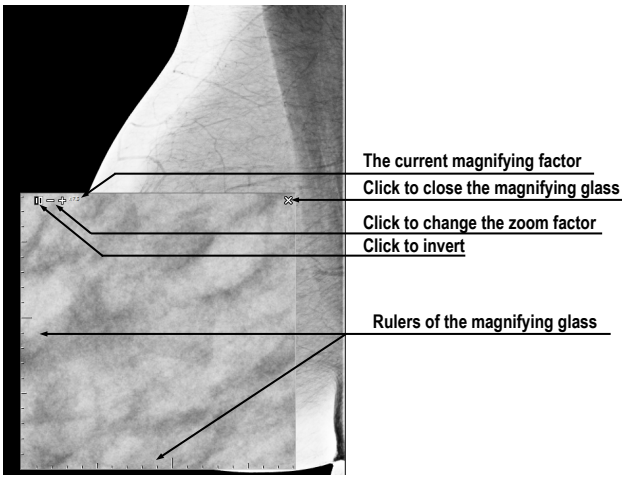
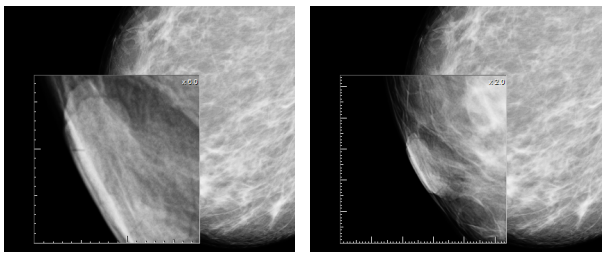


Figure 411 – Inverted magnifying glass with 3x zoom factor

To change the position of a displayed magnifying glass, select the magnifying glass function (by clicking the  or  button) and click in the view to define the new position. You also can hold down the mouse button and move the cursor to the desired position.

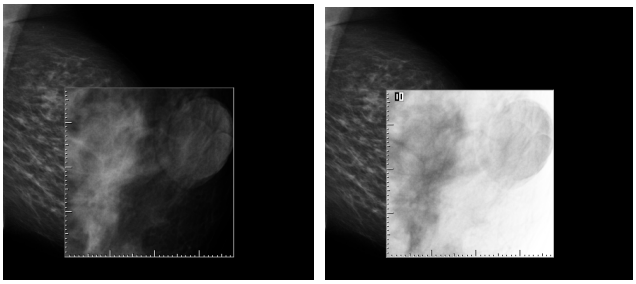
To change the zoom factor, click in the magnifying glass window, press and hold down the **Ctrl** key and scroll the mouse wheel. It is possible to set a zoom factor of up to 8. The current zoom factor of the magnifying glass is displayed in the upper right-hand corner of the magnification window (see Figure 412).

To close the magnifying glass window, simply double-click it or click the button in the upper right-hand corner of the magnifying glass window (the ⊠ icon).



(a) **(b)**

Figure 412 – The same part of an image magnified 6x (a) and 2x (b)



(a) **(b)**

Figure 413 – Mammography magnifying glass window; normal (a), invert (b)

To invert the zoomed image in the displayed magnifying glass window (see Figure 413), press the **Tab** key or click the invert button in the upper left-hand corner of the magnifying glass window (the icon). To turn off the invert mode, press the **Tab** key again.

24.11 Image roaming

For the diagnosis of mammography images in TomoCon, a very detailed examination is required. This can be done by using the zoom function or the magnifying glass manually or, alternatively, you can use the image roaming method. This method allows you to automatically proceed step by step through the entire mammography image in the defined resolution (see Figure 414). The image is divided into several non-overlapping (except for the image border) rectangular sub-regions. Using image roaming, you sequentially set these image parts into the view in ascending or descending order. Once you have proceeded through all of them, it is guaranteed that the entire mammography-related image area is being previewed.

To initiate image roaming, click the **Next image roaming** button or the **Previous image roaming** button. The image roaming mode is then activated and the first image sub-region is displayed within the views. This mode is not bound only to the selected view, but rather to all views in the mammography mode. As a result, this simultaneously changes the image sub-regions in all views.

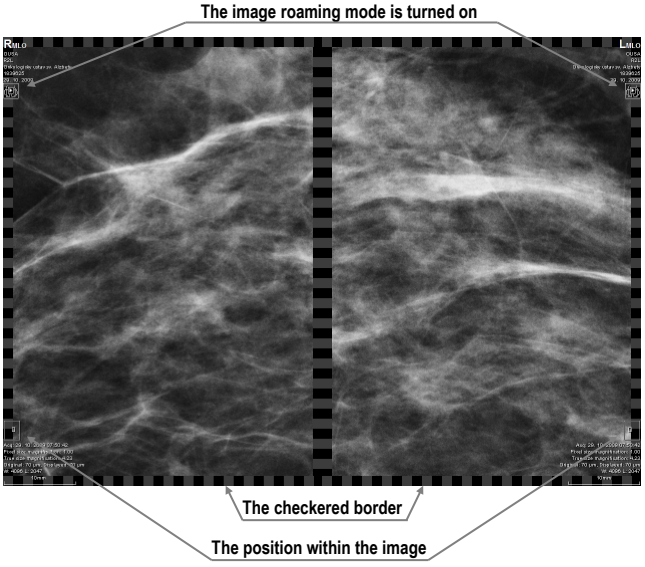


Figure 414 – Image roaming turned on

To go forward, click the **Next image roaming** button .

