TomoCon 3.0

User's Manual

TatraMed

TomoCon 3.0 Workstation
TomoCon 3.0 Viewer
TomoCon 3.0 Lite

User's Manual

Version 3.0.15

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TomoCon PACS 3

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1 General note

1.1 Intended use

TomoCon PACS is a PACS system intended to be used for patient image data storage, handling, transport, visualization and diagnostics. It allows DICOM data import and export and visualization of stored images for diagnostic purposes.

1.2 Safety precautions

TomoCon user interface is written in English language; therefore the knowledge of English on an appropriate level is required.

The software is running on Microsoft Windows 2000, Windows XP, Windows Vista or Windows 7, therefore good knowledge of the used operation system is recommended.

Good understanding of installation instructions in this document (see 2.1.2 Installing TomoCon) is mandatory before installing TomoCon for clinical usage. Good understanding of the whole user's manual is mandatory before using TomoCon clinically.

Diagnosing users should be aware that certain views might display interpolated data. Interpolated data, although based on the original data set, may give the appearance of healthy tissue in situations, where 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 real pathology.

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

1.3 Medical device class and CE Mark

TomoCon 3.0 has been classified as a *Class IIb medical device*, according to the directive MDD 93/42/EEC and has been certified so. Written declaration of conformity is available on request (see 24 Contact).

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2 Getting started

2.1 Installing and uninstalling TomoCon

2.1.1 System installation requirements

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

2.1.1.1 Hardware requirements

- **CPU**   Pentium III, 1.7 GHz (Pentium 4, 2.5 GHz)
- **Memory**   512 MB (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)

2.1.1.2 Additional hardware recommendation

- **Printer port** or **USB port** for attaching 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 2000, Windows XP, Windows Vista, Windows 7
- **Microsoft Internet Explorer** version 6.0 or higher

TomoCon Viewer, TomoCon Lite:

- **Operating System**   Microsoft Windows 2000, Windows XP, Windows Vista, Windows 7
- **Microsoft Internet Explorer** version 6.0 or higher

2.1.2 Installing TomoCon

To install TomoCon:

1. Insert the installation CD into the drive. A window should be displayed automatically after a while, allowing you to select **TomoCon** to install. If it displays, proceed to step 3. If it does not display, follow step 2.

2. Run `SETUP.EXE` from the installation CD. You can do this by double-clicking on `'My Computer'` icon on your desktop, then double-clicking the icon of your CD-ROM drive (`'D'` for example), and finally double-clicking `'Setup'` or `'Setup.exe'` executable file.

3. Follow the instructions given by the Setup program of **TomoCon**.

2.1.3 Uninstalling TomoCon

To uninstall **TomoCon**, click the MS Windows **Start** button, go through **Settings**, **Control Panel** and start **Add/Remove Programs**. From the list of currently installed programs select **TomoCon** and press the **Change/Remove** button.

2.1.4 Installing licenses

Application TomoCon Advanced Workstation provides the following licenses:

- MIR registration license (see 16.1.6 MIR)

- Extended volume rendering license (see 15.4 Volume rendering).

- License for saving RT structures in DICOM format.

> ⚠ After installing licence for RT structures, all saved studies containg RT structures must be resaved (open in TomoCon and save again).

To install a license to TomoCon follow these steps:

1. Click on the **Licenses...** item in **Help** menu.

2. In **Licenses…** dialog (see Figure 1), which will be displayed with already installed licenses, you can install new license (click on the **Install** button) or you can remove selected license from list (select the license and click on the **Remove** button).
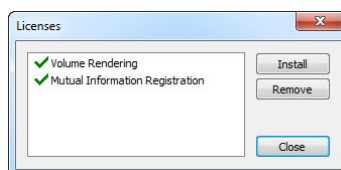
Figure 1 – Licenses… dialog

2.1.5   Installation verification

To verify installation process of TomoCon Viewer or TomoCon Workstation follow these steps:

1. Install the application.

2. Check if the icon of the application is placed on the MS Windows desktop.

3. Check if the application shortcut is contained in the MS Windows Start menu:

   - TomoCon Viewer: **Start / Programs / TomoCon 3.0 Viewer / TomoCon Viewer**.

   - TomoCon Workstation: **Start / Programs / TomoCon 3.0 Workstation / TomoCon Workstation**.

4. Launch the application and check the following steps in TomoCon.

   - If the application is installed for the first time (it is not upgraded) the dialog **Select TomoCon 3.0 Language** will be displayed. Then select language and click on the **OK** button.

   - If the DICOM receiver is not configured correctly, the warning message "Could not start DICOM receiver" will be displayed. The possible reason can be, that the TomoCon's DICOM receive port is used by another application. Then click on the **OK** button.

   - Check if the main window of application is displayed.

   - Click on the **About...** item in **Help** menu. The **About box** of TomoCon will be displayed.

   - Check if the build number in the displayed **About box** is 3.0.15.

2.2   Starting TomoCon

To start TomoCon, click the MS Windows **Start** button; go through **Programs**, **TomoCon 3.0** and finally **TomoCon**.

Optional start-up parameters:

- /**t** - to start TomoCon in touch screen mode, (see 19 Touch screen mode).

2.3   Logging in to TomoCon

TomoCon application provides to you with following possibilities of access authorization:

- Non-authorized access, when each user logged on computer can launch TomoCon.

- Authorized access with user name and password. When user is launching application, he has to enter his user name and password in **Log On to TomoCon** dialog (see Figure 2) and press **OK** button to confirm and start application.

Figure 2 – Log On to TomoCon dialog

3 Using TomoCon

The TomoCon consists of the following parts (see Figure 3):

- 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 Toolbars)

- Status bar (see 3.6 Status bar)
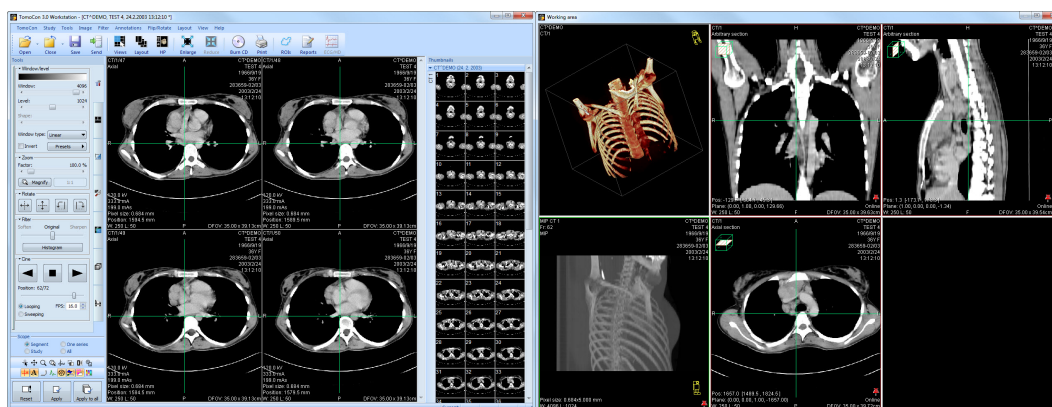
Figure 3 – Application TomoCon

3.1   Working area

Working area an area for visualization and diagnostics of patient data (displays images of examination, MPR, 3D, etc.). Main working area is bound to main application window. If you want to expand existing working area, you can anytime create new independent working area with variable size and place it on next free monitor. You can create new working area with a click on the **Create new working area** item in the **View** menu. New working area will be automatically created and placed on the first free monitor.

3.1.1   Working area layout

A newly created working area consists of one segment, which covers the whole working area and can be divided into views. Segment is a defined part of working area with resizable bounds and it can be divided into other smaller segments. After having created a new working area, you can divide it into the desired layout by

dividing segments and defining views layout for each of from them (by default the segment contains one view). You can also change the existing layout anytime by resizing or deleting segments, which have been defined previously. This way you can create all kinds of layouts for your viewing and diagnosing.
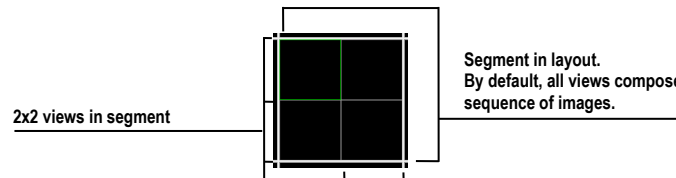
Figure 4 – Four views in segment

TomoCon allows you define a requested layout in simple and quick way by using the tools docked in the **Define layout** tooltab in the tools panel. **Define layout** tooltab (see Figure 5) is initially docked in the tools panel in the second tab. You can get to it at any time by clicking the tab with ⬛ icon. All these functions are also available over the **Layout** system menu.
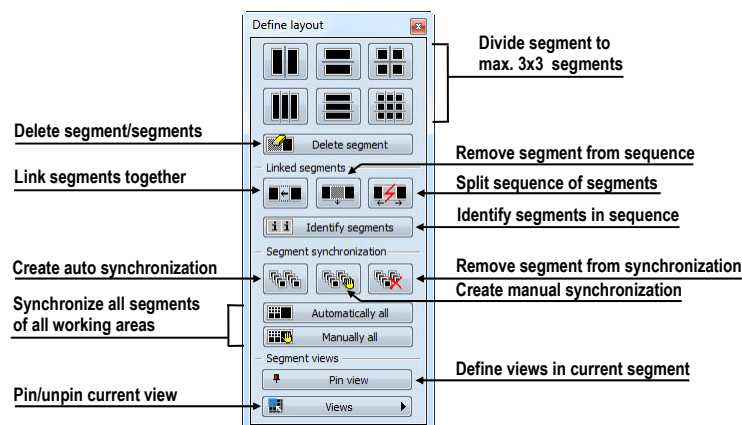
Figure 5 – Define layout tooltab

To divide an existing segment into other smaller segments (see Figure 6 a):

1. Select the requested type of division from the **Define layout** tooltab.

2. Click with the left mouse button on the segment, which you want to divide.

Segments are divided by thick moveable separation lines. Size of each segment can be simply modified by dragging and moving them with the mouse cursor.

To resize adjacent segments (see Figure 6 b):

1. Move the mouse cursor on the boundary (separation) line, which you want to move.

2. Press the left mouse button, move the line to the requested place and release the mouse button.

To remove existed segment/segments (see Figure 6 c):

1. Click on the ✏️ **Delete segments** button in the **Define layout** tooltab.

2. Move mouse cursor on segment/segments, which you want to delete (the segment/segments will be marked with white color) and click with left mouse button.

| (a) | (b) | (c) |
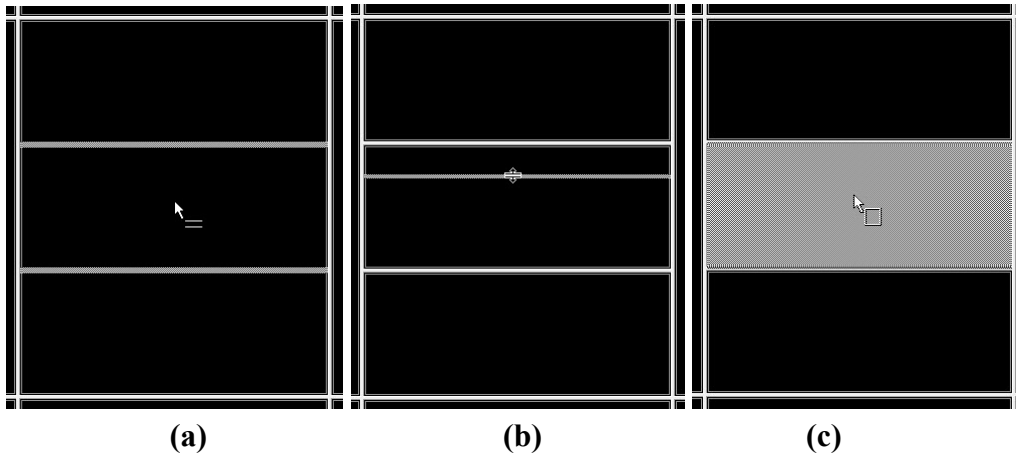
Figure 6 – Definition of segments in working area, divide segment (a), move bound of segment (b), delete segment (c)

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

To define layout views in segment (see Figure 7):

1. Click with left mouse button into the selected segment.

2. Click on the 🔳 **Views** button in the **Segment views** part of the **Define layout** tooltab or click on the 🔳 **Views** button in the main toolbar of TomoCon.

3. Select requested layout of views in grid, which has been displayed.
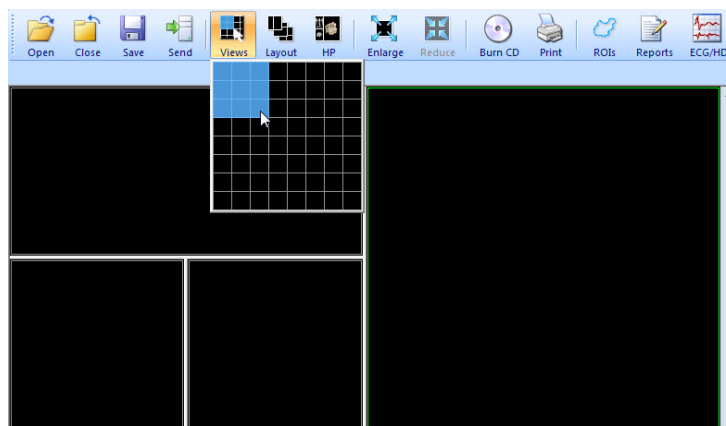
Figure 7 – Definition of views for segment

3.1.2   Organizing your layouts

When you have finished the creation of working areas and segment definition on each of them, you can save the whole layout in application for next use. Application allows you to manage your layouts in the following lists and use any from them:

- **Recent layouts -** list of four last used layouts.

- **Favorite layouts -** list of favorite layouts (any saved layout can be added into or removed from this list with **Layouts manager**).

- **Others layouts** - list of others layouts, which is not in favorites list. From this list you can move any layout to **Favorite layouts** list.

3.1.2.1   Save layout

To save current layout of application:

1. Click on the **Add layout...** item in **Layout** menu.

2. Press **Add** button in **Add layout** dialog (see Figure 8), which will be displayed.
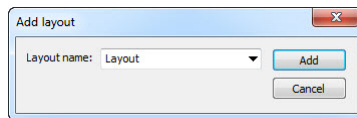
Figure 8 – Add layout dialog

Current layout with entered name will be automatically added to particular list of layouts (**Others layouts**). In the case, that you want to rewrite some layout, which has been already saved, enter the name of this layout a press **Add** button to confirm overwrites.

3.1.2.2   Load layout

To load any saved layout from selected list:

1. Click on the ⬛ **Layout** item in main toolbar or on the **Favorite**, **Recent** or **Others** button in the **Layouts** tooltab of the tools panel.
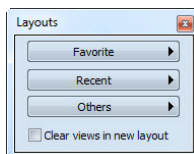
Figure 9 – Layouts tooltab

2. Click with left mouse button on the requested layout in window, which will be displayed. Selected layout will be automatically loaded to application.
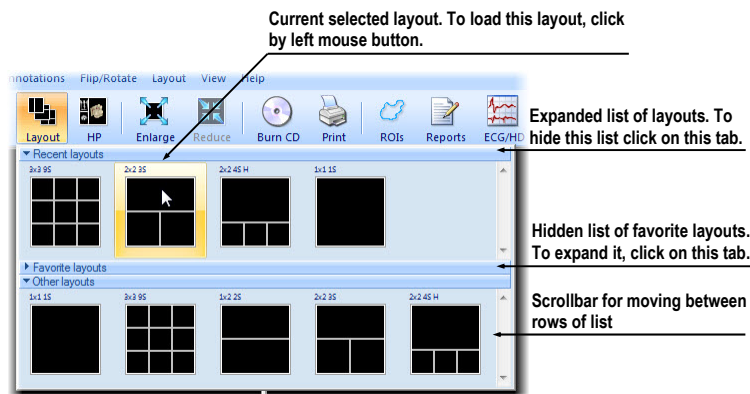
Figure 10 – Layouts list

3.1.2.3   *Layouts manager*

Layouts manager allows you to change base properties of already saved layouts with **Layouts manager** dialog (see Figure 11). In this dialog, which will be displayed, when you click on **Layouts manager…** item in **Layout** menu, you can delete (**Delete** button), or rename (**Rename** button) selected layout and move it from/to list of favorite layouts (**Favorite** check box).
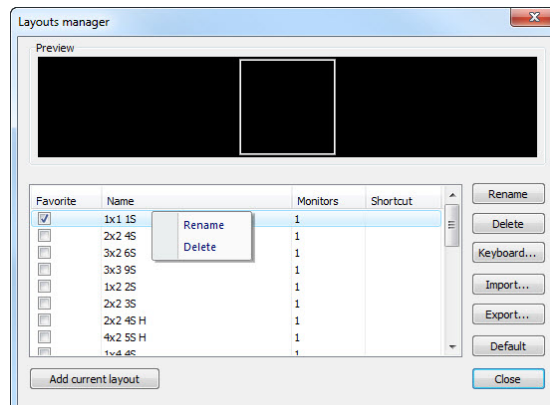
Figure 11 – Layout manager dialog

3.1.3   Current view

Current view is the most recently selected view from all existed working areas, which you have selected by clicking with any mouse button. When you select one view and make it current, all actions, which you will perform, will be applied just to this view.

To change current view, move mouse cursor to another view and click with any mouse button (see Figure 12). Current view is outlined with a colored frame according to the TomoCon settings (you can change the colour of the frame, see 4.6 Color settings).
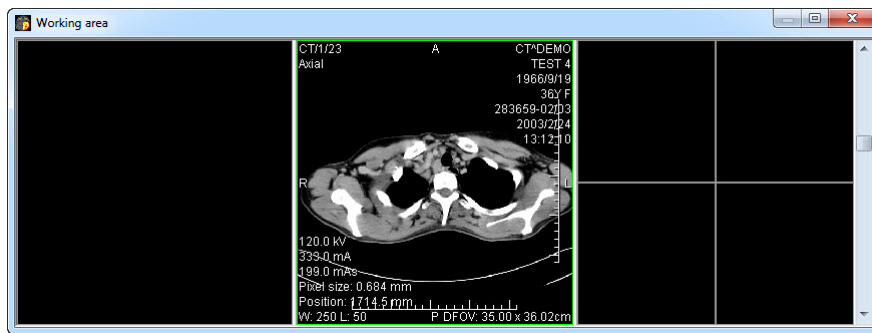
Figure 12 – Working area

3.2 Tools panel

The tools panel contains the main tools to view and diagnose loaded images in TomoCon. It is highly configurable and you can easily move its parts around and even hide/show them altogether. This panel can be useful for maximizing your actual working area.

You can place it to any position on the screen in floating state or dock it to the left or right side of the main workspace. Default, the panel is docked on the left side by default.

To undock a panel into a floating position, drag the panel's title bar, move the panel to a new position on the screen and release the mouse button.

To dock tools panel to a new dock position, drag the panel's title bar and move the panel. While moving the tools panel, docking navigators will be displayed in the application window. Each navigator shows an available docking position for the panel. When the mouse cursor hovers over any docking navigator, a new docking position for the tools panel will be displayed (see Figure 13). To dock the panel on the displayed place, just release the mouse button while the cursor is placed over the navigator.
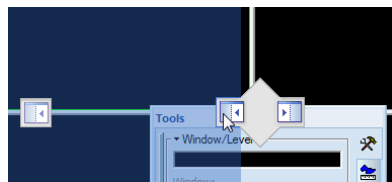
Figure 13 – Docking tools panel to left TomoCon's side

3.2.1 Navigating through the tools panel

The tools panel (see Figure 14) is a very simple topmost dialog, composed from three parts. The first, main part consists of a selected group of tools for viewing and

diagnosing of images. Next parts are scope and apply panel, on the bottom part of the tools panel.
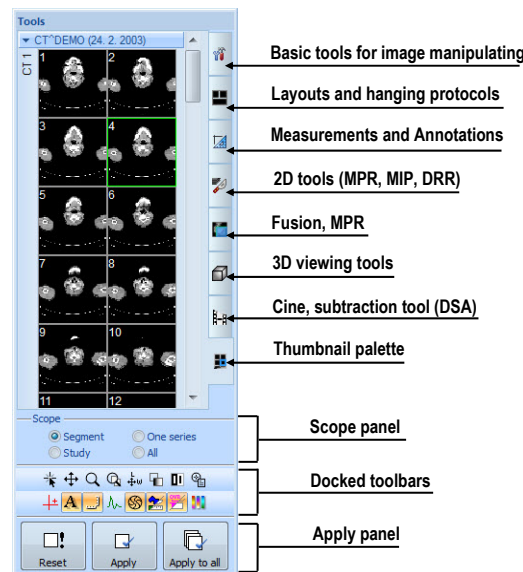
Figure 14 – Tools panel

The main part is divided into 6 simply labeled sections for easy tool selection. Each section is organized as a separate tab page with docked tools in specified arrangement. It can be customized to display the tools you use most often. Order of docked tools can be rearranged in each page and each tool can be individually undocked from tools panel. Each tool is bounding by group box with tool's title in the left-top corner.

To dock a tool dialog to the tools panel, press the left mouse button on the tool dialog's title bar, drag it to the tools panel on a preferred position and release the mouse button. The tool window will be automatically docked to the tab page where it belongs to.

To collapse or display the docked tool in the tools panel, click on the tool's title bar (see Figure 15 a) or use the tools panel's context menu (see Figure 15 b). To display the context menu, click on any tab page in the tools panel with the right mouse button.

(a)   **(b)**
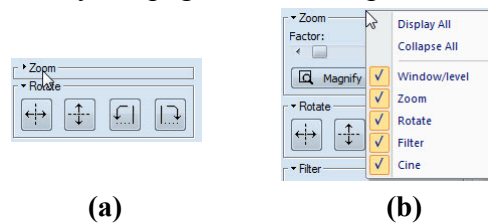
Figure 15 – Collapsed Zoom tooltab (a), displayed context menu of the tools panel (b)

3.2.2   Scope panel

When adjusting your images, sometimes you might want to change just one image in the working area. Other time you might want to change all the images in a series or study at once. To do this, you can use the **Scope** panel in TomoCon (see Figure 16). The **Scope** panel is permanently available at the lover left part of the tools panel.
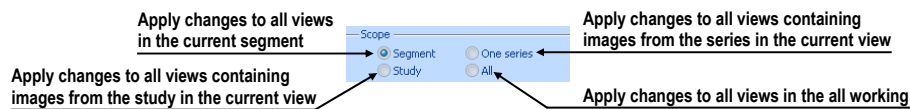
Figure 16 – Scope panel

3.3   *Thumbnails palette*

The thumbnails palette is a powerful navigation tool (see Figure 19), which lets you select images to be displayed in the working area. It always contains images of all opened studies displayed as thumbnail previews. The thumbnails palette may be resized and can be docked inside the application border, but it can be also floating, placed anywhere on the screen. When starting the application, the thumbnails palette is docked at the right side border by default. Afterwards its size and position can be changed by dragging and moving the palette the same way as moving the toolbars.

It is possible to display multiple thumbnails palettes, e.g. each one with different series displayed (see 3.4 Main menu).
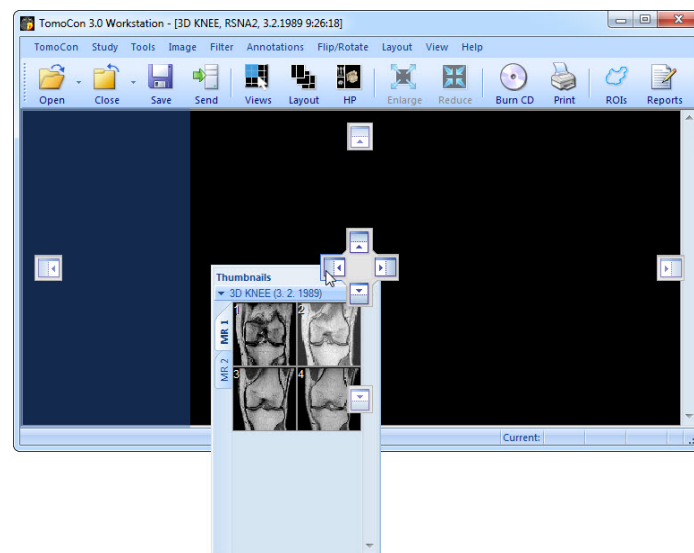
Figure 17 – Navigation of thumbnails palette

To dock a thumbnails palette to the left side of the application window:

1. Drag the thumbnails panel's title bar and move 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 with blue translucent color (see Figure 17).

3. Release the mouse button.

To dock a thumbnails palette to the tools panel, drag the thumbnails panel's title bar and move the panel over the tools panel. Next move the thumbnails palette over the special docking navigator ▦, which will be displayed (see Figure 18 a). A new docking position for the thumbnails palette will be displayed with blue translucent color. To dock the palette, release the mouse button.

To undock a thumbnails palette from tools panel, drag the thumbnails panel's tab with ▦ icon (see Figure 18 b). Thumbnails palette will be undocked from tools panel immediatelly and you can place it to any desired position. To finish the undocking process, release the mouse button.

(a)   (b)
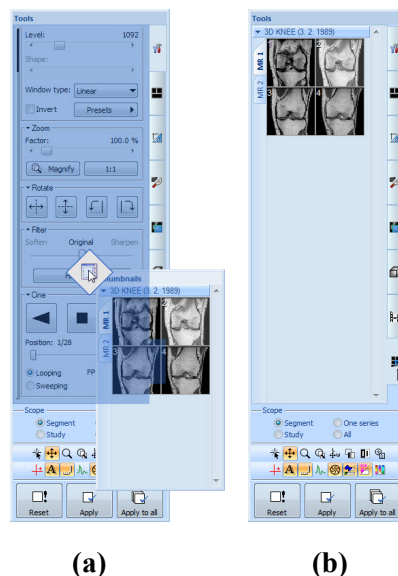
Figure 18 – Docking thumbnails palette to the tools panel (a), undocking thumbnails palette from the tools panel (b)

3.3.1   Working with thumbnails palette

Each study is displayed in the thumbnails palette as a tab with patient name and an examination date (date of creating the study), if the date is available. Under these tabs there are reduced images of the series displayed according to the selected series representation type for the study in the thumbnails palette. Selection of this representation type is possible using the thumbnails palette's context menu (after

pressing right mouse button on the selected study in the thumbnails palette and selecting the **Show series** item).
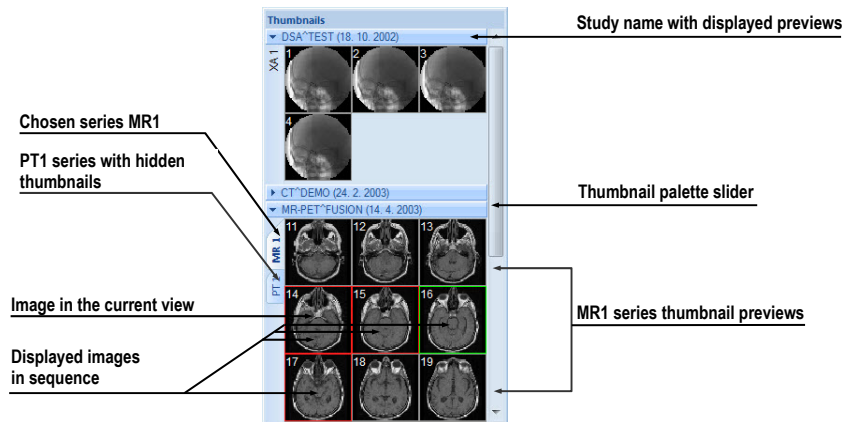
Figure 19 – Thumbnails palette (Tabbed mode)

Thumbnails palette supports 3 different series representation types for the study:

- **Tabbed mode**, selection of the series, which thumbnails are to be displayed, can be selected by clicking with the left mouse button on the button with the series name in the list of series. Only one series from the study can be displayed at a time (see Figure 20 a).

- **All - separated**, thumbnails of all series of the study are displayed at once, sorted according to series (see Figure 20 b).

- **All - in one**, reduced thumbnails of all series of the study are displayed at once one after another without dividing them into series (see Figure 21).

(a)   **(b)**
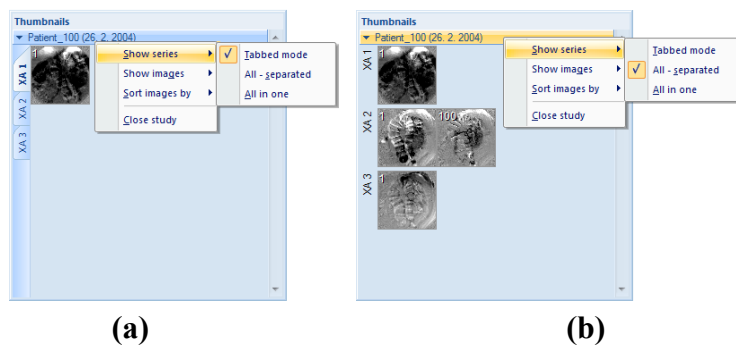
Figure 20 – Displaying series in Tabbed mode (a), All – separated (b)
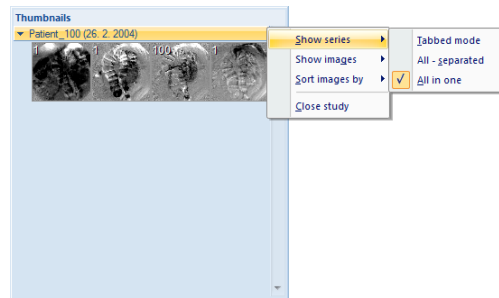
Figure 21 – Displaying series in All – in one mode

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. Image representation type is possible using the thumbnails palette's context menu and selecting the **Show images** item (see Figure 22). Thumbnails palette supports following image representation types for the series:

- **Show all images**, when all images of each series of the selected study are displayed.

- **1 image out of**, when selected number specifies the image interval of each series of the selected study to display.

- **One image only**, when first image of each series of the selected study is displayed.

- **First, middle and last**, when the first, middle and last image of each series of the selected study is displayed.
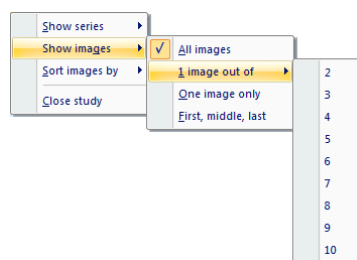
Figure 22 – Context menu for selection of the image representation type

Additionally, image thumbnails from the selected study can be sorted in the Thumbnails palette using the **Sort images by** context menu item (see Figure 23):

- **Index number** - as opened in TomoCon

- **Instance number** - instance number value in DICOM data

- **Image position** - image sorted by position

- **Reverse sort mode**
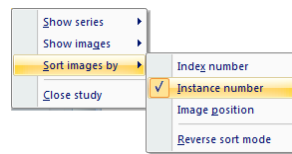
Figure 23 – Context menu for sorting images

Tabs with opened patient studies can be folded/unfolded by moving the mouse cursor over the patient's name and clicking the left mouse button at the chosen study. When the triangle arrow in front of the patient name directs to the patient's name, the thumbnails are folded; when the triangle arrow points down, the thumbnails are unfolded and can be seen (see Figure 19).

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

When opening a new patient study in TomoCon all studies already in TomoCon will be automatically folded and the first series of the new patient will be displayed. Use the scrollbar on the right side of the thumbnails palette to select from the series (thumbnails) that could not be seen on the screen.

3.4 Main menu

The whole TomoCon functionality and features can be found in the main menu. It provides direct access to all functions for viewing and diagnosis of images. As with other MS Windows applications, the items in main menu are divided into groups (sub-menus) according to the type of their usage. The TomoCon main menu consists of the following sub-menus:

- **TomoCon** – main application sub-menu for defining application settings, printing (image data printing on MS Windows printer, DICOM printer, logging in to or out from the application or terminating it), see Figure 24.
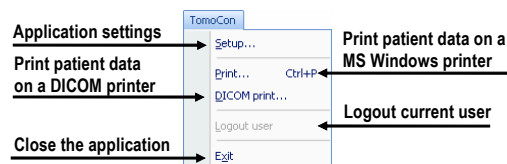
Figure 24 – TomoCon menu

- **Study** - patient study handling, it contains functions for opening/closing/saving studies, anonymizing and burning studies, exporting images and creating/viewing structured reports about studies (see Figure 25).

Open selected DICOM studies
after retrieving them from an
external data source or open
them from the Local Studies

Close/send opened DICOM studies

Creates a new series in a
new or an existing study

Create a video file from a multi-frame
image or a series of patient images

View and edit structured reports

Display information about the current study

Save modified DICOM studies to Local studies

Anonymize opened studies

Export selected patient image (or
series of images) into bitmap files

Archive DICOM study and burn a CD

Display ECG/HD waveforms

Figure 25 – Study menu

- **Tools** - tools for image data handling like windowing/zooming, 3D viewing, reconstructed viewing (MPR, MIP, DRR), subtraction viewing (DSA), creating regions of interests and registrations, defining multimodality registrations (see Figure 26).

Create and modify ROI

MIP creation

Three-dimensional viewing

Window/level manipulations

Multi-frame images
playback

Make registration between
series of patient image data

MPR creation

Image fusion of registered series

DRR creation

Zooming of the current view

DSA viewing of XA images

Run the touch screen mode
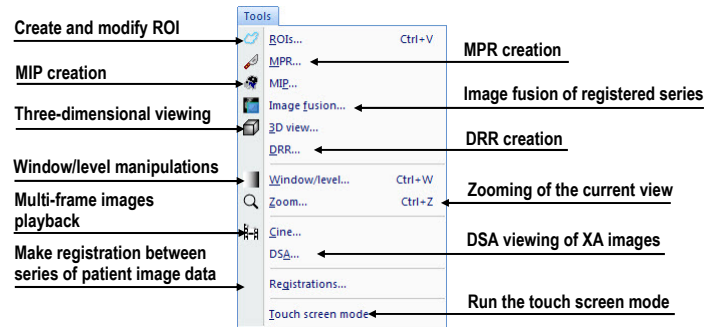
Figure 26 – Tools menu

- **Image** - viewing and manipulation of images. It contains a complex group of functions for windowing and zooming images in a view, creating shutters and reading raw DICOM data of images (see Figure 27).

A click inside the image
selects the current point and
obtains coordinates, that will
be displayed in the Status bar

Windowing in the the current view

Zooming in the the current view

Panning in the the current view

Scrolling through the
series of images or MPRs

Display detailed DICOM information
about image in the current view

Rotate and move MPRs in the current

Define rectangular or
elliptical shutter for
hiding some image parts

Figure 27 – Image menu

- **Filter** - filters for softening or sharpening of image in the current view (see Figure 28).
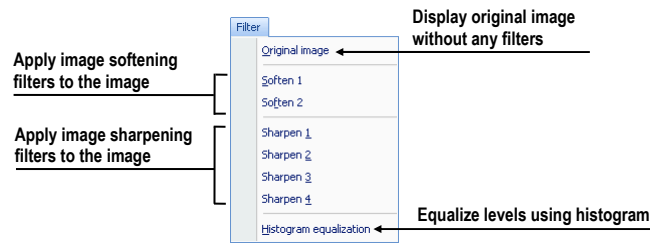
Figure 28 – Filter menu

- **Annotations** – function for managing annotations 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 29).
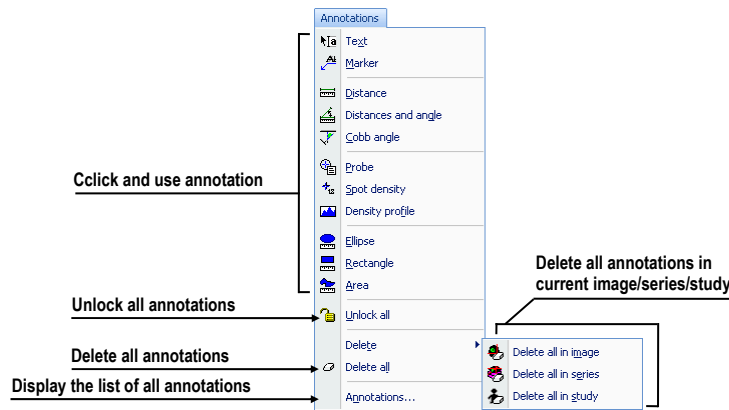
Figure 29 – Annotations menu

- **Flip/Rotate** – flipping and rotation of the image in the current view (see Figure 30).
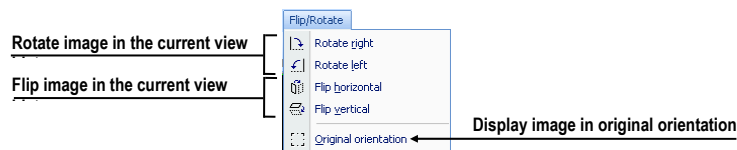
Figure 30 – Flip/ Rotate menu

- **Layout –** functions for managing layouts and hanging protocols in TomoCon, like creating a layout or hanging protocol, defining sequences or synchronizations, etc. (see Figure 31).
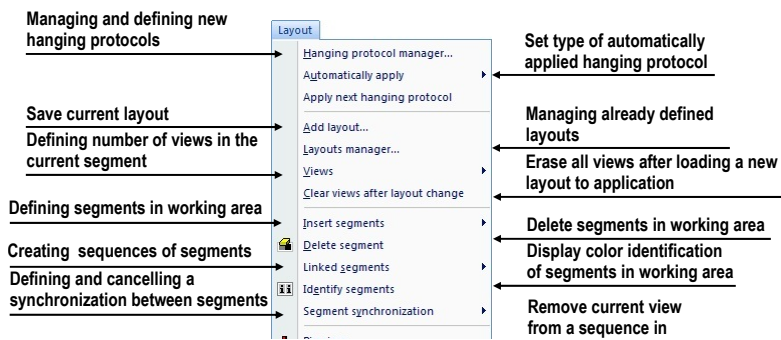
Figure 31 – Layout menu

- **View** – displaying/hiding toolbars, image descriptions, cutlines, changing the current view size, deleting views, creating new working areas or thumbnails palettes and changing alignment of images in views (see Figure 32).
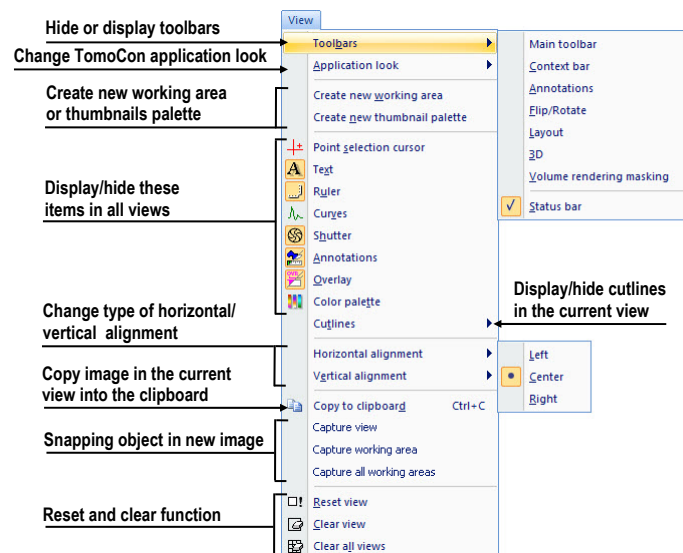
Figure 32 – View menu

- **Help** – display the application version, install licenses or browse the electronic version of the user's manual (see Figure 33).
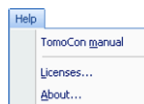
Figure 33 – Help menu

3.5 Toolbars

TomoCon allows you to use toolbar buttons for tasks you perform frequently. Buttons are grouped together on the following toolbars, which can be displayed and positioned at any side of the application window. To show/hide a toolbar, click on the toolbar's name in the **View/Toolbars** menu.

- **Standard** toolbar (see Figure 34): The main functions for viewing images in TomoCon are grouped in the **Standard** toolbar, which is docked on the upper border of the application window by default.
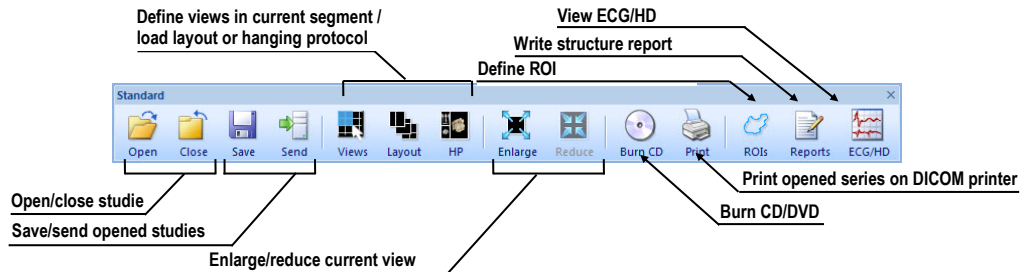
Figure 34 – Standard bar (big version)

- **Context** bar (see Figure 35), which contains the most frequently used tools for diagnosing images in the current view.

Figure 35 – Context bar

- **Annotations** bar (see Figure 36), which contains all measurements, annotations and function for their displaying.

Figure 36 – Annotations bar

- **Flip/Rotate** bar (see Figure 37), which allows you to rotate and flip an image in the current view.

Figure 37 – Flip and rotate bar

- **Layout** bar (see Figure 38), which contains functions for definition of working area layouts.

Figure 38 – Layout bar

- **3D toolbars** (see Figure 39), which allows you to directly and simply create 3D (see Figure 39 a) and Volume rendering (see Figure 39 b) views of patient images.
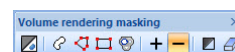
(a)   **(b)**

Figure 39 – 3D toolbars, 3D toolbar (a), Volume masking toolbar (b)

3.6 Status bar

The **Status** bar (see Figure 40) is located at the bottom part of the application window. If you select a menu item or a toolbar button, its description appears on the left side of the **Status** bar. On the right side of the **Status** bar the current point coordinates will be displayed, if you select current point in the selected view.

In the case, the TomoCon application is receiving or sending studies through queue management, the count of reaming studies for transfers will be displayed on the right side of the **Status** bar.

Moreover, if the TomoCon application is printing selected studies on a DICOM printer, the actual state of these printing tasks will be displayed on the right side of the **Status** bar.
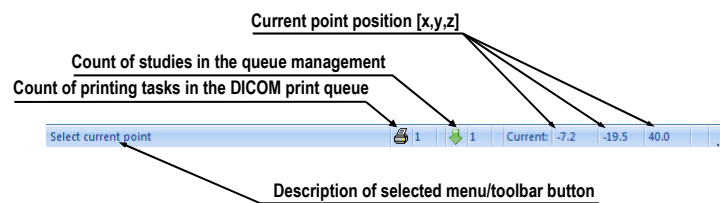
Figure 40 – Status bar

3.7 Coordinate Systems

To be able to display the image position in the patient coordinate space a transformation between images and the real 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.

Orientations used in TomoCon: **A**nterior, **P**osterior, **L**eft, **R**ight, **H**ead and **F**eet.

TomoCon's coordinate system:

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

The coordinates are displayed in millimeters, angles in degrees.

3.7.1 Image Transformation

If **Image Transformation** is available in imported patient images from an imaging device, it is kept and stored with patient data.

After clicking into an image with available transformation, a corresponding spatial position can be calculated.

3.7.2   No Transformation

If the patient data does not contain sufficient information about the placement of images in the coordinate space, the images are handled as simple images. It is not possible to obtain positional coordinates by clicking at the image pixels.

Contours drawn in these images are not displayed in MPR, 3D views and it is not possible to use them to define ROI.

3.7.3   Current point

After clicking into an image, when the point selection mode is activated, a corresponding position is automatically calculated and displayed as the current point in the **Status** bar (see 3.6 Status bar). If the series is displayed in the **Status** bar, it informs which series the displayed position belongs to.

3.7.4   The limits of accuracy in measurements

The image pixel size affects precision of all measurements (the bigger pixel size, the lower 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 measured distance and P_s is pixel size.

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

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

4 Setting up the application - User Preferences

The **TomoCon setup** dialog can be opened by clicking on the **Setup…** submenu in the **TomoCon** menu (see 3.4 Main menu). The **TomoCon setup** dialog (see Figure 41) allows to:

- Set up the application settings (see 4.1 Setting up the application)
- Change the scaling of application's fonts and dialogs (see 4.2 Scaling application fonts)
- Set up the mouse wheel and buttons behavior (see 4.3 Mouse actions)
- Display/hide text types in views (see 4.4 Displayed texts in views)
- Set up the modality settings (see 4.5 Modality settings)
- Set up color shades and shape of TomoCon's objects (see 4.6 Color settings)
- Create shortcuts (see 4.7 Creating keyboard shortcuts)
- Set up the application language (see 4.8 Application language)

Application settings except the language settings changed with the **TomoCon setup** dialog are saved and immediately applicable to the opened application.

4.1 Setting up the application

Common application settings can be set up in the **View/Controls** tab (see Figure 41), in the **TomoCon setup** dialog:

- **View options -** view settings:
  - Turn on/off DSA mode automatic activation (**Always apply DSA**) - if the image in the current view contains DICOM structure for DSA.
  - Turn on/off the possibility of image selection into the current view by left mouse button click on image in the thumbnails palette (**Allow select slice by click**).
- **User interface –** define scaling degree of TomoCon (see 4.2 Scaling application fonts).
- **Mouse options -** for more mouse options using the buttons and the scrolling wheel in the current view (see 4.3 Mouse actions).
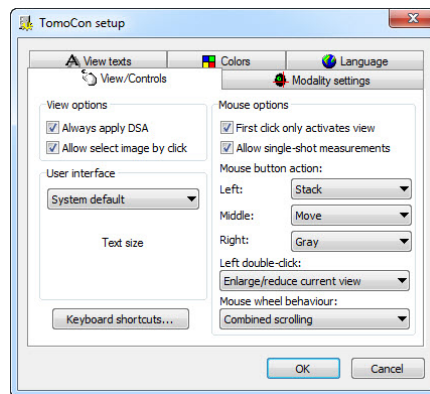
Figure 41 – TomoCon setup dialog, View/Controls tab

4.2 Scaling application fonts

TomoCon is designed to work with monitors with all resolution presently in use. It can works with resolution from 1024x768 up to multi-monitor systems with high resolution. And especially if you use the monitors with high resolution, you may wish to adjust the size of all fonts in order to make the application more readable. Or you can only want to create more space for viewing on a small monitor. In TomoCon you can change the size of fonts used in all windows (dialog boxes, menus, etc.) by changing the scale degree of TomoCon's GUI in the **View/Controls** tab (**User interface** part) in the **TomoCon setup** dialog (see Figure 41).
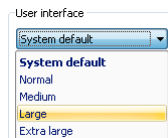
Figure 42 – GUI scale part of View/Controls tab

To change the scale of fonts used in TomoCon, click on the combo box (see Figure 42). The list of all possible font sizes will be displayed ordered from the minimum size. Then click on the required size. A preview of the selected size will be automatically displayed bellow the combo box. To apply the new user interface scale, you have to restart TomoCon.