To go backward click the **Previous image roaming** button .

When in the image roaming mode, you can skip to the first image roaming sub-region at any time when you reset the view. Additionally, when you place a different image into the view while in the image roaming mode, this mode is preserved and the view displays the first image roaming sub-region.

When image roaming is active, you can use any of the image functions (WL, zoom, move, magnifying glass, etc.). If, when using such a function, a change is made to the position or size of a sub-region of the displayed image, the image roaming mode is canceled. To return to the image roaming mode, click the **Next image roaming** or **Previous image roaming** button again.

24.11.1 Image roaming sub-regions

The size, the position and the order of the image roaming sub-regions are determined by certain factors in the mammography mode in TomoCon, such as the image and view size, the image laterality and orientation and the roaming zoom mode.

The Pixel for pixel zoom mode or the Right size zoom mode (with a scale factor) can be used for the computation of the image roaming sub-region size. You can toggle between these two options by selecting the **Pixel for pixel** option or the **Right size zoom** option (with the **Scale factor**) on the **Mammography** tab of the **TomoCon options** dialog (see 4.8 Mammography). The sub-regions size is then set according to the selected zoom mode.

The mammography image orientation and laterality determine the order of the sub-regions. The first sub-region is always the image's upper chest wall corner, after which the sub-regions are ordered so that they continuously follow one another until the lower against-chest wall corner is reached. Figure 415 depicts the order of the roaming sub-regions for a mammography image with right laterality.

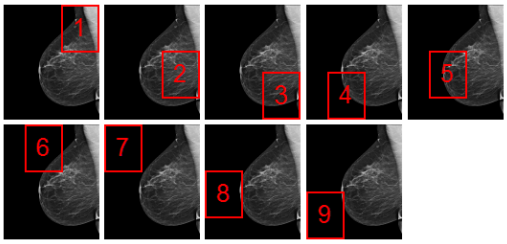


Figure 415 – The order of image roaming regions (image with right laterality)

In certain mammography images, the air, or non-tissue area, can be defined. When previewing such images in image roaming, TomoCon offers you the possibility to skip such air areas. In this manner, the number of steps required to preview an entire image can be significantly reduced (see Figure 416). To enable the skipping of empty

air areas, check the **Exclude empty area from the image roaming** option on the **Mammography** tab of the **TomoCon options** dialog (see 4.8 Mammography).

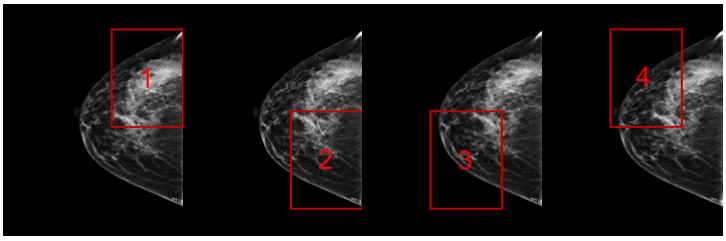


Figure 416 – Image roaming sub-regions not covering air area

24.12 Measurements

The mammography mode offers the possibility to mark and describe the image details using the measurements in the same way as in the general mode of TomoCon. Because the mammography mode does not support tool dialogs, the only way to activate and use all the measurement types is using the **Annotations** menu in the main menu of the mammography mode.

However, the most frequently used measurements in the mammography mode (ellipse, density area, distance) are accessible in the measurements section of the mammography toolbar on the right monitor (see Figure 417).

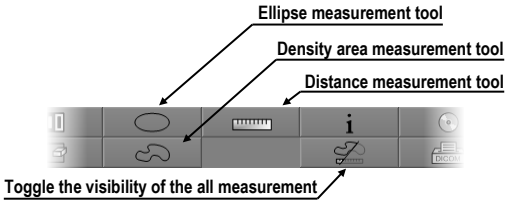


Figure 417 – Measurement tools section of the mammography toolbar

The following buttons are available for measurement activation:

- Clicking the **Ellipse** button activates the ellipse measurement.
- Clicking the **Density area** button activates the density area measurement.
- Clicking the **Distance** button activates the distance measurement.

The button in the measurements part of the mammography toolbar allows you to toggle the visibility of all defined measurements within all views.

25 Quick support

TeamViewer QuickSupport is a tool of the TomoCon application used to provide remote computer assistance. TomoCon uses this tool in support of the Standard Desktop Support services.

To activate QuickSupport in TomoCon, proceed as follows:

1. Select the **QuickSupport** item in the main TomoCon menu.
2. Be prepared to provide your ID and password, which are displayed in the TeamViewer QuickSupport application (see Figure 418), and call the Tatramed customer support center (see 26 Contact).
3. Provide your ID and password to the technician, who will then work to resolve your problem. You can monitor the work that the Support Center technician is carrying out on your computer.
4. To end the remote session, simply close the TeamViewer QuickSupport application.

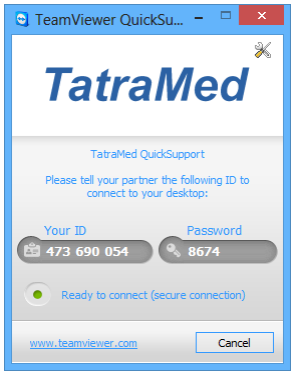


Figure 418 – TeamViewer QuickSupport with your ID and password

26 Contact

If you have any questions or comments, please contact our headquarters:

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