4.3 Mouse actions

All TomoCon functions are designed to make the standard mouse buttons usable to the maximum extent possible. It allows you to customize the use of mouse by mapping pre-defined actions on selected mouse buttons, including the scrolling wheel. These actions will be active anytime when you press the mouse button, without a need

to somehow activate it. The mapping process is very simple by using the **View/Controls** tab (**Mouse options** part) in **TomoCon setup** dialog (see Figure 41).

After mapping the pre-defined action, following mouse button behavior will remain:

Left mouse button is by default used to:

- Select items (study, image in thumbnails palette, select current view, etc.).

- Perform a clicking task (on the buttons, menu items, etc).

- Perform a primary action (window/level, zoom, etc.). Primary action is actually selected action in the current view and you can activate it by pressing the left mouse button. When you release it, the primary action will be deactivated.

Right mouse button is by default used to:

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

- Display context menu of any window (tools panel, thumbnails palette, etc.).

- Select group of images in a thumbnails palette.

To map a pre-defined action on the left mouse button, click on the **Actions** combo box (see Figure 43). The list of all possible actions will be displayed. Then click on the required action to confirm. To remove a mapping, click on the --**No action--** item in this list.

Mouse button action:
Left: Stack ▾
-- No action --
Move
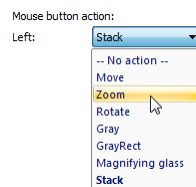Zoom
Rotate
Gray
GrayRect
Magnifying glass
Stack

Figure 43 – Actions combo box

Furthermore it is possible to define following behavior for single and double clicking with the left mouse button (see Figure 44):

- **First click only activates a view**, after clicking into an inactive view it will only become an active view. If this checkbox is not selected, after clicking into an inactive view it becomes an active view and selected action will be triggered in it immediately.

- **Allow single-shot measurements**, after selecting type of measurement, only one measurement can be defined.
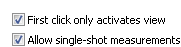
☑ First click only activates view
☑ Allow single-shot measurements

Figure 44 – Left mouse button clicking options

To define behavior of the left mouse double clicking in the current view, click on the **Left double-click** button. The list of predefined functions for current view will be displayed (see Figure 45). Next click on the requested item in displayed list. To cancel of mapping for left mouse double click select the **–No action–** item.
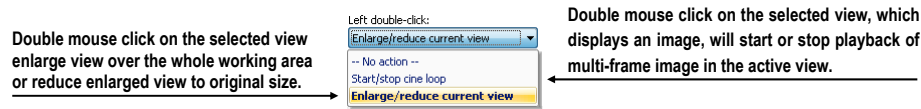

Figure 45 – Mapping action for left mouse double click

To define the scrolling behavior of the mouse, click on the **Mouse wheel behavior** combo box (see Figure 46). The list of all possible scrolling types will be displayed. Then click on the required behavior to confirm.

- **Scroll by images -** move the images within the series in the current view backwards and forwards.

- **Scroll by frames** - move the images of the multi-frame image in the current view backwards and forwards; the function is not available for single images.

- **Combine scrolling** - move the single and multi-frame images in the current view within the series backwards and forwards.

Figure 46 – Mouse wheel behavior combo box

4.4 Displayed texts in views

Each user may have their own specific requests for information displayed in various views. TomoCon comes with pre-configured set of texts, which will be displayed in each type of view and are freely user-adjustable by you (see Figure 47). In addition, you can also define your own texts, which will be displayed together with the predefined texts in views.
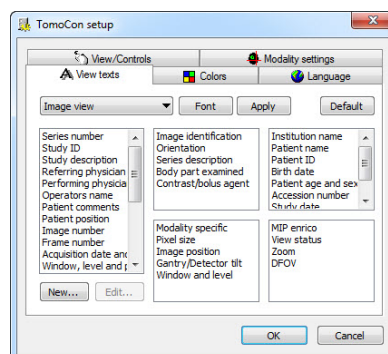

Figure 47 – TomoCon setup dialog, View texts tab

To define displayed texts in view use the **View texts** tab in the **TomoCon setup** dialog.

Select a view type to be adjusted. Four identical square areas represent four view corners and contain description texts to be displayed in the corresponding corner. The fifth rectangular area on the left side contains unused description texts. The descriptions can be moved with mouse per drag-and-drop between the five areas.

Press the **Apply** button to use the selected settings.

The **Default** button returns to the factory defaults.

The **Font** button allows selection of different fonts or font sizes for the description texts. New font settings will be applied immediately.

To define your own texts to be displayed in a view, press **New…** button in this dialog. **Custom view text** dialog (see Figure 48) will be displayed, in which you can select particular DICOM element for displaying and assign some description to its. To confirm your new text, press on the **OK** button and this text will be automatically added to predefined text in the **View texts** tab.
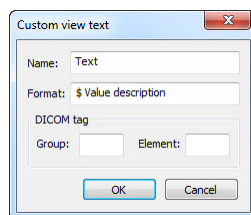

Figure 48 – Custom view text dialog

4.5 Modality settings

Use the **Modality settings** tab in the **TomoCon setup** dialog (see Figure 49) to set up properties separated for each modality:
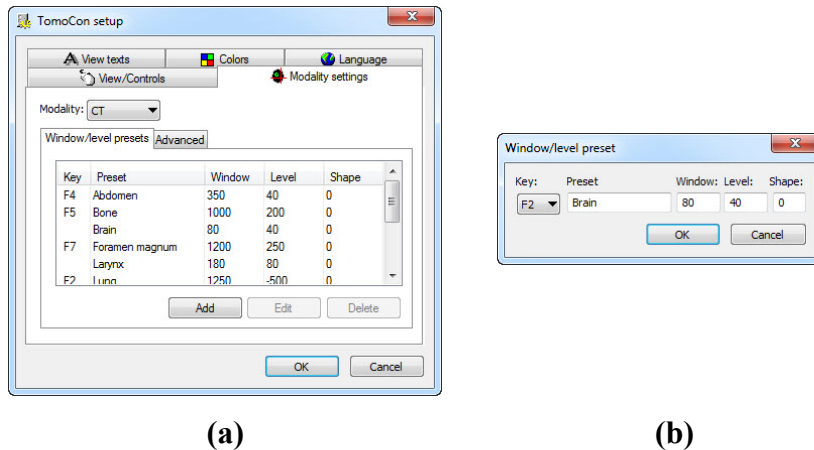

(a)   (b)

Figure 49 – TomoCon setup dialog, Modality settings tab,
Window/Level presets sub tab (a), Window/level preset dialog (b)

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

- **Window/Level presets** sub tab (see Figure 49 a) collects user-defined window, level and shape combinations for each modality, which are used in image grayscale settings. These combinations may be bound to keyboard function keys F2 to F9 as accelerators.

   New presets can be added after pressing the **Add** button and already existing ones can be modified by pressing **Edit** in the **Window/Level preset** dialog.

   A combination chosen from the list can be deleted after pressing the **Delete** button or edited by pressing the **Edit** button. When pressing the **Edit** button the **Window/Level preset** dialog (see Figure 49), which allows you to make the changes, will be opened.

- **Advanced** sub tab (see Figure 50) allows to:
   - select **Color map** palettes
   - select palette gradation type (**Window type** and **Default shape**),
   - select **Adjust Grayscale** type
   - define default Cine frame rate (**Default frame rate**, **Use image frame rate**)
   - **Image interpolation mode** - specify bitmap interpolation mode for image data visualization: **None**, **Bilinear**, **Bicubic**
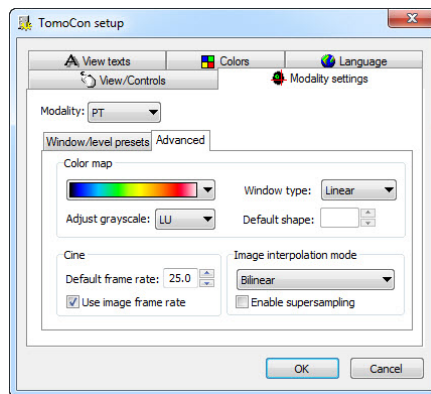   - turn on/off the **Enable supersampling** function

Figure 50 – TomoCon setup dialog, Modality settings tab, Advanced sub tab

4.6 Color settings

Default colors of certain displayed objects in TomoCon can be changed in the **Colors** tab, the **TomoCon setup** dialog (see Figure 51).
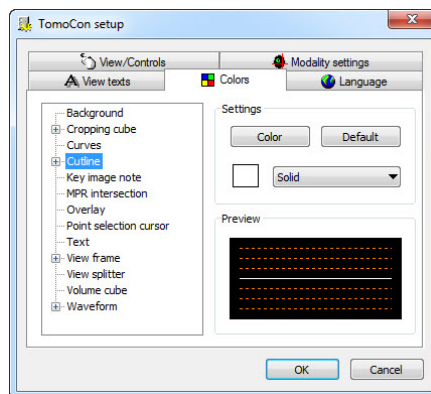

Figure 51 – TomoCon setup dialog, Colors tab

To change color of selected object, click on the **Color** button or the current object's color box in **Settings**. A dialog will be opened with default color palette or a palette created by the user. In **Preview** the subject with changed color or shape will be displayed.

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

4.7 Creating keyboard shortcuts

Keyboard shortcuts let you perform tasks by pressing a simple key combination. This method can be much faster than using a mouse. Also, the sequences of keys (called accelerators keys) might even become essential if for some reason it is not possible to use a mouse. TomoCon provides you with own predefined shortcuts and accelerator keys for many tasks. Off course it also lets you define your own shortcuts for any task

you would like to do. A complete listing of predefined shortcuts is described in the following table.

Shortcut description	Shortcut
Open TomoCon manual	F1
Quit the application	Alt+F4
Open patient study...	Ctrl+O
Save currently opened studies	Ctrl+S
Close currently opened studies	Ctrl+F4
Next image	Page Down, Num 3
Previous image	Page Up, Num 9
Insert new series into selected study	Ctrl+N
Select all images from series	Ctrl+A
Copy selected image to clipboard	Ctrl+C
Deselect all images from series	Ctrl+D
Invert selection	Ctrl+I
Show working area for DICOM print	Ctrl+P

TomoCon allows you to define your own shortcuts using keyboard shortcuts management in the well-arranged **Shortcuts keys** mapping dialog (see Figure 52). You can display it with a click on the **Keyboard shortcuts…** button in the left bottom corner of the **View/Controls** tab, the **TomoCon setup** dialog.
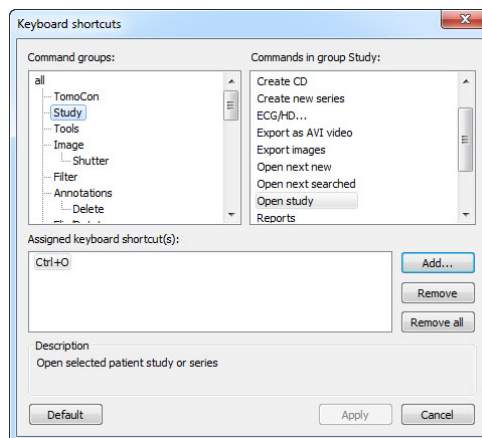

Figure 52 – Shortcut keys dialog

To create your own shortcut in the **Shortcuts keys** dialog:

1. Look through the command groups in the list on the left side of the dialog. To see, which commands belong to a group, click on group and look at the list on the right side.

2. When you find a command (in the list of commands on the right side) for which you would like to create a shortcut, select the command and click on the **Add**... button.

3. The **Define shortcut keys** dialog will be displayed (see Figure 53). Then press the key combination for your shortcut. The pressed keys will appear in the **Pressed key(s)** box.

4. If you wish to add the entered shortcut, click on the **Apply**.

5. If you want to add multiple shortcuts, click on the **Assign** button. The shortcut will be assigned to a command and you can define a new one into the **Pressed key(s)** box. Repeat the steps for each of your defined shortcuts. Finally click on the **Apply** button.
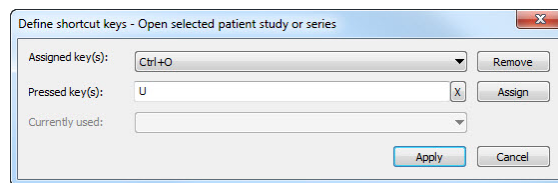

Figure 53 – Define shortcut keys dialog

To remove a keyboard shortcut in the **Shortcut keys** dialog:

1. Find the command group in the list on the left side of the dialog (see Figure 52), into which the shortcut (to be removed) belongs.

2. Select the specific command (to be removed) in the command list on the right side of the dialog.

3. Click on the **Remove** button.

The **Remove all** button removes all defined and predefined keyboard shortcuts in TomoCon. The **Default** button removes all the keyboard shortcuts that have previously been assigned.

4.8   Application language

TomoCon allows selecting the application language using the **Language** tab in the **TomoCon setup** dialog (see Figure 54):

- **Slovenčina (Slovak)**
- **Čeština (Czech)**
- **English**

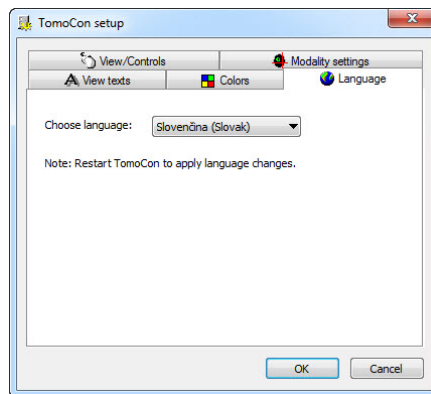The language will be changed after restarting the application.

Figure 54 – TomoCon setup dialog, Language tab

4.9   Application look

You can customize the look of the TomoCon application according to your requirements. TomoCon allows you to completely change its user interface to match any of the broadly used MS Windows applications.

To change the TomoCon application look:

1. Click on the **View/Application look** item in the TomoCon main menu.

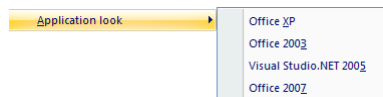2. Select the desired application look from the list (see Figure 55), displayed in the menu.

Figure 55 – Application look list

5 Retrieving and Opening study

TomoCon application provides to you with studies management on all available storages in one clearly-arranged dialog (see Figure 58). You can display this dialog clicking on the 📂 **Open** icon in main toolbar or by select **Open study…** item in the **Study** menu (see 3.4 Main menu).

TomoCon enables handling patient image data, archived on following data storages:

- **Local studies** (see 5.2 Local studies)
- DICOM format source (CD, HD, etc.) (see 5.5 DICOMDIR)
- PACS system (see 5.4 TomoCon PACS server)
- Device with DICOM protocol (see 5.6 External data acquisition devices)

TomoCon application saves all data in the local studies on the local workstation. It is also possible to export the data from this storage to other external data storage

5.1 Finding studies

When opening a study from any type of data source (except DICOMDIR), only studies meeting selected requirements will be displayed. Select requirements at the top of the **Search studies** dialog, the **Filter** part (see Figure 56):

Following criteria are available:

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

After pressing the **Search** button the search process will be started and a list of studies will be displayed in the **Search studies** dialog window.
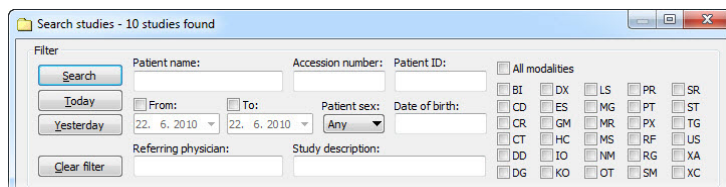

Figure 56 – Filter condition for searching studies

In addition, it is possible to search studies according to the selected study (see Figure 57). Search parameter is defined in **Search by** item in selected study's context menu (to display context menu, click with right mouse button on selected study).

Figure 57 – Search study by selected study

These studies can be then sorted according to the selected study parameter (by clicking at the column header, where is the selected parameter displayed).

For each study it is possible to unfold a list of series by clicking on the ⊞ symbol or fold the list by clicking on the ⊟ symbol. Unfolded series list displays basic series information including number of images in the series.

Studies can be selected by marking the particular study in the list (by clicking at the study) or marking multiple studies while holding the **Ctrl** key (selection of more single studies) or the **Shift** key (selection of a group of studies between two clicked studies).

5.2   Local studies

DICOM data is retrieved from external data sources and stored locally in the **Local studies** area. All studies stored in this area can be searched in the **Local studies** tab (see Figure 58) and after select they can be opened.

Figure 58 – Search studies dialog

After pressing the **Search** button the searching process will start and studies fulfilling the specified criteria will be displayed.

Selected studies can be opened in TomoCon (after pressing the **Open study** button).

The dialog also supports following operations with each selected study in this list:

- Lock study against automatic deletion (after pressing the **Lock/Unlock** button).

- Send study to external PACS server (after pressing the **Send** button).

- Delete study (after pressing the **Delete** button).

- Burn study on CD (after pressing the **Create CD** button the **Create CD** dialog will be opened (see 23 Archive images on CD), after pressing the **Add** button the selected study will be added to the list of studies, ready to be burned).

- Define study status by item **Status** (see Figure 59 a) in context menu of selected study (to display context menu click by right mouse button on selected study). Defined status is displayed in studies list in the **Status** column and it is also possible to search studies according to it (to search studies for status, click on the icon ▼ in **Status** column header and select concrete status, see Figure 59 b).
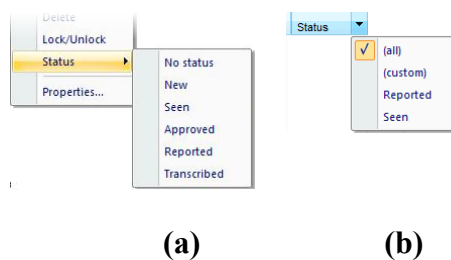

(a)   (b)

Figure 59 – Define study status (a), Search studies by status (b)

5.3 Opening multiple studies

Multiple patient studies can be opened simultaneously in TomoCon. When opening another study, a dialog will be opened (see Figure 60). Select the **No** button if you want to keep the currently opened studies. Press **Yes** to close the studies.
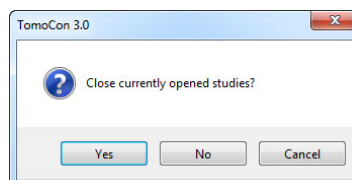

Figure 60 – "Close currently opened studies?" message box

5.4 *TomoCon PACS server*

TomoCon can be connected to any standard PACS server for data acquisition. The default one is **TomoCon PACS** server, pre-configured for the immediate use. Detailed information is accessible through the **PACS studies** tab, the **Search studies** dialog (see Figure 61).
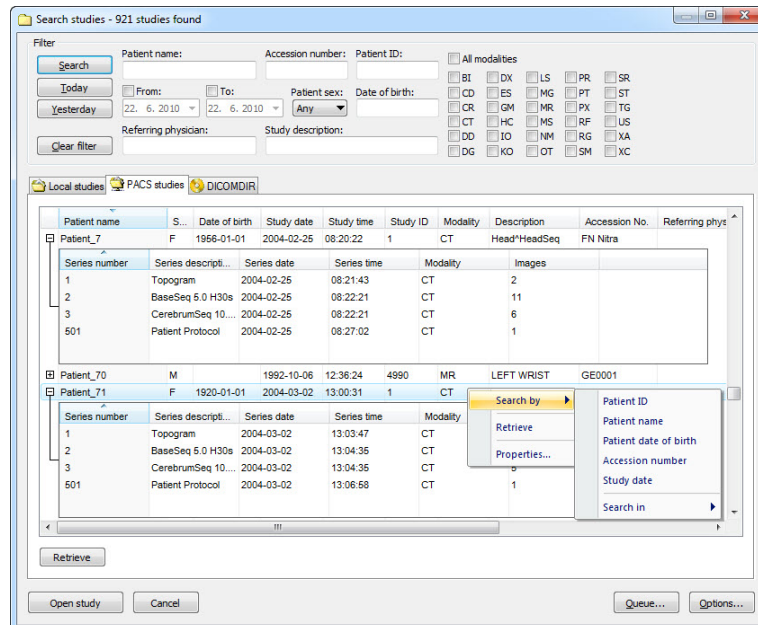

Figure 61 – Search studies on PACS server dialog

The selected study can be retrieved from PACS server into Local studies area by pressing the **Retrieve** button. After pressing the **Open study** button instead of **Retrieve**, the study will be automatically opened in TomoCon immediately after being retrieved from the PACS server.

5.5 *DICOMDIR*

> ⚠ This functionality is available only in TomoCon WS.

Any data stored in DICOM format, whether on CD, HD or shared network server directory, can be accessed over the **DICOMDIR** tab (see Figure 62).

After pressing the **Search** button, TomoCon will ask for the directory pointing to the DICOM data.

In the **DICOMDIR** area it is not possible to specify settings in the **Filter** box for data selection.
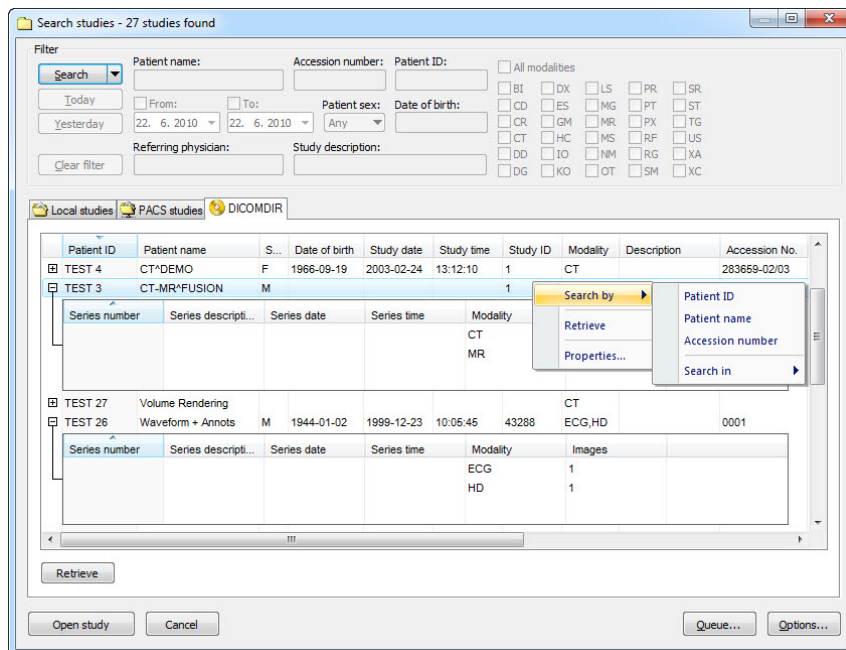
Figure 62 – Search studies in DICOMDIR dialog

5.6 External data acquisition devices

Multiple available data acquisition devices and PACS servers can be defined and accessed over network. They can be specified after pressing the **Options…** button. After the specification (see 5.9 Settings), the new DICOM data source will be displayed as another data source (a new tab with the source name) in the **Search studies** dialog.

5.7 Send study to external data device

Patient data can be sent over network to any PACS server or other DICOM data storage device. In the **Local studies** area, the **Search studies** dialog, select a study and press the **Send** button. If multiple remote devices are available and defined, the **Select remote device** dialog (see Figure 63) will pop up to specify the target device. Select the desired remote device and press the **OK** button. The study will be sent. To define DICOM data source see the **Options** dialog (see 5.9 Settings).
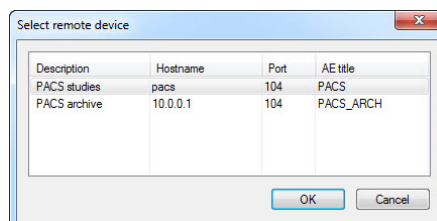

Figure 63 – Select remote device dialog

5.8   Monitoring and controlling the send/receive process

There is a possibility in TomoCon to monitor and control the process of sending or receiving studies between the local studies storage and external data storages including the PACS system by using the dialog **Queue management** (see Figure 64). This dialog will be displayed after click on the **Queue** button in the **Search studies** dialog. In this dialog you can monitor processes of the receiving studies (**Receive queue** tab), processes of the sending queue (**Send queue** tab) and history about all transmission (**History** tab). Each selected process in the **Receive queue** or in the **Send queue** can be by restarted (**Restart**), suspended (**Stop**), and consequently continued (**Continue**) or deleted (**Remove**) by clicking on the functional buttons in this dialog. Eventually, details about selected process can be displayed by clicking on the **Details** button.
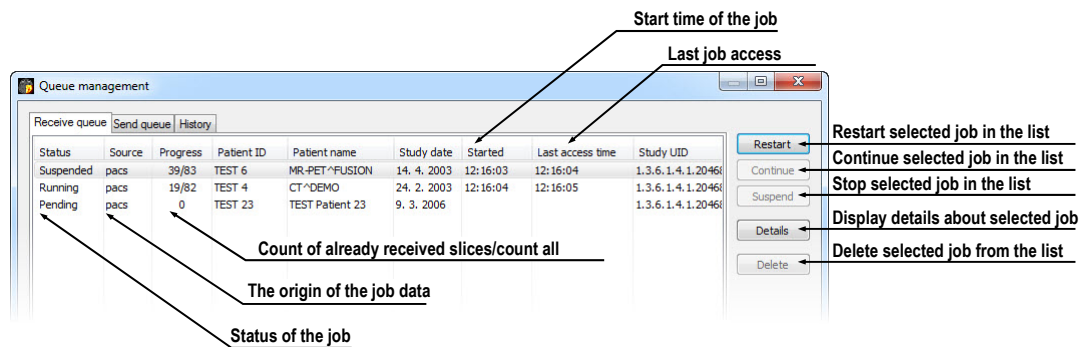
Figure 64 – Queue management, Receive queue tab

Process of receiving/sending selected studies to/from **Local studies** storage can be moved to the **Queue management** by clicking on **Move to Queue** check box during receive/send process (see Figure 65). Consequently, receive/send process will be moved to Receive/Send queue.
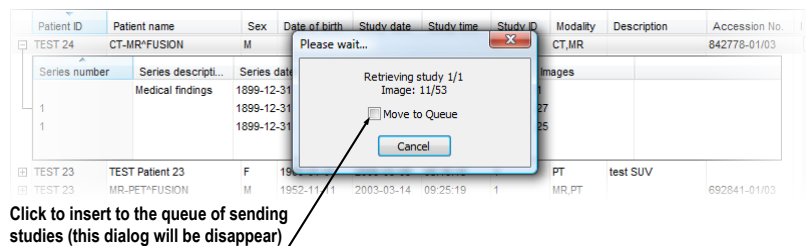

Figure 65 – Search studies dialog, sending of selected study from Local studies

5.9   Settings

Following settings are available through the **Options** dialog (see Figure 66 a) that will be displayed after pressing **Options** in the **Search studies** dialog:

- **Local studies folder -** local studies folder properties (see 5.9.1 Local studies properties).

- **Local DICOM settings -** settings for importing DICOM data to **TomoCon** (see 5.9.2 DICOM receiver settings).

- **Remote devices -** external devices settings for DICOM data exchange (see 5.9.3 External DICOM device configuration).
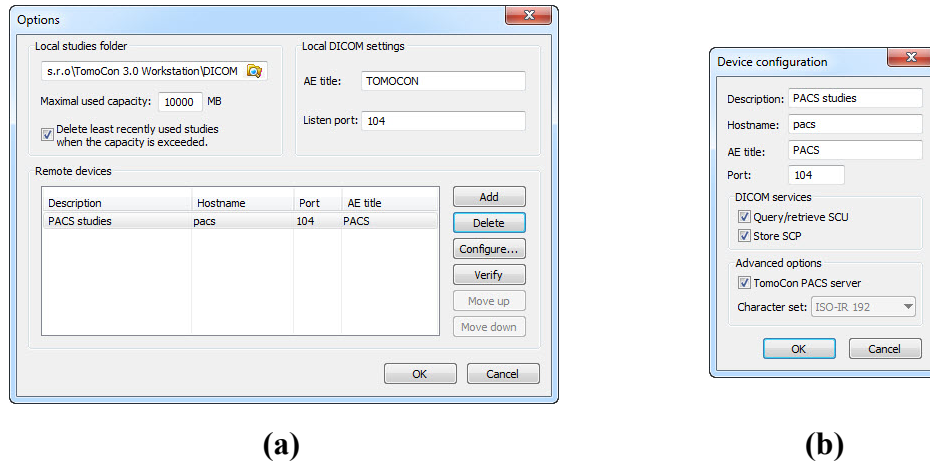

(a)   (b)

Figure 66 – Options dialog (a), Device configuration dialog (b)

5.9.1   Local studies properties

It is possible to define a folder for Local studies in the **Options** dialog (see Figure 66 a). If local saved data size exceeds **Maximal used capacity** and **Delete least recently used studies when the capacity is exceeded** option is checked, the oldest studies will be deleted.

5.9.2   DICOM receiver settings

TomoCon contains the local DICOM receiver, which saves patient data to Local studies automatically. It is possible to set following properties:

- **AE Title**

- **Listen port** - port for receiving DICOM data

5.9.3   External DICOM device configuration

DICOM device definition can be added (**Add**) and configured (**Configure…**). After pressing one of these buttons a device configuration dialog will be opened (see Figure 66 b). The new device, named in **Description**, will be displayed in **Remote devices**

and in the **Search studies** dialog. It is possible to reach it the same way as the other data sources.

5.10 Save a patient study

To preserve changes made on the opened study of patient (defined ROIs, registrations, description texts) save the patient data prior to closing the patient or exiting the application. (Note: it is not possible to save patient data in demonstration versions of TomoCon and in the TomoCon Lite viewer).

Study changes can be saved by clicking on the **Save** button in the **Study** menu.

Wait a moment while saving the data. Depending on amount of data to be saved it can take few seconds to half a minute. The **Please wait…** dialog (see Figure 67) will inform you about the ongoing progress.
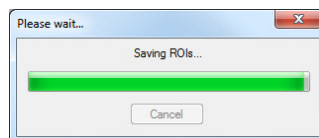
Figure 67 – Saving modified study data in progress…

5.11 Close a patient study

Open DICOM studies can be closed by clicking on the **Close studies** icon in the **Standard** toolbar or on the **Close** submenu in the **Study** menu. When closing the study a dialog will be opened (see Figure 68) allowing you to save unsaved changes (ROIs, registrations, annotations).
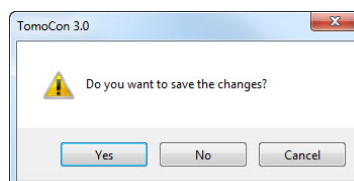
Figure 68 – "Do you want to save changes?" dialog

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 to display an image in a view. You can use the selection of images in the thumbnails palette or move them by drag and drop method within TomoCon.

To display an image in selected view using the thumbnails palette:

1. Move mouse cursor over the requested view and click by left mouse button (this view will be changed to current view).

2. Move mouse cursor over the requested image in thumbnails palette and click by left mouse button (see Figure 69 b). The image will be displayed in the current view.

or by drag and drop method:

1. Move mouse cursor over the requested image in thumbnails palette and press and hold left mouse button.

2. Move mouse cursor over the requested view and release mouse button. Image will be displayed in this view and the view will be changed to current (see Figure 69 a).

(a)   (b)
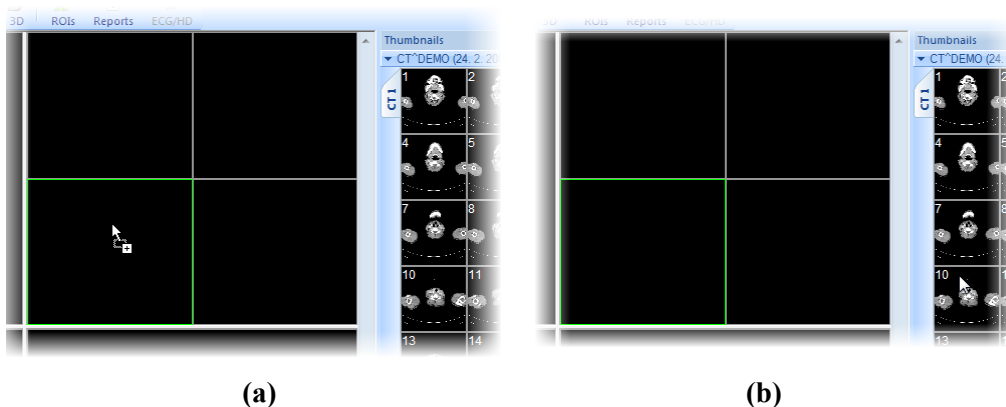
Figure 69 – Display image in view by drag&drop (a) Select image to display in current view (b)

There is also a simplified version of selecting a series into the current view. You can quickly select the exact series you want to view using the context menu.

1. Move the mouse cursor over the requested view and click with the left mouse button (this view will be changed to current view).

2. Click with the right mouse button to display its context menu.

3. Select requested series in the top sub-menu **Select series…**. The first image of the selected series will be displayed in this view immediately.
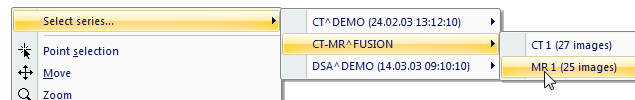
Figure 70 – Series selection by context menu

When you select image in the current, non-pinned view, application will automatically create a sequence (see Figure 71), which will contain all non-pinned views from current segment and from all others segments, linked with it (see 6.2 Image sequence).

Identification of image order in series, which is displayed in the current view, is indicated by scrollbar on the right side of the working area. Its position represents approximate image position in the series.
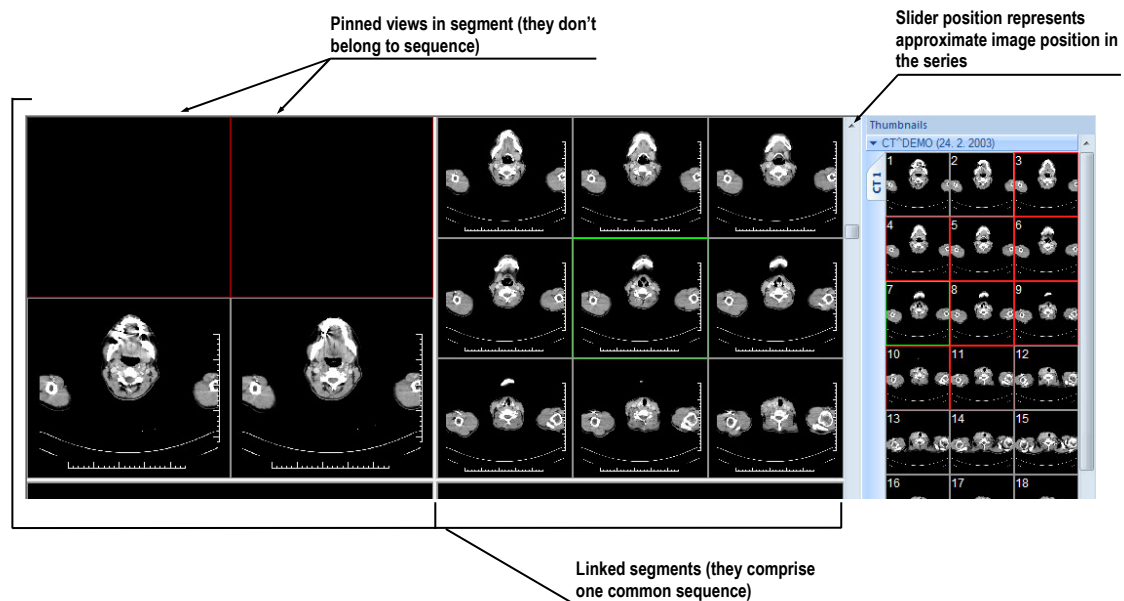
Figure 71 – Working area with non-multiframe image in current view

When a multi-frame image is displayed in the current view, the scrollbar is divided into two parts separated with a square box (see Figure 72).
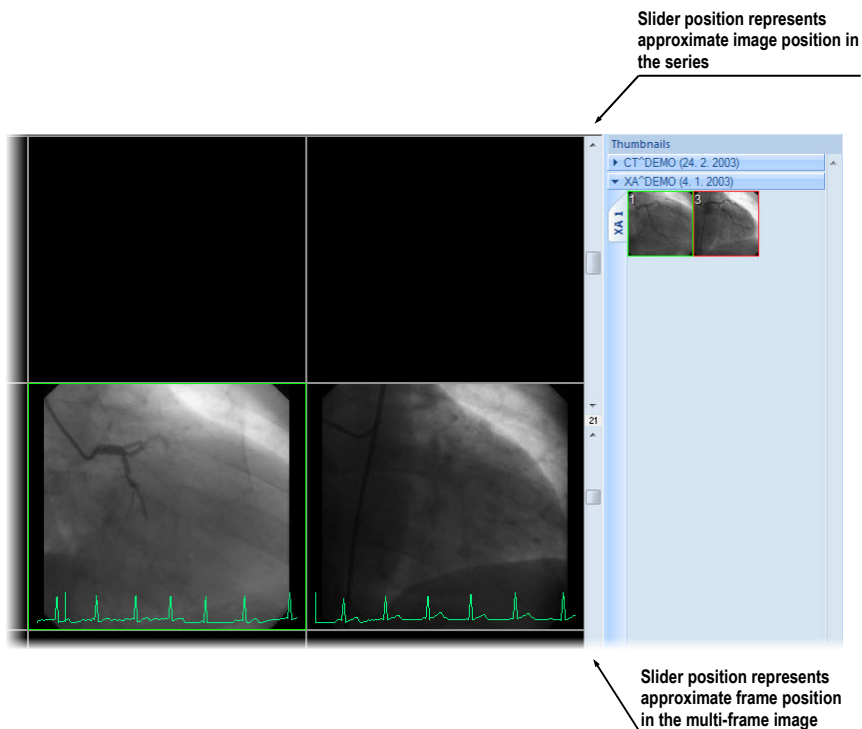
Figure 72 – Working area with multiframe image in current view

Use the scrollbar in the upper part to move between the images of the chosen series in the current view. The scrollbar in the bottom part is used to move between the frames of the multi-frame image in the current view. In the box between the scrollbar the current frame number of the multi-frame image is displayed.

6.2 *Image sequence*

When new image in the current view is selected, TomoCon creates a sequence of images in the current segment automatically. This sequence will contain all views from this segment (linked by rows), with the exception of pinned views. Pinned view can be used to display arbitrary image without changing the sequence, eventually to display MPR, 3D, etc. This view is outlined with a colored frame (default color is red, but you can change the frame color, see 4.6 Color settings).
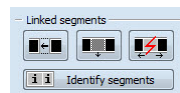
Figure 73 – Linked segments part of Define layout tooltab

To manually pin/unpin current view, click on the ⊞ item in the context menu. It will be displayed after clicking by right mouse button. Status of this icon is displaying the pin status of current view (see Figure 71).

If you want to create sequence, which will contain more than one segment, TomoCon allows you to link selected segments (see Figure 74).

Follow these steps:

1. Click with left mouse button on the first segment in sequence.

2. Click on the ▣ button in the second tab (▣ icon) of the tools panel (see Figure 73).

3. Move cursor over the working area. The first segment in sequence will be marked with number 1.

4. Move mouse 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 with left mouse button. If you want to add additional segments into the sequence, keep the **Ctrl** key pressed while clicking with the mouse.

5. To add next segment, repeat step 4 with the **Ctrl** key pressed. If you want to finish linking of segments, press **Esc** key.
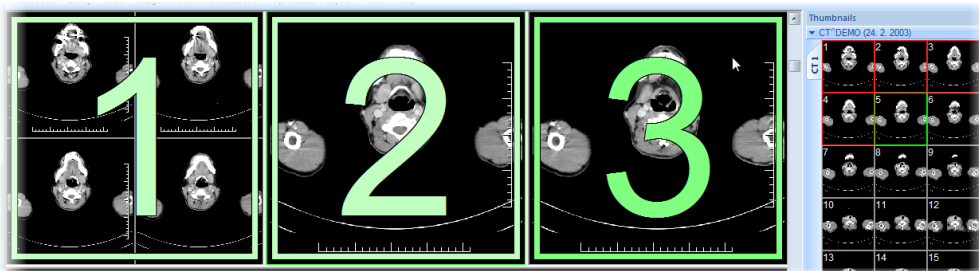
Figure 74 – Linking of segments to sequence

To remove linked segment from sequence (see Figure 75):

1. Click on the ▣ button in the second tab (▣ icon) of the tools panel (see Figure 73).

2. Move mouse cursor over the segment, which you want to remove (segment will be marked with cross) and click with left mouse button.

3. If you want to remove multiple segments from a sequence, keep the **Ctrl** key pressed while clicking with the mouse.
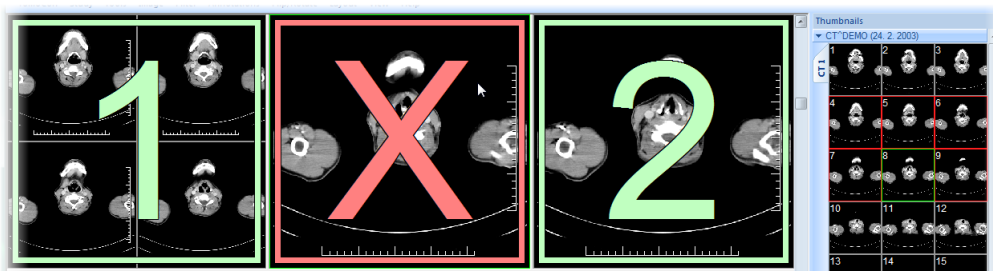

Figure 75 – Removing segment from sequence

To split already existing sequence (see Figure 76):

1. Click on the ▣ button in the second tab (▦ icon) of the tools panel (see Figure 73).

2. Move mouse cursor over the first segment of next sequence (segment will be marked with number 1 and next linked segments with next numbers in new sequence) and click with left mouse button.
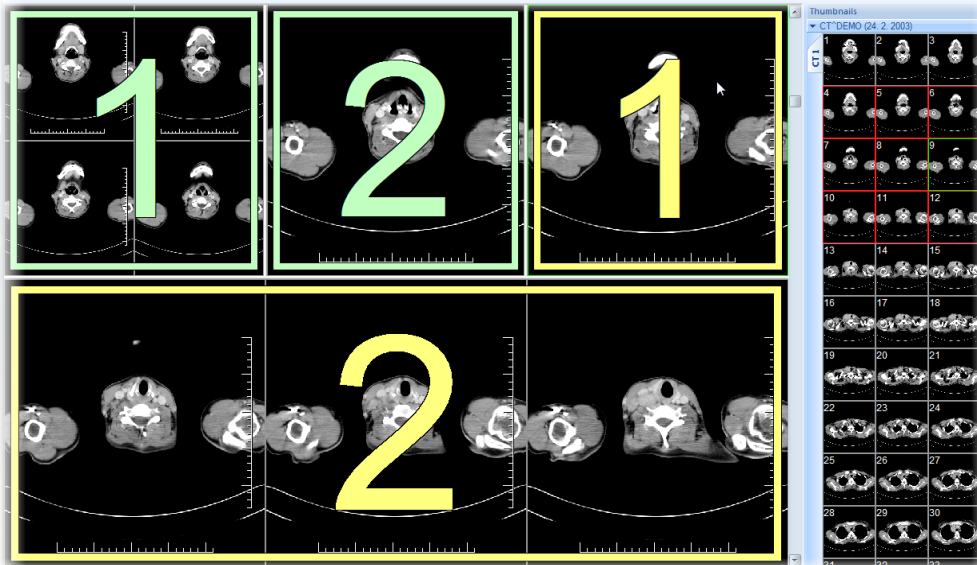

Figure 76 – Dividing existed sequence

6.3 Series synchronization

Multiple series can be "locked" together to scroll synchronously in segments. This mode can be selected by clicking on the **Segments synchronization** part in second tab (tab with ▦ icon) in the tools panel (see Figure 77).
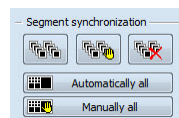

Figure 77 – Segments synchronization part of Define layout tooltab

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

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

In manual mode the displayed images in segments are considered as "currently being displayed at correct positions". While scrolling one segment, images in other segments are scrolled by approximately same offsets.

To define automatic/manual synchronization of selected segments (see Figure 78):

1. Select layout of working area with at least two segments, which have the same layout of views.

2. Display desired series in these segments (in manual synchronization mode, set position of series in segments).

3. Select segment, which will be used as the primary (set current view in it).

4. Click on the ⬚ button for automatic synchronization or the ⬚ button for manual synchronization and move mouse cursor over the working area.

5. Click on another segment in working area with same layout like the primary segment, which should be synchronized with it (primary segment will be marked like **Pri.**). If you want to add additional segments into the synchronization, keep the **Ctrl** key pressed while clicking with the mouse.

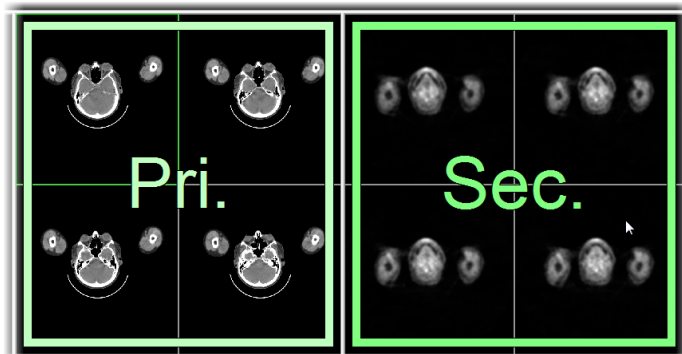6. To add other segments to this synchronization, repeat step 5 with the **Ctrl** key pressed.

Figure 78 – Definition of synchronization for selected segments

To cancel synchronization of selected segments:

1. Click on the ⬚ button and move mouse cursor over the working area.

2. To remove whole synchronization move mouse cursor over the primary segment (segment will be marked with red frame and **Pri.** title) and click with left mouse button.

3. To remove only one segment from synchronization move mouse cursor over it (segment will be marked with red frame and with **Sec.** title) and click with left mouse button.

To synchronize/cancel synchronization of all segments in all working areas, simply click on the ⊞■ **Automatically all**/ ⊞✋ **Manually all** button in the **Define layout** tooltab (see Figure 77) at any time.

When you insert segment to series synchronization, views in this segment will be marked with colored icons. These icons identify synchronization status of segments (see Figure 79). To define the location of these icons in the view see 4.4 Displayed texts in views, text type **View status**.
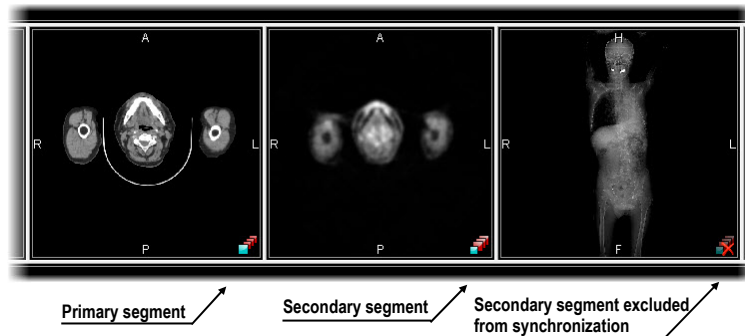

Figure 79 – Segment status in synchronization

6.4   *Play multi-frame images*

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

TomoCon allows you to quickly create and manipulate cine loops in any view of your working area by using the **Cine** tooltab in the tools panel. **Cine** tooltab (see Figure 80) is docked in tools panel in the first tab by default. You can get to it at any time by clicking the tab with 👫 icon.
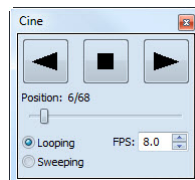

Figure 80 – Cine tooltab

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** tooltab you can select the playback mode. Then you can select another view and in

this tooltab 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**)

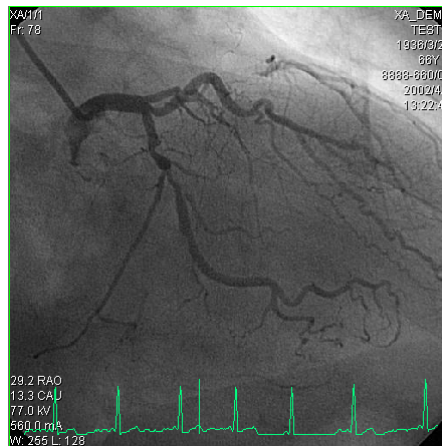- change the frame rate - **FPS** (frames per second)

Figure 81 – Cine view playing multi-frame image with ECG curve

If a multi-frame image contains curves (like ECG), these can be drawn into the image selecting the **Curves** option in the **View** menu (see Figure 81). While playing, the current position in the sequence of frames will be marked with a small vertical line inside the curve.

If the **Double click starts/stops playback** option is allowed in the TomoCon settings, (see 4.3 Mouse actions), it is possible to start or stop playback of multi-frame image in the current view by simple double click with the left mouse button.

7 Manipulating Images

7.1 Window and level manipulations

Window and level manipulations is one of the most common tasks in digital medical imaging. They allow you to see patient image data with correct contrast and image details in some particular grayscale range.

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

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

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

The window/level changes from the current view can be also applied to the image (which will be also displayed in the thumbnail preview). Press **Apply** in the current view's context menu to apply this changes to the image. Press **Apply to all** to apply this changes to all images and views of the current series.

7.1.1 Window/level tooltab

Window/level tooltab (see Figure 82) is initially docked in the tools panel in the first tab. You can get to it at any time by clicking on the tab with 🎎 icon.
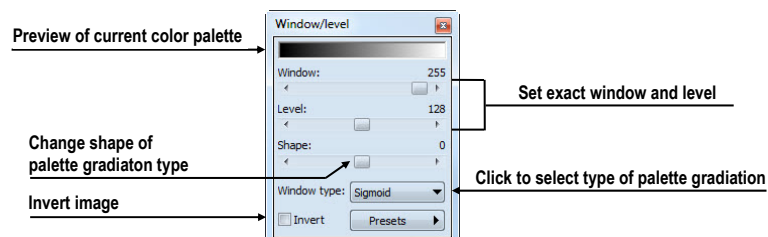

Figure 82 – Window/level tooltab

To adjust the window/level using this tooltab, select a view in the working area, where you want to change the grayscale values. Then drag and move sliders to the desired position. Window/level values will be changed in the current view immediately and actual values will be automatically displayed at the right side above each slider.

Changes made with **Window** and **Level** sliders define the current contrast level of the displayed data. These changes remain valid in the view until a new image from the thumbnails palette is copied into the view. Window and level values in the **Window/level** tooltab will be then set up according to the values in the newly chosen image.

The palette gradation **Shape** slider modifies the gradation curve of the selected palette. It can be used only for a non-linear type of color map palette gradation (exponential, sigmoid). To change the type of gradation, click on the **Window type** combo box.

7.1.2   Presets

You can create and use your own "predefined window, level and shape settings". You can define these for a specific modality or you can use pre-defined presets in TomoCon.

To use a preset on image, select a view in the working area, on which you want to apply it. Then display drop-down list of all applicable presets by clicking on the **Presets** button in the tools panel, **Window/level** tooltab, or by clicking on the **Window/level preset** item in the current view's context menu. Select the preset you want.

If you have mapped any of keyboard shortcut keys F2 to F12 onto your preset, simply activate the view and press the keyboard shortcut.

To create your own preset:

1. Adjust the window/level/shape values in the current view.
2. Click on the **New preset…** item in the drop-down list of all applicable presets in the **Window/level** tooltab. You can display the list by pressing the **Presets** button.
3. The **Window/level preset** dialog with grayscale values from current view will be opened (see Figure 83).
4. Optionally select any of keyboard shortcuts F2 to F9 from the **Key** combo box to be bound to the selected preset.
5. Fill the preset name in **Preset name** edit box. Then press the **OK** button.

To remove a defined preset, click on the **Delete preset…** item in the drop-down list of presets in the **Window/level** tooltab. You can display the list by pressing the **Presets** button. Then click on the preset you want to remove in the displayed list of removable presets.
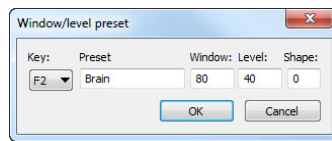
Figure 83 – Window/level dialog – defining new Window/level/Shape preset

Use the same process to set up, edit or remove preset for each modality in **Modality settings** tab, the **TomoCon setup** dialog (see 4.5 Modality settings).

7.1.3 Adjusting Window/Level with the mouse

To modify window and level simultaneously without the **Window/Level** tooltab, click on the ⇕w **Window/Level** icon in the **Image** menu or on the Window/Level item in context menu of the view (mouse cursor will change to ⊕ form). Then click at the view and move the mouse (with the left mouse button pressed) horizontally (window) and vertically (level). Level and window are changed immediately.

For optimal level and window setting for the patient images you can also use the **Window/Level Rectangle** function in the **Image** menu or in the context menu. Click on the ▣ **Window/Level Rectangle** icon. The mouse cursor will change to ▭ form. Click into the image and hold the mouse button. Move the cursor (shaped ▭) across the area. A rectangle will be drawn around the area. You can cancel the dragged rectangle by pressing the **Esc** button on the keyboard. After releasing the mouse button, window and level will be set for optimal contrast in the area within the rectangle.

7.2 Zooming image views

Zooming the image allows you to change the zoom factor in the current view for displaying selected details, e.g. while contouring small structures or clicking reference points, within zoom range 50% to 1600%. To change this factor, you can use zooming functions in the context menu, the magnifying glass tool, the **Zoom** tooltab in the tools panel or the mouse wheel with pressed **Ctrl** key.

Changes of zoom in the current view are automatically and instantly applied to all images according to the selected limit in the **Scope** tool. You can limit changes to a single segment, a series or a study.

The zoom and move changes from the current view can be also applied to the image (which will be also displayed in the thumbnail preview). Press **Apply** in the current view's context menu to apply this changes to the image. Press **Apply to all** to apply this changes to all images and views of the current series.

7.2.1   Zoom tooltab

Zoom tool tab (see Figure 84) is initially docked in the tools panel in the first tab. You can get to it at any time by clicking on the tab with 👬 icon.
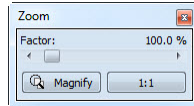
Figure 84 – Zoom tooltab

The **Zoom factor** can be changed by moving the slider in this dialog and it can be varied between 50% and 1600%. New zoom value will be changed in the current view immediately and actual values will be automatically displayed at the right side above the slider. The same effect has scrolling the mouse wheel while the **Ctrl** button is pressed on the keyboard. The image is zoomed from the middle of the view equally to all directions.

To set a pixel-for-pixel in the current view, click on the **1:1** button. The image in the current view will be centered and displayed with this ratio (one pixel of original image data will be identical to one displayed pixel). To cancel the pixel-for-pixel spacing, click on the on the **1:1** button again.

7.2.2   Zooming with the mouse

To modify the zoom factor using the mouse (without the **Zoom** tooltab), click on the 🔍 **Zoom** icon in the **Image** menu (mouse cursor will change to 🔍 form). Click in the view and move the mouse (with the left mouse button pressed) in the image vertically. The image will be zoomed immediately and the clicked point will stay at the same position. This is useful when zooming a particular detail.

Use the 🔍 **Zoom rectangle** function in the **Context** toolbar or in the **Image** menu to zoom an exact image area to the whole view size (up to the maximum of 1600%). Click on the icon (mouse cursor will change to 🔍 form), then click into the image and hold the mouse button. Move the 🔍 cursor with mouse across the area, a rectangle will be drawn around the area. You can cancel the dragged rectangle by pressing the Esc button on the keyboard. After releasing the mouse button, the area within the rectangle will be zoomed to fill the view.

7.2.3   Panning with the mouse

You might need to move the zoomed part of the image to the side with the **Move** function in the **Image** menu or by pressing the ✛ **Move** icon in the **Context** bar to see desired detail (mouse cursor will change to 🖐 form).

To move the image in the current view press and hold left mouse button over the desired place. Mouse cursor will change to 🖐 form. Move the mouse to desired position and release the mouse button.

7.2.4 Magnifying glass

Magnifying allows you to magnify an area of interest within a small, separate magnification window that moves together with the cursor.

To activate the magnifying glass:

1. Click on the **Magnify** button in the Zoom tooltab or on the 🔍 **Magnifying glass** item in context menu of current view (mouse cursor will change to 🔑 form).

2. Press and hold the left mouse button over the area of the image you want to magnify.

3. The magnifying window appears and follows the mouse cursor (see Figure 85).

4. To close the magnifying glass window release the mouse button.

Figure 85 – Active Magnifying glass window

7.3 *Image filters*

TomoCon includes a lot of image processing filters for noise removal and small structures enhancement. They can be applied onto any image in the working area using the **Filter** tooltab (see Figure 86) in the tools panel.
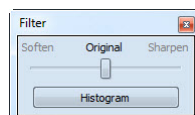

Figure 86 – Filter tooltab

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

To apply histogram equalization, click on the **Histogram** button in **Filter** tooltab.
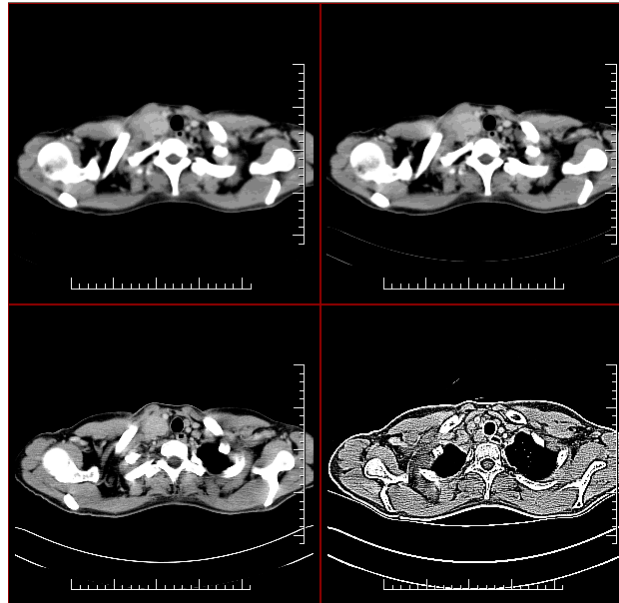

Figure 87 – The effects of the various filters available in TomoCon

7.4 DSA - Digital Subtraction Angiography

The DSA mode supports displaying multi-frame images with image sequence taken with the contrast media and without it. The final DSA image is then displayed as a difference between the base image (with the contrast media) and mask image (without the contrast media). To separate the base and mask images, use the following modes:

- Automatic - the images contain DICOM information from the patient examination and the separation is realized automatically after opening the patient in TomoCon (see 7.4.1 Automatic DSA mode).

- Manual - the image separation has to be made manually (see 7.4.2 Manual DSA mode).

7.4.1 Automatic DSA mode

Open a patient study with a multi-frame image containing DICOM information about DSA examination. After displaying this image, depending on the **View/Controls/Always apply DSA** settings in the **TomoCon setup** dialog (see 4.1 Setting up the application), DSA mode is turned on automatically in all views for all image types. After selecting the image into the current view all modification available in the application can be used to work with the image (see Figure 88).
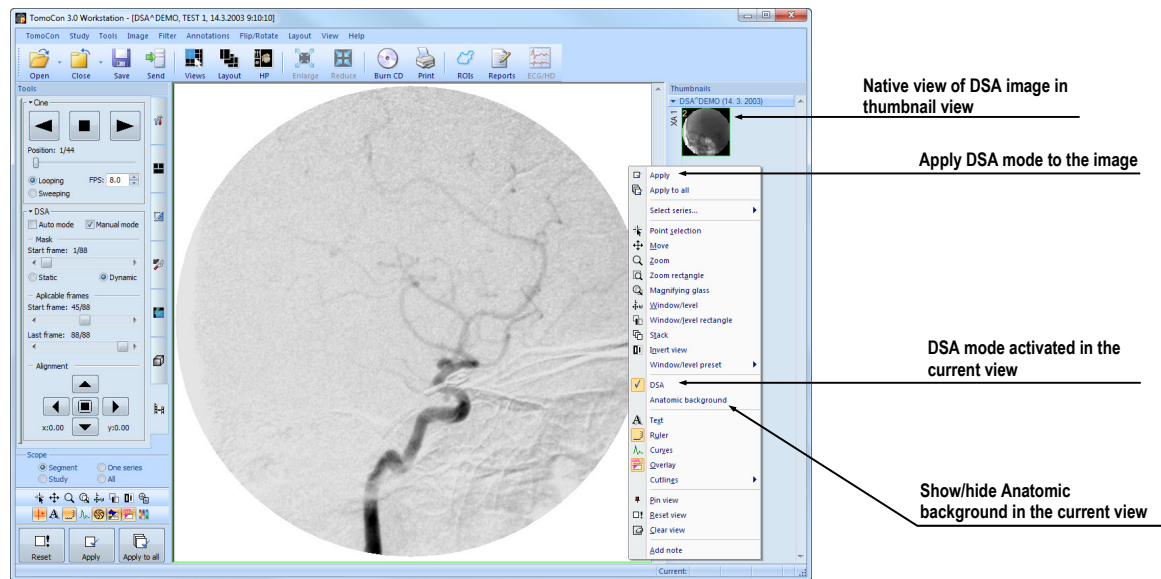
Native view of DSA image in thumbnail view

Apply DSA mode to the image

DSA mode activated in the current view

Show/hide Anatomic background in the current view

Figure 88 – Automatic DSA mode

DSA mode in the current view can be turned off using the view's context menu. Click on the **DSA** item. The changes made in the current view can be applied to the image's thumbnail preview by pressing **Apply** in the current view's context menu. Apply the changes to all images in the current series by clicking on the **Apply to all** items in the current view's context menu.

7.4.2 Manual DSA mode

To activate the manual DSA display mode, use the **DSA** tooltab, which is initially docked in the tools panel in the seventh tab. You can get to it at any time by clicking on the tab with ⊞ icon or by clicking on the **DSA…** item in the TomoCon tools menu. Follow these steps:

1. Open a patient study containing a multi-frame image without DICOM information about DSA examination and select the multi-frame image in the current view.

2. Click on the **Manual mode** in the **DSA** tooltab (see Figure 89). The manual DSA mode will be active in the current view according to the following parameters of the **DSA** tooltab:

   - **Mask frame** - starting image number in the mask (image sequence without the contrast media):

     o **Static mask** - mask frame is static for all chosen frames

     o **Dynamic mask** - mask frame is changed dynamically according to the chosen current frame

- **Applicable frame** - image sequence with the contrast media covered with the mask image(s):

  o **Start** - first sequence image number

  o **Count -** number of sequence images

- **Alignment** - move the mask image relative to the base image (**U** - up, **L** - left, **R** - right, **D** - down, **C** - centre, original position)

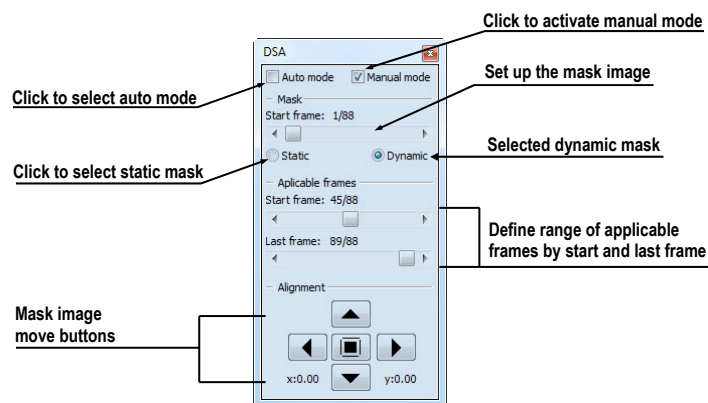The changes of these parameters will be applied to the image in the current view immediately.

Figure 89 – DSA tooltab

Switch automatic DSA mode of the image with DICOM information to manual wherever appropriate. DSA setting changes can be made using the **DSA** tooltab. To return to the original settings, click on the **Auto mode** item and the settings will return to the image original DICOM setting.

7.5 *Cutlines*

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

The **Cutlines** function can be used in CT and MR studies only if there are registrations created between these studies (see 16 Registrations).

Open a patient study with more series and registrations between them. Select an image in the thumbnails palette where the cutlines should be displayed. Click on the **Cutlines** option in the view's context menu or the **View** menu/**Cutlines** to activate the **Cutlines** function (see Figure 90).

Select a patient series from the **Cutlines** menu. The cutlines of chosen series will be displayed in the current view immediately, called standard cutlines (if the planes are not parallel). Standard cutlines are displayed as lines with series and image

description (see Figure 90). Set up the cutlines color and the line shape in the application settings (see 4.6 Color settings).
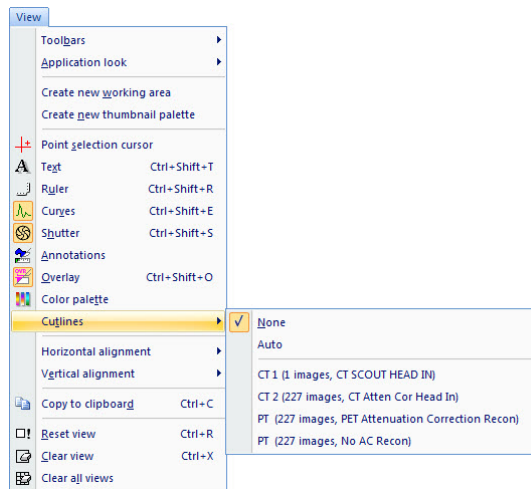

Figure 90 – View/Cutlines menu

Load an image from the chosen series into another view; its position will be displayed in the view with displayed cutlines (current cutline). The current cutline is displayed as a line; set up the color and the line shape in the application settings (see 4.6 Color settings). The cutline will be automatically changed when choosing another image of the chosen series. They will be also displayed when scrolling the images of the series with displayed cutlines (if the planes are not parallel).

It is possible to present cutlines of more series in one image. Select series you want to display in the image in the **Cutlines** menu.

It is also possible to display cutlines in more views at a time (see Figure 91). In each view, click on the context mouse button; select **Cutlines** and the registered series.

When the cutlines can not be displayed, it means:

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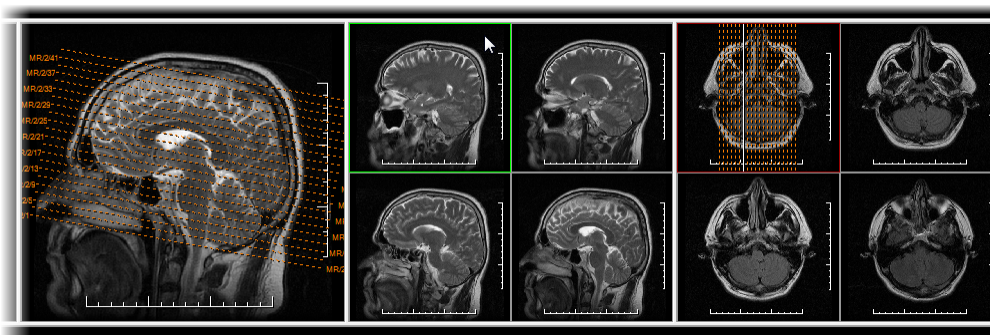- Section planes are parallel (they do not intersect).

Figure 91 – Displayed cutlines at the working area

7.5.1 Delete cutlines

The **None** option in the **Cutlines** menu (see Figure 90) is predefined, that means no cutlines will be displayed. Once the cutlines have been activated, click at **None** to turn the displayed cutlines off. (Click on the context mouse button, select **Cutlines/None**).

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

7.5.2 Auto mode

Click on the right mouse button in the current view and select **Cutlines**/**Auto** item in the context menu (see Figure 90). Open an image from any patient series in a new window. The cutlines of the new series will be displayed automatically in the view with the **Auto** mode. The chosen image will be displayed as a current cutline. Current cutlines will be changed automatically when changing an image in the current view.

7.5.3 Print and save cutlines

Defined cutlines can be printed out with the image on a standard MS Windows printer (see 17.1 MS Windows printer) and a DICOM printer (see 17.2 DICOM printer). When closing a patient study, cutlines will not be saved.

7.6 *Key image notes*

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

7.6.1 Add key image note

To add key image note:

1. Move mouse cursor over the thumbnail preview of image, which is dedicated to define key image note.

2. Press right mouse button to show context menu of thumbnail pallet.

3. Select item **Add note** (dialog **Key image note** for define new note will be displayed).

4. Fill information about new note into displayed dialog. Fill firstly title of new note (see Figure 92 a) and click on the **Next** button. Next fill information

about creator (see Figure 92 b) and click on the **Next** button. In the end write description about new note in this dialog (see Figure 92 c) and click on the **Finish** button. New note will be automatically added to the image.
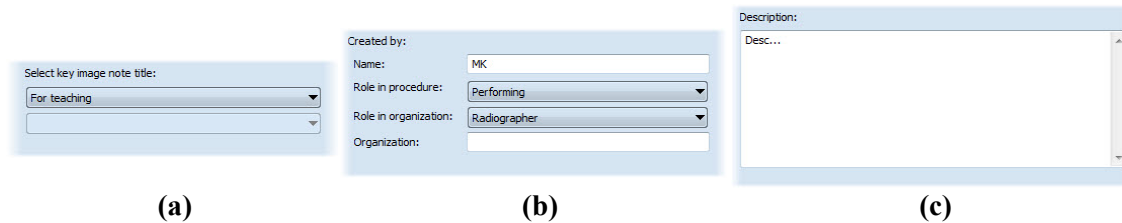

(a)	**(b)**	**(c)**

Figure 92 – Key image note dialog, Note title (a), Information about creator (b), Description (c)

7.6.2   Review and edit key image note

Each key image note belongs to just one image. If the image has defined one or more notes, the small triangle of defined color will be displayed in the thumbnail preview of this image. When mouse cursor move over this triangle and left mouse button double clicks, detailed information of key image notes will be displayed in **Key image note** dialog (see Figure 95). If the image has more than one note, **Key image notes** dialog (see Figure 94) will be displayed to select concrete note by double click.

(a)	**(b)**
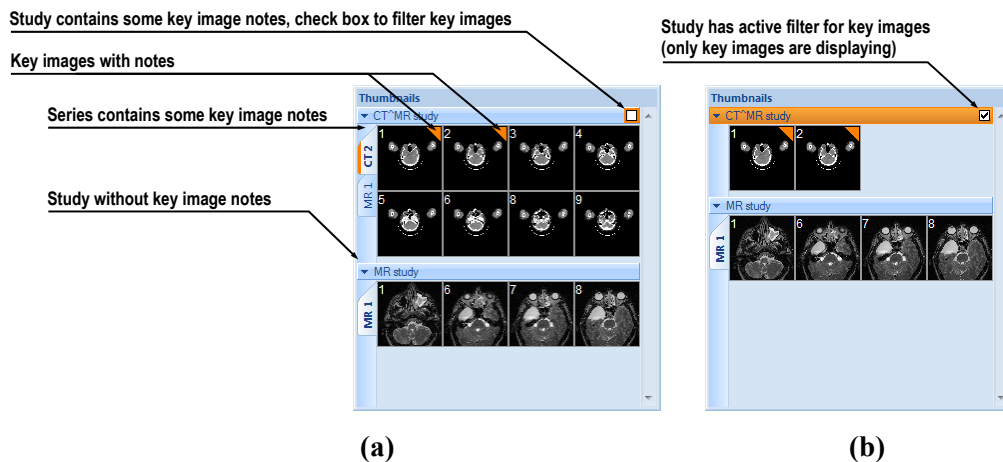
Figure 93 – Key image notes in thumbnails palette, (a) filter for key images id disabled, (b) filter for key images is enabled

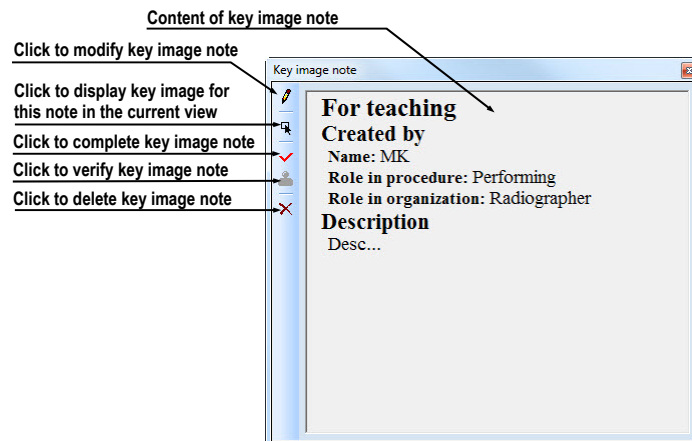**Figure 94 – Key image notes dialog to chosen concrete note**

Figure 95 – Key image note dialog

7.6.3   Load and save key image note

TomoCon allows you to save the notes of all opened studies as a DICOM objects to the Local studies storage. The notes can be further send to the PACS. Key images notes can be saved by clicking on the **Save** button in the **Study** menu or when closing TomoCon a dialog will be opened allowing you to save unsaved changes.

If the series has some key image notes, they will be displayed in the **Search studies** dialog as objects with KO modality (see Figure 96). When study with some key image notes will be opened, associate key image notes to this study also will be automatically opened.

Figure 96 – Search studies dialog, study with key image notes

7.7   Exporting images

TomoCon offers to export the image patient data to the following formats:
- JPEG, DICOM, TIFF, BMP (see 7.7.1 Export images)
- AVI (see 7.7.2 Export images to AVI format video file)

7.7.1 Export images

It is possible to export a selected patient image (or the whole series of patient images) into bitmap file or DICOM file. The **Export** dialog can be opened by clicking on the **Export images…** submenu in the **Study** menu (see Figure 97).

Available bitmap file formats are: JPEG, BMP, TIFF, and DICOM. Select an appropriate **Image dimensions** for the bitmap file or **Use** the **original image dimensions** supplied by the dialog.
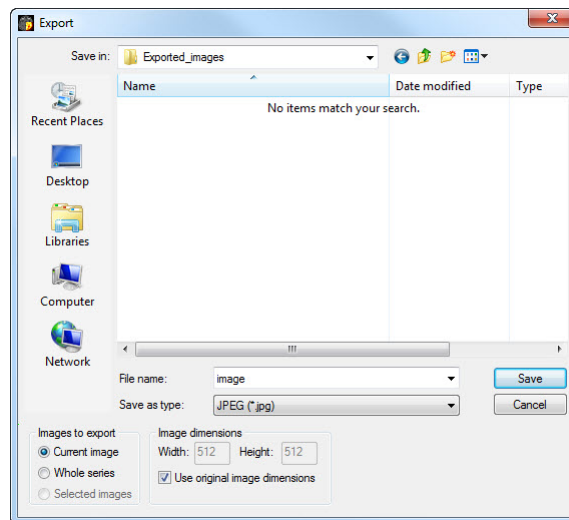

Figure 97 – Export images dialog

If you have selected the whole series option in this dialog and pressed the **Save** button, **Images to export** dialog will be displayed and you can define the range of images to be exported in this dialog (see Figure 98).
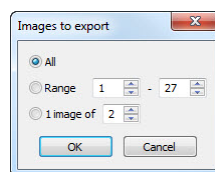
Figure 98 –Images to export dialog

7.7.2 Export images to AVI format video file

Sometimes it might be useful to create a video file from a series of patient image data to play back the data on another computer.

The **Create AVI** dialog (see Figure 99) will be opened by clicking on the **Export as AVI video…** submenu in the **Study** menu.
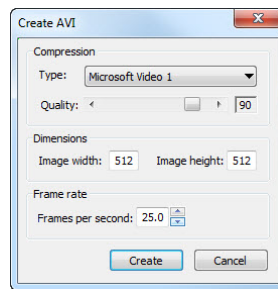
Figure 99 – Create AVI dialog

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

- **Compression -** current 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 another computer to play back the video file, otherwise it will not be possible to play back the file.

- **Dimensions** - image dimensions.

- **Frame rate** - playback speed.

You can also keep the defaults values supplied by the dialog.

When you are finished with definition of video parameters in this dialog, click on the **Create** button. In **Frames to export** dialog, which will be displayed (see Figure 100), you can define the range of images to be exported.
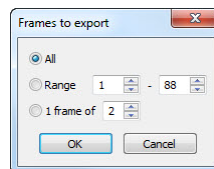
Figure 100 – Frames to export dialog

7.8 Adding and removing images of series

Sometimes it is necessary to remove non-relevant images from a series or append some images to a series, or add a screenshot or a copy of the working area as a separate image. You can use the functionality of thumbnails palette in TomoCon to perform these tasks.

To insert screenshot of working area (screenshot will be added as a DICOM image):

1. Select requested working area (click to any view in this working area).

2. Move mouse cursor over the images, belonging to target series, to which you want to add screenshot.

3. Press right mouse button, in the context menu (see Figure 101) select **Insert image/Insert working area screenshot** item. Image from the current view will be automatically inserted to the end of the target series.

To insert screenshot of the current view:

1. Prepare image for screen shot in the current view.

2. Move mouse cursor over the thumbnail previews of images from series, which is dedicated to insert new image.

3. Press right mouse button to display context menu (see Figure 101) and select **Insert image/Insert view screenshot** item. Screenshot of the current view will be automatically inserted to the end of this series.

To insert selected image from the current view:

1. Select the image to insert to the current view.

2. Move mouse cursor over the thumbnail previews of images from series, which is dedicated to insert new image.

3. Press right mouse button to display context menu (see Figure 101) and select **Insert image/Insert image copy** item. Image from the current view will be automatically inserted to the end of this series.

To delete selected image from series:

1. Move the mouse cursor over the thumbnail preview of an image, which should be deleted. If you want to delete a group of images from the same series, press the right mouse button on the first image, move to last image and release the mouse button. The images for deletion will be marked with blue color.

2. Press right mouse button to display context menu (see Figure 101) and select **Delete image** item. Image will be automatically deleted from series.

Show series	▶	
Show images	▶	
Sort images by	▶	
Insert image	▶	Insert working area screenshot
Delete image		Insert view screenshot
		Insert image copy
Close study		
Add note		
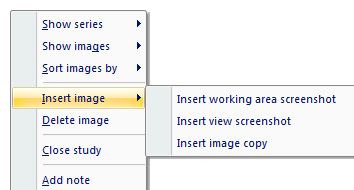
Figure 101 – Context menu of thumbnails palette

8 Hanging protocols

If you frequently work with same kind of data series of particular patients, TomoCon offers you the possibility of display images from these series by your entered rules. Such group of rules defines a hanging protocol, which can be saved in application for later usage. You can later view or edit all stored hanging protocols or define new ones with the Hanging protocol manager (**Hanging protocol manager** dialog, see Figure 102). To display **Hanging protocol manager** dialog click on the **Hanging protocol manager…** item in the **Layout** menu.

You can manually apply the defined and stored hanging protocols on already loaded studies in TomoCon or you can turn on their automatic usage according to the first loaded studies.
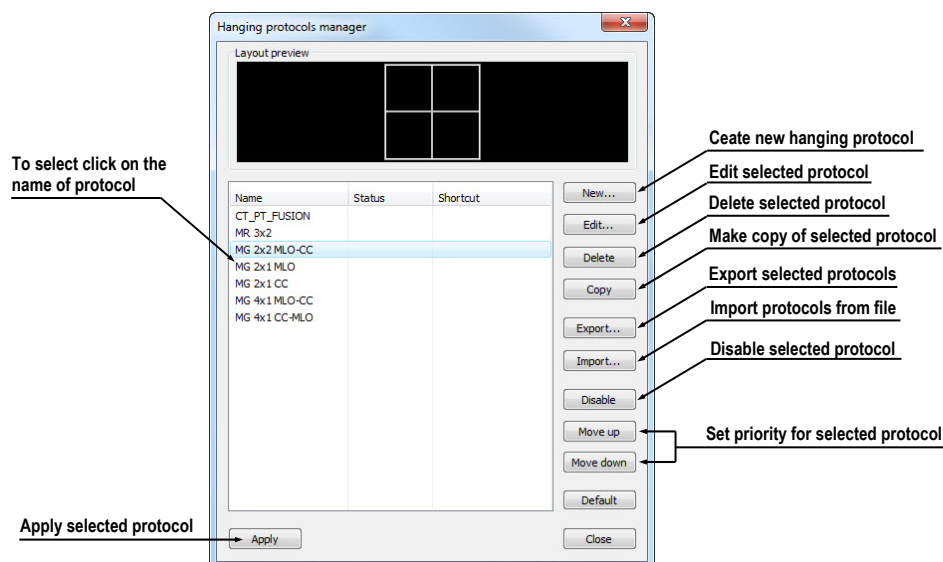
Figure 102 – Hanging protocol manager dialog

8.1 Apply hanging protocol

TomoCon application offers you the possibility of manually or automatically applying selected hanging protocol to current working area.

For automatic applying of hanging protocol check at least one of the following items in the **Layout** menu:

- **Automatically apply/Auto-apply hanging protocol -** selection of protocol is done by priority. Application checks all protocols step by step beginning from highest priority and applies first protocol, whose criteria are conforming to already opened study.

- **Automatically apply/Apply last used hanging protocol -** when you open the first study in application, the most recently used protocol will be automatically applied to this particular study.

For manual application of hanging protocol (see Figure 103):

1. Click on the ⬛ **HP** icon on the main toolbar.

2. In the displayed window click with left mouse button on requested hanging protocol, which will be subsequently applied.
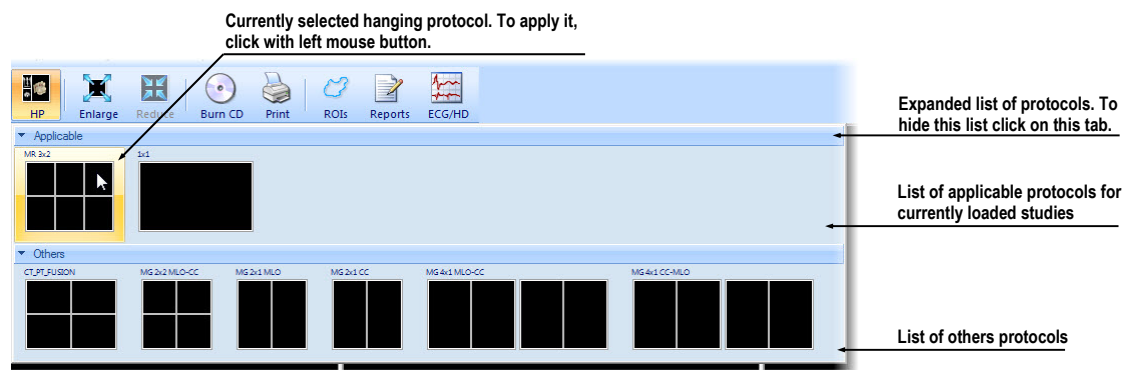
Figure 103 – Hanging protocols list

8.2 *Importing and exporting of hanging protocols*

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

To export hanging protocols:

1. Select required protocols for export in displayed list (for multiple selections hold the **Ctrl** key).

2. Press **Export…** button and enter the name of protocol in dialog, which will be opened.

To import hanging protocols:

1. Press **Import…** button and select requested file.

2. Imported hanging protocols will be automatically added to list of all protocols. If some of the imported protocols already exist, you can leave it or overwrite it.

8.3   *Creating and modifying hanging protocol*

Hanging protocol manager dialog allows you to define new protocol or edit already existing protocols (to display **Hanging protocol manager** dialog, click on the **Hanging protocol manager…** item in **Layout** menu).

The main part of each protocol is layout of working area (to define layout see 3.1.1 Working area layout). When you apply selected protocol to opened study, current application layout will be automatically replaced by this layout and consequently all properties of the protocol will be applied to particular parts of working area.

To define new hanging protocol:

1.   Press **New…** button and select the layout of working area in displayed list.

2.   In **Hanging protocol properties** dialog, which will be displayed, define particular properties of new protocol and press **OK** button to finish.

To modify properties of hanging protocol:

1.   In the list of all protocols, click on the hanging protocol to be changed and click on the **Edit…** button.

2.   In **Hanging protocol properties** dialog, which will be displayed, change requested properties and press **OK** button to confirm the changes.

8.3.1   Hanging protocol properties dialog

In this dialog (see Figure 104) you can attach some criteria and properties to selected hanging protocol.
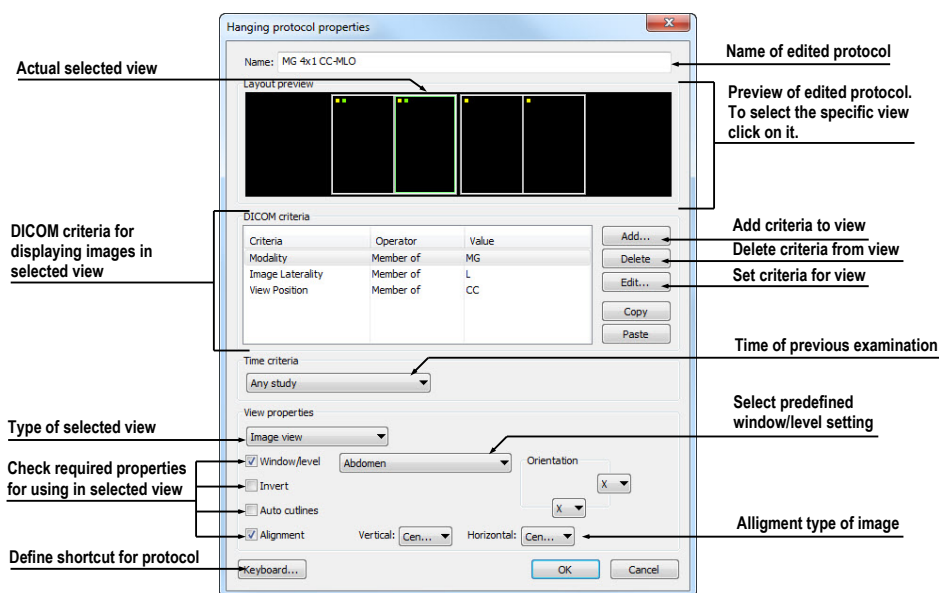
Figure 104 – Hanging protocol properties dialog

These criteria and properties are related to particular view from layout of this protocol and they can be different for each view. Therefore you have to first select the view in **Layout preview** window, before you define these criteria and properties.

Assigning hang criteria

The hang criteria determine, which images can be displayed in particular view. They can be formulated using DICOM tags (list **DICOM Criteria**) or specifying the time order (**Time Criteria**).

To add/edit DICOM criteria, click on the **Add…/Set…** button and define properties of criteria in **Hanging protocol selector** dialog, which will be displayed (see Figure 105).
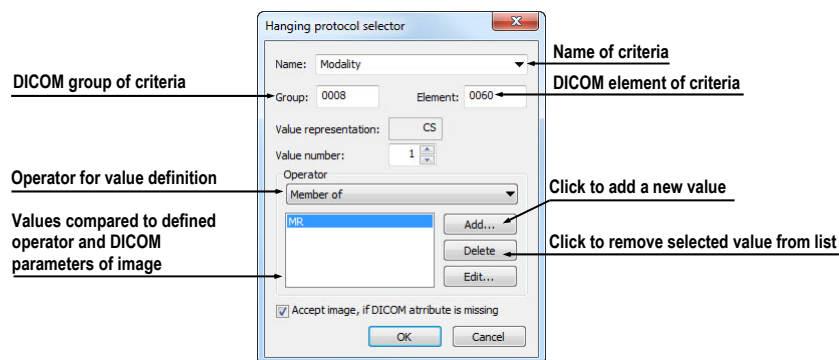
Figure 105 – Hanging protocol selector dialog

To remove criteria, select particular DICOM criteria in list by left mouse click and press **Delete** button.

To define time order criteria, select time constraint from displayed list. If there is a time constraint defined in a view, all images which should be displayed in this view, have to meet the time constraint.

Assigning view properties

These properties will be applied to the images displayed in particular view. To apply selected properties, check particular named properties in dialog and eventually set their parameters (see Figure 104). You can set following properties:

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

8.3.2   Identification of criteria and properties

When you assign hang criteria and properties to particular views, small colored squares will appear in corresponding views (in their upper left corner) in **Hanging protocol properties** dialog in **Layout preview** window (see Figure 106), describing its properties. The colors signify:

- yellow - view has defined DICOM criteria
- red - view has defined time criteria
- green - view has defined some properties
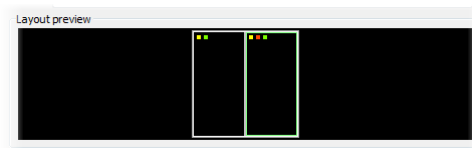
Figure 106 – Color identification of criteria and properties

9 Annotations and measurements

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

- **Text -** detailed information on text description (see 9.1 Text annotations)

- **Marker -** text description with a marker pointing to the point described (see 9.2 Marker annotations)

- **Distance -** distance between two points (see 9.3 Distance)

- **Distances and angle** (see 9.4 Distances and angle)

- **Cobb angle -** angle between two independent lines (see 9.11 Cobb angle)

- **Probe -** tracking circle tool to display point level values in the specified round area (see 9.5 Probe)

- **Density spot -** desired point level values (see 9.6 Density spot)

- **Density profile -** characteristics of all image points between two points (see 9.7 Density profile)

- **Ellipse** - characteristics of all image points included in the elliptical area (see 9.8 Ellipse)

- **Rectangle** - characteristics of all image points included in the rectangular area (see 9.9 Rectangle)

- **Area** - characteristics of all image points covered by a free area (see 9.10 Free area)

All annotations and measurements can be found in the **Annotations** menu (see Figure 107). It is also possible to activate them in the tools panel (the the third tab with icon).

After using an annotation and measurement tool, it is possible to set up its properties through the annotations and measurements context menu (see Figure 107). It will be appeared when moving the cursor over the tool (it will be highlighted and cursor will be changed from an arrow to a cross) and pressing the mouse context button. The following actions are available:

- **Font** settings and **Color** settings

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

- **Edit label**, **Delete** a tool and **Locked** a tool in the image against moving, deleting or above mentioned actions
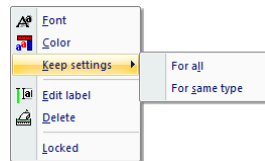
Figure 107 – Annotations and measurements context menu

When using a tool defining an area (Ellipse, Rectangle, Free area), the **Show text** option is added (see Figure 108), which allows to show or to hide **Size** of the outlined area, **Min value**, **Max value**, **Mean value** and **Deviation**.
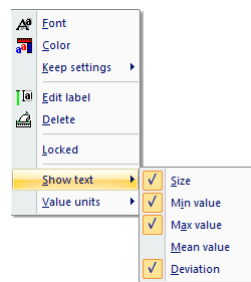
Figure 108 – Context menu for ellipse, rectangle and free area

In case of using Density profile, the **Show/Hide graph** option is added (see 9.7 Density profile).

If the image selected in the current view contains DICOM information of the measurements value units, **Value units** item will be added to the context menu of selected measurement to change actual value unit.

To move the annotation and the measuring tool to a different position within the view, move the mouse cursor over the annotation and the measuring tool until its highlighted (the cursor will change from an arrow to a cross). Hold the left mouse button and release when desired. The annotation text will be moved together with the tool. In addition, if selected measurement type is Density spot, Density profile, Rectangle, Ellipse or Density area and the image within the current view will be changed while the left mouse button is pressed, selected measurement tool will be moved to the new image.

When moving angle and distance measuring tool, it is also possible to move only one point at the end of the measuring line. When moving the mouse cursor over the chosen end point, this will change into a red circle (see Figure 112). Press the left mouse button and move the point to a different place within the current view.

After replacing the annotation and the measurement tool or its point the displayed values will be recalculated immediately.

With each annotation you can use an edit box to write necessary notes about the annotations and measurements. When moving across the edit box with mouse cursor, it will be highlighted with rectangle in the same color as the annotation connected with it. The mouse cursor will change its shape from an arrow to a cross. Hold the left mouse button and relocate the edit box in position with the annotation. When moving the whole annotation the edit box will move with the annotation in the changed position.

TomoCon calculates the real point distances or area automatically for patient images with transformation automatically (see 3.7.1 Image Transformation). Images with no transformation (see 3.7.2 No Transformation) rarely contain sufficient information in the patient study data needed for these calculations. The calculations are therefore given in pixels. In this case you can convert pixel units to length units (mm) or area units (cm^2) manually using the calibration tool (see 9.12 Calibration).

9.1 Text annotations

Short text descriptions can be written directly inside the image, near the important structure or object using the **Text annotation**. **Text annotation** mode can be initiated by clicking on the ▸ᴀ **Text** item in the **Annotations** menu or by clicking on the **Text** button in the **Annotations** tooltab of the tools panel (see Figure 109).
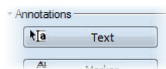

Figure 109 – Annotations tooltab

Click at the point in the image, which should be annotated. Small white text line editing box will be opened (see Figure 110). Type in the description text and press **Enter**.

Figure 110 – Image with Text annotations

9.2 Marker annotations

Short text descriptions pointing at the important structure or object can be written directly inside the image using the **Marker annotation** mode. It can be initiated by clicking on the ✐ **Marker** item in the **Annotations** menu or by clicking on the **Marker** button in the **Annotations** tooltab of the tools panel (see Figure 111).
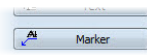
Figure 111 – Annotations tooltab

Click at the point in the image, which should be annotated. Drag a thin line to the place, where the annotation text should be placed. Click the mouse button, a small white text line editing box will be opened. Type in the description text and press Enter (see Figure 112).
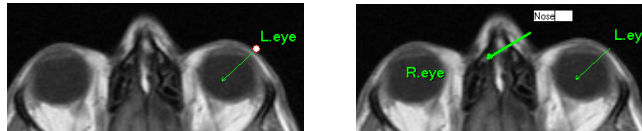
Figure 112 – Image with Marker annotations

9.3 Distance

Distance measurement can be used after clicking on the ▭ **Distance** item in the **Annotations** menu or by clicking on the **Distance** button in the **Measurements** tooltab of the tools panel (see Figure 113).
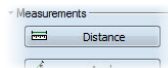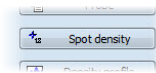

Figure 113 – Measurements tooltab

Click at the first and at the second point, while dragging the measurement line. The distance between these two points is displayed near the second point (see Figure 114).
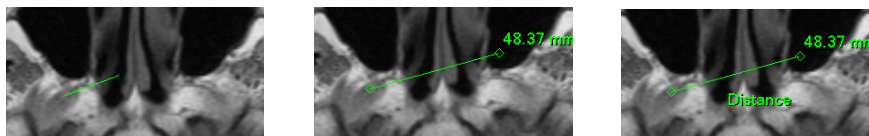
Figure 114 – Distance between 2 points

9.4 Distances and angle

Distances and angle measurement can be used after clicking on the ◿ **Distances and angle** item in the **Annotations** menu or by clicking on the **Angle** button in the **Measurements** tooltab of the tools panel (see Figure 115).
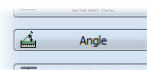
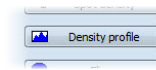**Figure 115 – Measurements tooltab**
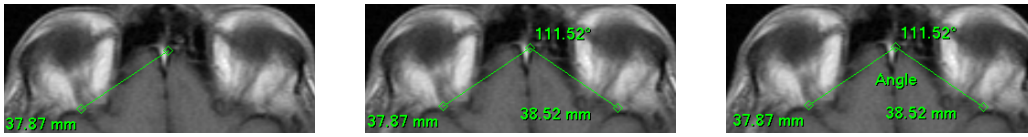
Figure 116 – Distances and angle between 3 points

Using this measurement is similar to using Distance measurement, except the additional third point has to be defined. Both distances and an angle between distance-lines are displayed (see Figure 116).

9.5 Probe

Probe is a special circle measurement tool for tracking actual pixel value at specified place in the selected view. This measurement can be used after clicking on the ⊕ **Probe** item in the **Annotations** menu or by clicking on the **Probe** button in the **Measurements** tooltab of the tools panel (see Figure 117).
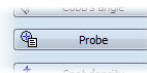
Figure 117 – Measurements tooltab

Press left mouse button at the desired point and move measurement through image within selected view and Probe will display current minimal pixel value, maximal pixel value and mean value from pixels, which are lying within probe's circle at actual place (see Figure 118). To stop to display these values release left mouse button and Probe measurement will be hidden. In addition, if selected image within the view will be changed while left mouse button is pressed, Probe will be displayed actual pixel values on new selected image.

To change circle size of this measurement press **Shift** key with pressed left mouse button on arbitrary place within selected view and move mouse. The size of Probe measurement will be changed according to actual movement of mouse. To stop change the size, release left mouse button or **Shift** key and new specified size will be remembered.
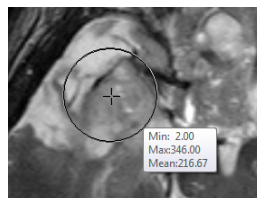
Figure 118 – Probe measurement

9.6 Density spot

Density spot measurement can be used after clicking on the ✛ᵢₛ **Density spot** item in the **Annotations** menu or by clicking on the **Spot density** button in the **Measurements** tooltab of the tools panel (see Figure 119).
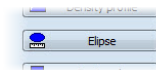

Figure 119 – Measurements tooltab

Click at the desired point. The value in the image point is displayed near the defined point (see Figure 120).
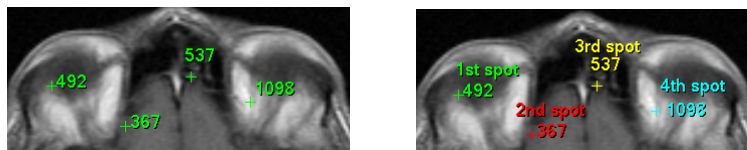
Figure 120 – Density spot at various points

9.7 Density profile

Line Density profile can be measured after clicking on the 🔺 **Density profile** item in the **Annotations** menu or by clicking on the **Density profile** button in the **Measurements** tooltab of the tools panel (see Figure 121).

Figure 121 – Measurements tooltab

Click at the first point with the left mouse button, hold it and drag a measurement line, until the mouse button is released. Characteristics of all image points covered by the line are summarized and displayed as a tool tip (see Figure 122).
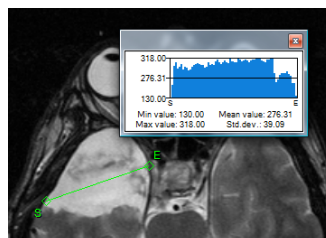
**Figure 122 – Density profile over a line between 2 points**

In open studies there can be more measurement lines created in the images. Their Density profiles can be temporarily hidden by clicking on the 🔳 button at the right top of the graph. After clicking at the measurement line with context mouse button,

the Density profile will reappear by choosing the **Show/Hide graph** option (see Figure 123).
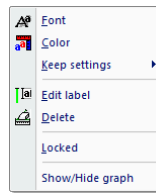
Figure 123 – Density profile's context menu

9.8 Ellipse

Ellipse drawing will be activated by clicking on the 🔵 **Ellipse** item in the **Annotations** menu or by clicking on the **Ellipse** button in the **Measurements** tooltab of the tools panel (see Figure 124).
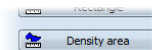

Figure 124 – Measurements tooltab

Click at any point with the left mouse button, move the mouse to desired position and click again to define second point of the ellipse. Characteristics of all image points covered by the elliptical area are summarized and displayed above the ellipse (see Figure 125).
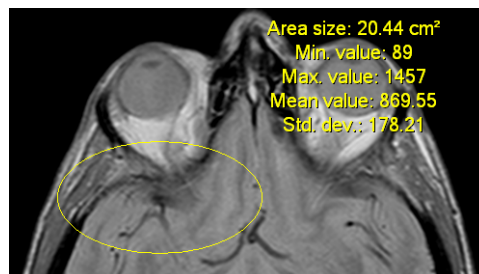
Figure 125 – Elliptical area profile

You can move the ellipse to any place inside the image simply by grabbing it with mouse or resize it by grabbing its corners. The displayed values will be recalculated.

9.9 Rectangle

Rectangle drawing will be activated by clicking on the 🔵 **Rectangle** item in the **Annotations** menu or by clicking on the **Rectangle** button in the **Measurements** tooltab of the tools panel (see Figure 126).
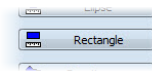
Figure 126 – Measurements tooltab

Click at any point with the left mouse button, move the mouse to desired position and click again to define second point of the rectangle. Characteristics of all image points, covered by the rectangular area, are summarized and displayed above the rectangle (see Figure 127).
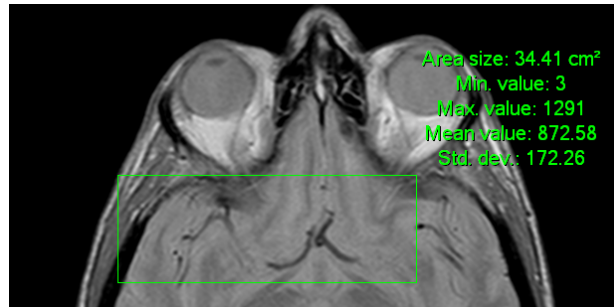
Figure 127 – Rectangular area profile

You can move the rectangle to any place inside the image simply by grabbing it with mouse or resize it by grabbing its corners. The displayed values will be recalculated.

9.10 Free area

Free **Area** drawing will be activated by clicking on the 🐌 **Area** item in the **Annotation** menu or by clicking on the **Density area** button in the **Measurements** tooltab of the tools panel (see Figure 128).

Figure 128 – Measurements tooltab

Outline an area dragging the 🖊 cursor with the left mouse button pressed. Characteristics of all image points covered by the free area are summarized and displayed next to the free area (see Figure 129).
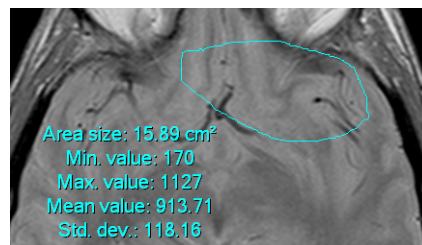
Figure 129 – Free Area

Press the 📏 **Area** icon, hold the **Ctrl** key and with the left mouse button pressed add an extra area (the mouse cursor will have ✏ form) to the already existing area. Press the icon again, hold Shift key and with the left mouse button pressed subtract a part of the area (the cursor will have ✏ form).

You can move the area to any place inside the image by grabbing it with mouse. The displayed values will be recalculated.

9.11 Cobb angle

Cobb angle measurement can be used after clicking on the ⌄ **Cobb's angle** item in the **Annotations** menu or by clicking on the **Cobb's angle** button in the **Measurements** tooltab of the tools panel (see Figure 130). It measures angle between two independent lines.
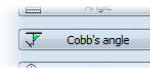
Figure 130 – Measurements tooltab

Click at the first and at the second point of first line and then at the first and second point of second line. Smaller angle between these defined lines will be displayed near the end of one of them (see Figure 131).
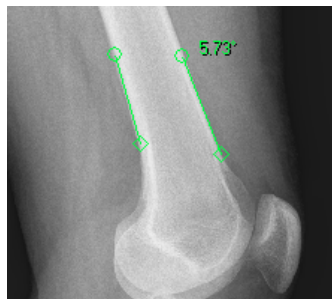

Figure 131 – Cobb's angle

9.12 Calibration

In images with no transformation, where pixel size is unknown, calibration can be used to calculate approximate distance between two points.

Select **Calibration** item (see Figure 132) in the **Annotations** context menu to activate calibration. The context menu will be displayed when pressing mouse context button at the Distance measurement.

Two options are available:

- **Calibrate measurement -** open the **Calibration** dialog to define the calibration (see Figure 132).

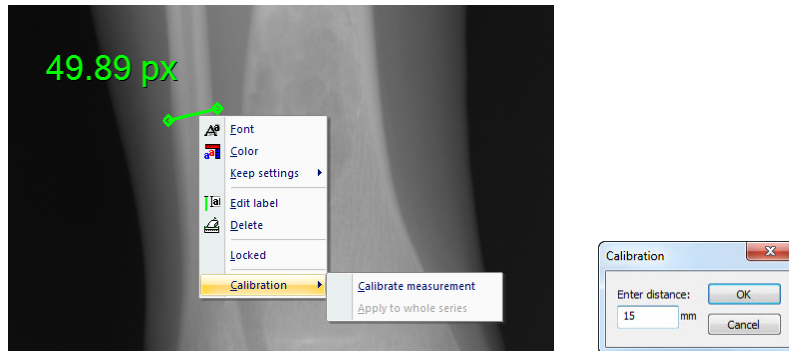- **Apply to whole series -** apply the defined calibration to the series.

Figure 132 – Calibration context menu and Calibration dialog

The **Calibration** dialog allows you to define the calibration by entering the chosen line length in millimeters in the **Enter distance** box. After pressing the **OK** button, all measured distances and areas in the image will be calculated according to the defined calibration.

The calibration of already calibrated images with no transformation can be changed again using the **Calibration** dialog. A dialog will be open informing that the image is already calibrated (see Figure 133).
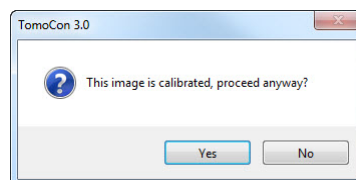
Figure 133 – Calibration dialog; This image is calibrated, proceed anyway?

If you want to change the calibration in the series with already calibrated images, use the **Apply to whole series** option. If any other image in the series is already calibrated, a warning dialog will be opened (see Figure 134).
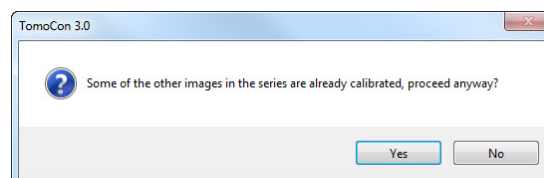

Figure 134 – Some of the other images in the series are already calibrated, proceed anyway?

NOTE! Calibration can not be used for images containing the transformation.

9.13 Hide / show annotations

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

Figure 135 – Hide all button

9.14 Discard annotations

A single annotation can be deleted by clicking at it with the context mouse button and selecting the **Delete** entry in the opened **Annotations** context menu. You can also select the **Annotations…** item in the **Annotations** menu (see 9.15 List of annotations).

To discard all defined annotations, defined in all opened patient studies, click on the **Clear all annotations** icon in the **Annotations** menu.

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

- **Clear all in image** icon

- **Clear all in series** icon

- **Clear all in study** icon

9.15 List of annotations

Click on the **Annotations…** item in the **Annotations** menu or click on the **Annotations…** button (see Figure 136) in the third tab (tab with icon) of the tools panel to open a dialog with the list of all annotations defined in the opened studies (see Figure 137).
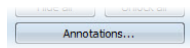

Figure 136 – Annotations… button

The list contains a type, location (series/image) and description of the annotations.

After selecting one of the annotations and pressing the **Go to annotation** button, the image with the selected annotation will be displayed in the current view.

By pressing **Delete** button the selected annotation will be deleted both from the list and the image.
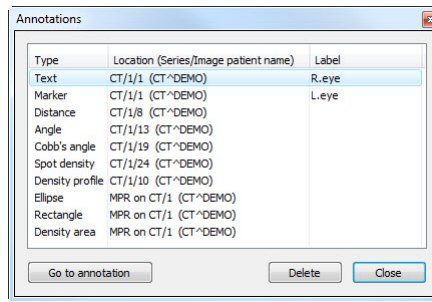
Figure 137 – Annotations dialog

10 Contouring the patient – create ROIs

Patient contouring is used with two-dimensional (2D) display for better description and better recognition of patient anatomical structures by their colored outlining in the image (see Figure 138). When creating contours on multiple images a ROI (Region of Interest) will be automatically created, which can be later displayed in space in three-dimensional (3D) patient presentation. Volume of each ROI (in cm^3) is calculated automatically.

NOTE! Calculated volume of ROI is depending on actual setting of resolution for specific ROI (see 10.6 Edit ROI properties).
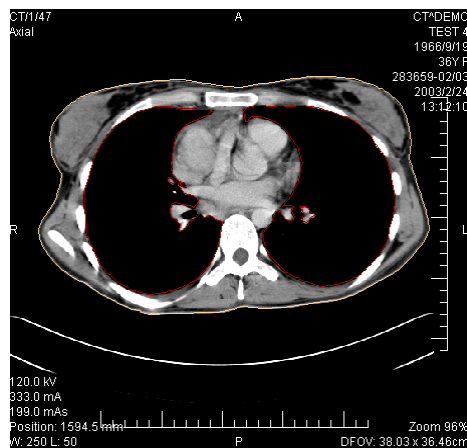

Figure 138 – Defined contour

Contours and ROIs can be defined using the **ROI properties** dialog (see Figure 139). It can be opened by clicking on the **ROIs…** item submenu in the **Tools** menu.
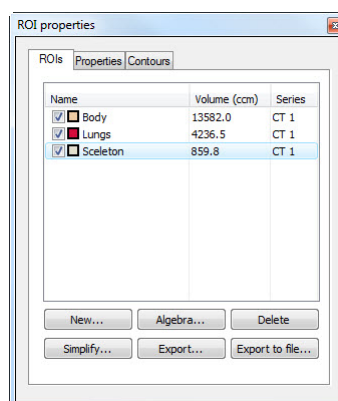

Figure 139 – ROI properties dialog, ROIs tab

The **ROI properties** dialog allows to:

- Define new ROI **-** the **ROIs** tab, the **New…** button (see 10.1 Adding new ROI).

- Realize based algebraic operations between two selected ROIs - the **ROIs** tab, the **Algebra…** button (see 10.2 ROI algebra).

- Delete the specified ROI from the ROIs list - the **ROIs** tab, the **Delete** button.

- Simplify selected ROI - the **ROIs** tab, the **Simplify...** button (see 10.3 Simplify ROI).

- Copy ROI between any two registered series - the **ROIs** tab, the **Export** button (see 10.4 Copying ROIs).

- Export selected ROI into a file - **ROIs** tab, the **Export to file…** button (see 10.5 Export ROI to DXF or VTK file).

- Define chosen ROI properties - the **Properties** tab (see 10.6 Edit ROI properties).

- Define contour - the **Contours** tab (see 10.7 Edit contours).

10.1 Adding new ROI

Add a new ROI to the list of ROIs by clicking on the **New…** button in the **ROIs** tab , the **ROI properties** (see Figure 139). If the current view is empty, the **New ROI** dialog will be opened with the list of series (see Figure 140).
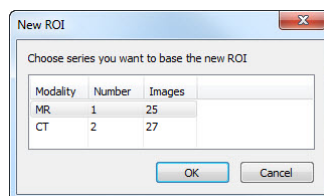

Figure 140 – New Region of Interest dialog

A new line will be added to the list of existing ROIs with name "New ROI …" (continuing sequentially within the same series) and some random color

.

The volume calculation will not be possible until the ROI is defined in at least one image. Each ROI's volume (in cubic cm) is shown behind its name.

The check box at the left side of each ROI's name specifies whether the ROI will be displayed in all views.

10.2 ROI algebra

If you have two ROIs defined in same series, you can make basic algebraic operations like Union, Intersection or Subtraction between them by ROI algebra dialog. Result of specified algebraic operations you can save to the new ROI or save to the ROI, which have been selected as first ROI for this operation.

To specify ROI algebra parameters in **ROI algebra** dialog (see Figure 141), click on the **Algebra...** button in the **ROIs** tab of the **ROI properties** dialog (see Figure 139).
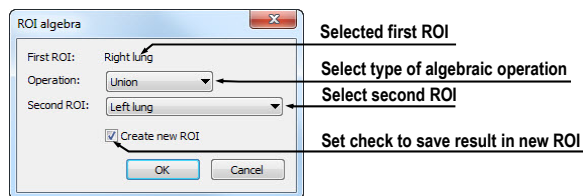

Figure 141 – ROI algebra dialog

After specifying the parameters, select the **OK** button to start calculation of the specified operation (current progress of calculation will be displayed in bottom part of the **ROI properties** dialog (see Figure 142)), or select **Cancel** button to close this dialog.
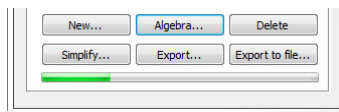

Figure 142 – Progress of the algebra computation

10.3 Simplify ROI

You may want to simplify all contours of one selected ROI in **ROI properties** dialog by selected criteria. You can do so using the **Simplify ROI** dialog (see Figure 143), which allows you to select one type of the following simplification possibilities:

- **Remove holes** - each hole will be removed from all contours of ROI.
- **Single polygon** - only one polygon will be leaved and each hole will be removed from each image.
- **Reduce number of vertices** - all polygons of each contour will be reduced to reach value bellow the entered number of vertices.

To display **Simplify ROI** dialog you have to click on the **Simplify...** button in the **ROIs** tab of the **ROI properties** dialog (see Figure 139).
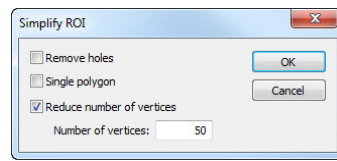
Figure 143 – Simplify ROI dialog

When you have selected the simplification method, select the **OK** button to start automatic simplification (actual progress of computation will be displayed in bottom part of **ROI properties** dialog (see Figure 142), or select **Cancel** button to close this dialog.

10.4 Copying ROIs

ROIs can be copied between any two registered series (see 16 Registrations). This can visually highlight objects, which are better viewable in another series.

You can do this with **Export ROI** dialog, which will be displayed, when you select the source ROI in the **ROIs tab** and click on the **Export...** button. In this dialog you can specify the target series for the ROI export. When you have selected the target series, select the **OK** button to create new ROI or select **Cancel** button to close this dialog.
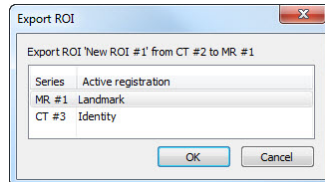

Figure 144 – Export ROI dialog

10.5 Export ROI to DXF or VTK file

It is possible to export selected ROI into AutoCAD DXF file or VTK file.
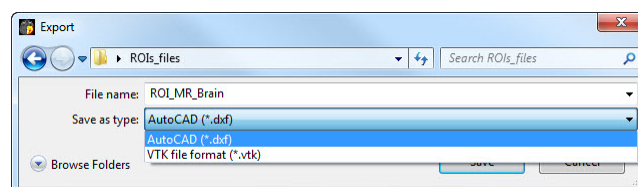

Figure 145 – Export dialog

To export ROI select defined ROI in the **ROIs** tab and click on the **Export to file...** button. In the next step, select desired file format, file name and target folder in the **Export** dialog (see Figure 145), which will be opened.

10.6 Edit ROI properties

Select ROI from the **ROIs**, the **ROI properties** dialog. ROI properties can be changed in the **Properties** tab in the **ROI properties** dialog (see Figure 146).
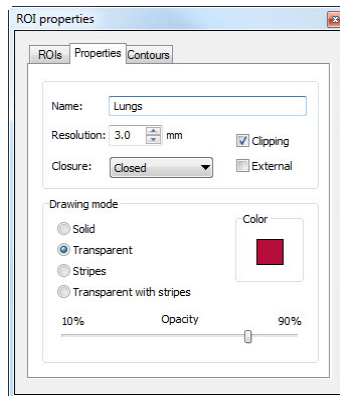

Figure 146 – ROI properties dialog, Properties tab

The **Properties** tab contains following options:

- **Name -** changes ROI's name.

- **Resolution** - specifies the fineness or coarseness of the contours defining ROIs. The finer the resolution, the smaller details can be contoured, but the graphical performance might decrease on large, complex contours. On the contrary, the coarser the resolution, the better graphical performance. Large contours (like head, body) will be better smoothed, with less jagged edges on image borders, but very small details or objects might partially disappear. The ROI object is not recalculated immediately. It is necessary to end work in the **Properties** tab to start the process. The calculation will be finished by choosing another tab;

- **Closure** - selects whether the ROI is displayed in 3D view:
  - **Open** (open from the top and the bottom)
  - **Closed** (from the top and the bottom)
  - **Top open**
  - **Bottom open**

- **Clipping** - specifies whether the part of ROI closer to the user will be cut off in 3D view by chosen MPR plane.

- **External** - specifies the chosen ROI as "Master" for clipping the MPR planes (see 15 Three-Dimensional Visualization). There can be only one "Master" ROI per series.

- **Drawing mode -** specifies the art of displaying the ROI in 3D view:

- o **Solid** - ROI will be displayed as an opaque object. Clicking at the ROI object surface delivers a new current point position.

- o **Transparent** - ROI will be displayed as a transparent object with selectable transparency ratio. **NOTE!** It is not possible to obtain a current point position by clicking at the transparent object surface! (Transparent objects are considered as not having a surface.) Surface position of the nearest solid object behind will be taken instead.

- o **Stripes** - ROI will be displayed as a set of contours (wire-frame model).

- o **Transparent with stripes** - ROI will be composed from transparent object and a set of contours.

- **Color** - ROI color settings.

- **Opacity** - describes transparent ROI's opacity. The higher percentage, the more opaque the ROI is.

10.7 Edit contours

ROI consist of separate contours, which can be manually edited or automatically created after switching to the **Contours** tab (see Figure 147), **ROI properties** dialog.
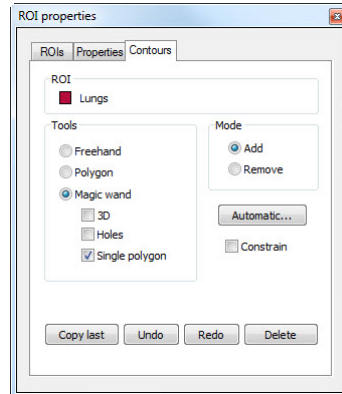

Figure 147 – ROI properties dialog, Contours tab

If you want automatically create ROI, you have to click on the **Automatic…** button and the dialog for automatic contouring will be displayed (see 10.8 Automatic contouring). For manual editing this dialog provides to you three main edits tools:

- **Freehand -** contour the area with free hand.

- **Polygon** - contour the area using a polygon.

- **Magic wand** - contour the area by joining adjacent image pixels with similar gray level values with following options:

- o **3D**, contour with selected gray level values in selected image will be applied to remaining images in the series.

- o **Holes**, image areas inside the region with different gray values will be contoured to mark holes in the final contoured area.

- o **Single polygon**, only one compact polygon from contoured region will be chosen as final contoured area.

In combination with two basic editing modes:

- **Add**

- **Remove**

there are 6 modes in creating contour available (indicated by cursor shape):

- **Freehand/Adding -** outline contour by dragging the cursor with left mouse button pressed. The first and the last line point will be connected to form a closed contour after you release the left mouse button. The area covered by the line will form a new contour or will join the existing contour.

- **Freehand/Removing -** remove a part of existing contour by dragging the cursor with left mouse button pressed around the area you want to remove. The overlapping areas will be removed.

- **Polygon/Adding -** outline contour point by point. The clicked points will be connected with straight lines. The polygon area will be closed after clicking to a position close to the first contour point (mouse cursor icon will get shape). The area covered by the polygon will form a new contour or will join the existing contour.

- **Polygon/Removing** - remove a part of existing contour. Outline the area point by point that should be removed. The overlapping areas will be removed.

- **Magic wand/Adding** - press the left mouse button inside the solid area (bone, tissue) and move the mouse (moving the mouse will modify the gray similarity factor), image pixels with similar gray level values as the clicked point will form a region. After you release the left mouse button, the region will be contoured. The contoured area will form a new contour or will join the existing one.

- **Magic wand/Removing** - press the left mouse button inside the solid area (bone, tissue) and moving the mouse (moving the mouse modify gray similarity factor), image pixels with similar gray level values as the clicked point will be removed.

In the Magic wand mode or in automatic mode of creating contours, you can specify boundary rectangle area for contouring, if you have checked option **Constrain**.

When editing contour, an infinite "undo buffer" is available. Press the **Undo** button (repeatedly) to revert the last steps. After reverting the steps with the **Undo** function, it is still possible to follow the changes by pressing the **Redo** button.

Press the **Delete** button to remove the contour from the current image.

To continue to another image, change the current image by clicking at a chosen thumbnail preview, press the **Prev** or **Next** button or scroll the mouse wheel.

It is possible to copy the contour from the previous or following image into the current image. Select an adjacent image, come back to the current one and pres the **Copy Last** button. The contour will be copied. This is useful if you draw contours sequentially in more images and the contours need only slight changes.

10.8 Automatic contouring

After pressing the **Automatic…** button in the **Contours** tab in the **ROI properties** dialog (see Figure 139) the **Threshold** dialog for automatic contouring will be opened (see Figure 148).
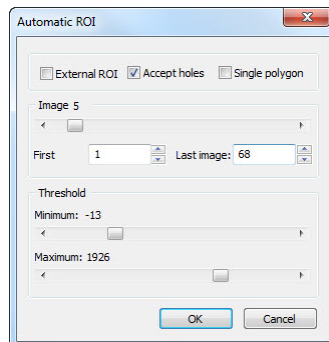

Figure 148 – Automatic contouring, Automatic ROI dialog

The following options are available in the **Threshold** dialog:

- **Image** slider - selects the range of images, which shall be used for automatic contour search, by selecting an appropriate **First image** and **Last image** values.

- **Threshold** sliders - select the **Minimum** and **Maximum** grayscale values for the search process. All grayscale values beginning within the selected threshold value range will be considered as matching. You can see this in the current view – matching regions are displayed red, the rest is black (see Figure 149).

- Type of automatic contouring:

- o **External ROI -** only one object in all images with maximal area according to setting of minimal threshold value is used.

- o **Accept holes** - looks for holes in each image according to setting of minimal and maximal threshold value.

- o **Single polygon** - only one polygon in each image without holes according to setting of minimal and maximal threshold value is used.
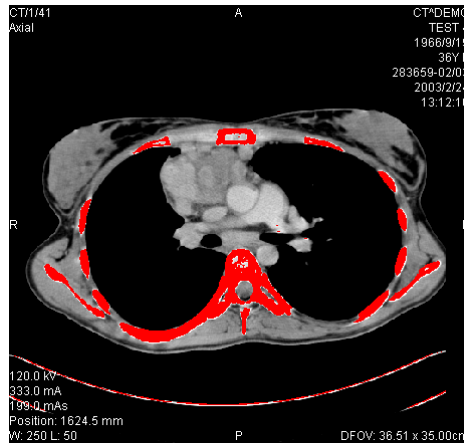

Figure 149 – Segmented image with threshold selection, contouring bones

It is recommended to check the whole image range by dragging the **Image** slider to see whether the currently selected **Threshold** setting delivers expected results and the inner parts of the surface are white. Press the **OK** button to start the automatic search process (see Figure 150).
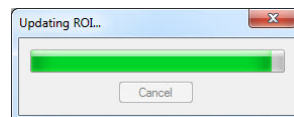

Figure 150 – ROI properties dialog, Automatic contouring

11   MPR - Multi Planar Reformatting

MPRs show sections in patient's body using the defined plane. They provide special way of looking at medical imaging data and give you additional insight during viewing. MPR allows you to view three-dimensional volume along a direction other than direction of the original images. You can start MPR simply and quickly on any suitable study you have selected in the current view by using the **MPR** tooltab in tools panel.

NOTE! Diagnosing users should be aware that MPR views display **calculated data**. Calculated data, although based on the original data set, may give the appearance of healthy tissues in situations, where pathology, which is smaller than the image distance, may be present. Occasionally, calculated data may also include image artifacts, which should not be interpreted as real pathology.

MPR tooltab (see Figure 151) is initially docked in the tools panel (the fourth tab). You can get to it at any time by clicking the tab with 🖊 icon. To start using this tooltab select image of series, which you would like to view with MPR, in requested view of working area. Then click by left mouse button on the requested type of MPR in this tooltab.
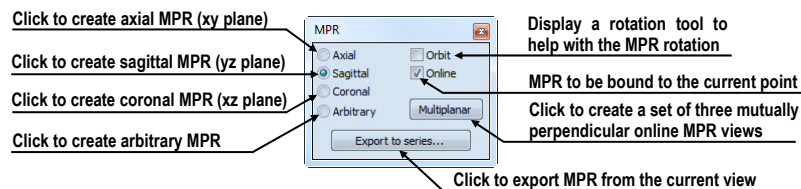

Figure 151 – MPR tooltab

For better spatial orientation, small box-like indicator in the upper right corner of the MPR view displays the approximate position and orientation of the MPR plane in patient image data. Additionally, plane position of each displayed MPR is indicated by a colored line (see 4.6 Color settings) in all views, which are intersected by this plane.

Figure 152 – Indicator of MPR plane position and orientation

11.1 Arbitrary MPR

MPR is not necessarily oriented parallel to main patient axes. It can be rotated into any orientation. This can be done by clicking on the ☼ **MPR rotate** icon (in the context menu or in the **Context** toolbar) and moving mouse with pressed left mouse button directly in the current view. Base MPR plane (axial, sagittal or coronal) will be change to **Arbitrary** plane in **MPR** tooltab.

To use the image rotation more comfortable, click on the **Orbit** checkbox. MPR view will be overlaid by set of blue circles that mark image areas with different rotation functionality. Check the mouse cursor when it hovers over these areas (⊕ , ⊕ , ⊕). It describes the rotation axis, which will be used if the left mouse button is used to rotate the plane.

11.2 Online MPR

The **Online** checkbox in the **MPR** tooltab defines the online MPR to be bound to the current point (see Figure 153). All online planes are automatically shifted to intersect the current point. If the current point is changed by clicking into one of the views, all online planes will be shifted immediately.
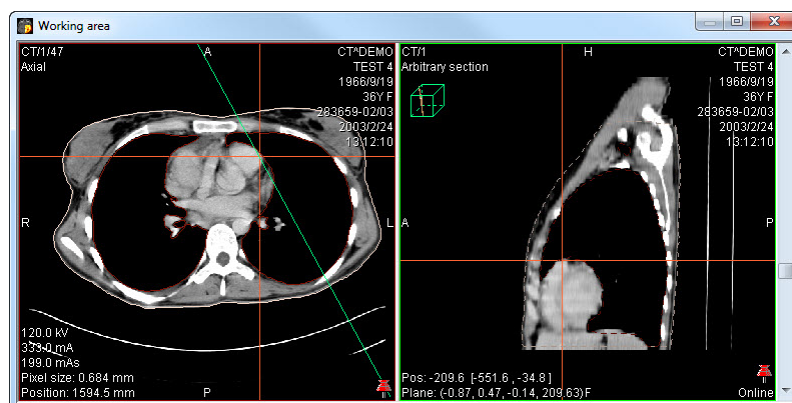

Figure 153 – Arbitrary MPR view and intersected axial MPR plane

11.3 Interactive moving and rotating

TomoCon application allows you to move and rotate MPR displayed in one view, from another view, by moving and rotating intersection lines. These lines are displayed automatically in all views, which planes are intersected with plane of this MPR. To move and rotate MPR (see Figure 154):

1. Display requested MPR in current view.

2. Select another view and display image or MPR in it, which intersects plane with MPR plane from step 1.

3. Intersection of planes will be displayed in current view.

4. If you move mouse cursor over this intersection line and press left mouse button, you can move plane of MPR in the first view (its frame is colored with blue color). To finish moving of plane, release mouse button.

5. If you move mouse cursor over circles on the intersection line and press left mouse button, you can rotate plane of MPR in first view (its frame is colured with blue color). To finish rotating of plane, release mouse button.
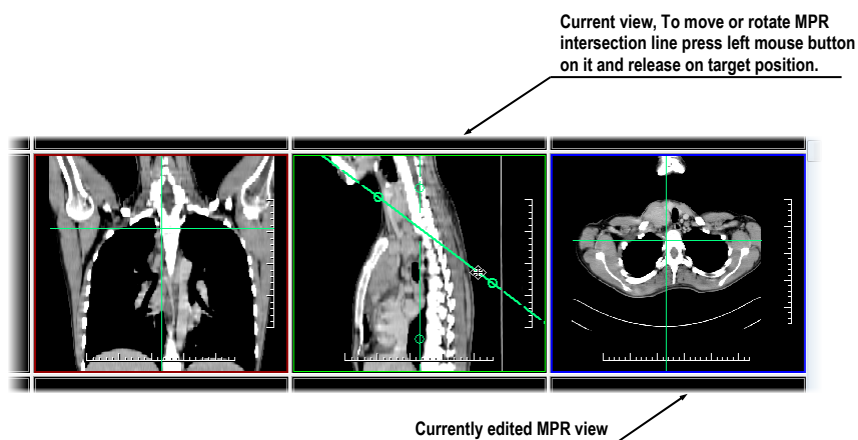

Figure 154 – Interactive moving of MPR

11.4 Export MPR to series

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

To export a MPR view to a study:

1. Display the requested MPR in the current view.

2. Click on the **Export to series…** button in the **MPR** tooltab.

3. The **Export to series** dialog will be displayed. In this dialog you can set the parameters for the MPR export (see Figure 155).

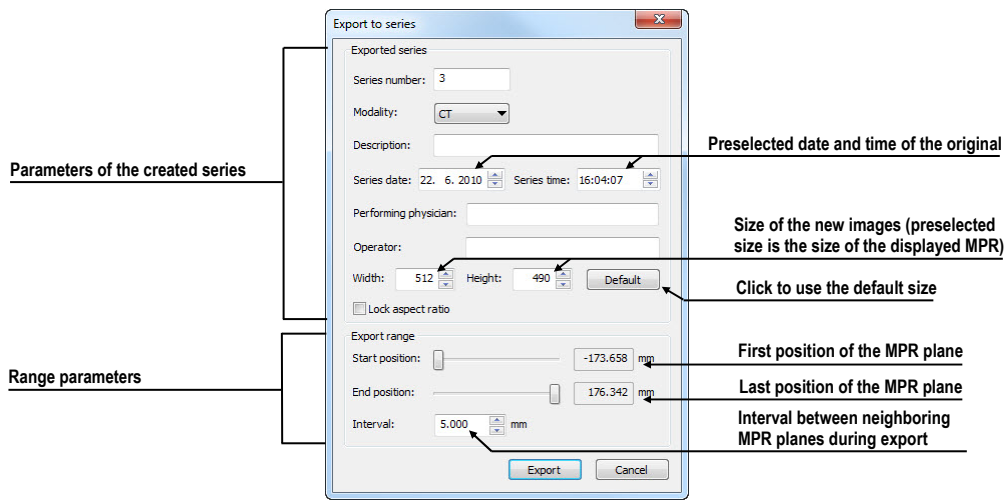4. After setting up the parameters, press the **OK** button.

Figure 155 – Export to series dialog

12   MIP - Maximum Intensity Projection

MIP is a spatial method for displaying patient data. This method displays a projection of maximum values from particular images to 3D space. It looks for maximum pixel values and displays these as is projected onto a plane. Result of this projection is a multiframe image with frames creating an impression of a MIP object rotating in front of you. Except the usual MIP visualization, calculated from maximum values, TomoCon allows you to create a visualization which calculated from minimum values, and called a MinIP.

You can create MIP visualization simply and quickly on any suitable study you have selected in the current view by using the **MIP** tooltab in tools panel.

By default, the **MIP** tooltab (see Figure 156) is docked in the tools panel in the fourth tab by default. You can get to it by clicking on the tab containing ![icon] icon.
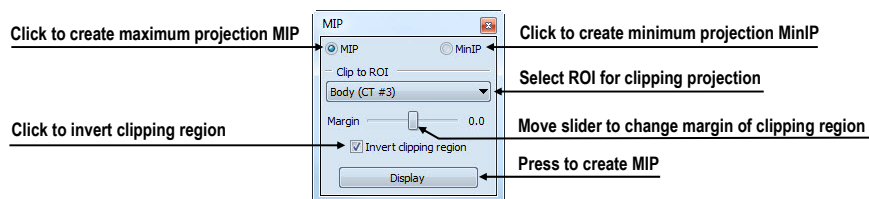

Figure 156 – MIP/MinIP dialog

To start using this tooltab, select image of series, which you would like to use for MIP visualization, in any view in working area. For the standard projection (MIP), select the **MIP** option, for a minimal projection (MinIP) select the **MinIP** option. To start the calculation process, press the **Apply** button. The calculated projection will be displayed in the current view immediately (see Figure 157).
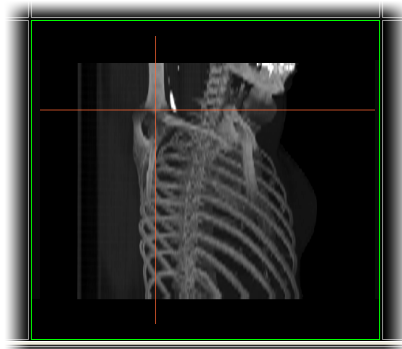

Figure 157 – MIP in the current view

13 DRR Reprojection

Digitally reconstructed radiograph (DRR) plays a more and more important role for clinical applications. It is a reprojection of a conventional 2D x-ray image, created from computed tomography data. TomoCon allows you to create DRR by summing CT intensities along a ray from each pixel (**View**) to simulated x-ray source (**Targed**).

To create **DRR** (Digitally Reconstructed Radiograph) reprojection from the patient image data use the **DRR** tooltab (see Figure 158), which is initially docked in the tools panel in the fourth tab. You can get in at any time by clicking on the tab with ✎ icon.
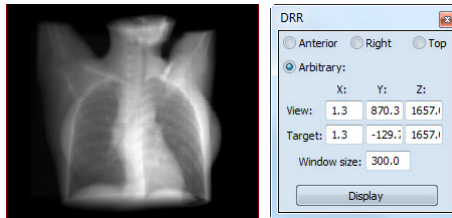

Figure 158 – DRR Reprojection image and tooltab

You can set following parameters for DRR reprojection in the **DRR** tooltab:

- **Viewport settings** - setting up the DDR position to the patient's position (**Anterior**, **Right**, **Top**, **Arbitrary** when DDR position using parameters **View** and **Target)**

- **Window size**

To start creating process of DRR reprojection, press the **Display** button.

14 Multi-modality fusion

Multi-modality fusion allows to display the data from two registered series combined or overlapped 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 the radiology. TomoCon supports multimodality fusion and provides users with the ability to identify structures in one imaging modality and then spatially locate the structures in the different modality (for example CT-PET, CT scans with contrast media and without it, MRI series taken with different parameters, scans before the treatment and after the treatment and others).

To create a fusion from a two-modality image series, use the **Fusion** tooltab in the tools panel. It provides controls for fusion settings like base series, fusions series, color palettes, translucency, fusion method, etc. **Fusion** tooltab (see Figure 159) is initially docked in tools panel in the fifth tab. You can get to it by clicking the tab with ![icon] icon.
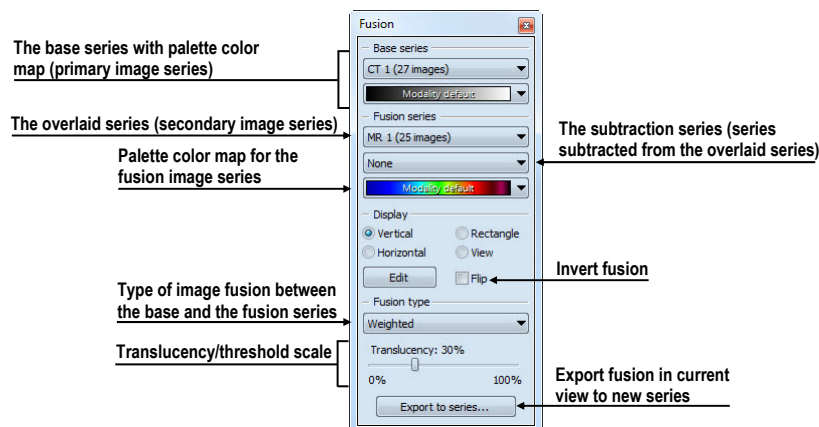

Figure 159 – Fusion tooltab

14.1 Create a multi-modality image fusion

To create a fusion from a two-modality image series, use the **Fusion** tooltab (see Figure 159):

1. Click on the **Base series** combo box to select the primary series.
2. Click on the **Base color map** to select the primary color map.
3. Click on the **Fusion series** combo box to select the secondary series.
4. Click on 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 be automatically set up according to the most recently used fusion.
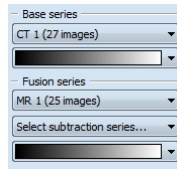

Figure 160 – Series and color maps selection

To add a subtraction series to a multi-modality fusion:

1. Click on the subtraction series combo box to select the subtraction series.

2. The color palette will be automatically changed to subtraction palette.

3. If you want to change the used subtraction palette, click on the fusion color map to select it.

4. To remove the used subtraction series from a fusion, select the **None** item in the **Select subtraction series…** combo box.
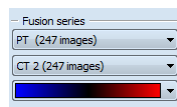

Figure 161 – Subtraction series and color map selection

To change the way how the fusion is displayed in the current view, click on the requested type in display part of fusion tooltab (see Figure 162). TomoCon provides following types of displaying:

- **Vertical** - the view is divided with a vertical line, image from the fusion series is on the right side (see Figure 163, right)

- **Horizontal** - the view is divided with a horizontal line, image from the fusion series is at the bottom

- **Rectangle -** the image from overlaying series is inside the rectangle (see Figure 163, left)

- **View -** the image from overlaying series is covering whole view

- **Edit -** after choosing this option (or double-clicking on the separation line or inside the rectangle) and holding the left mouse button, drag the rectangle, its frame or border to modify the border position, rectangle frame position and its size.
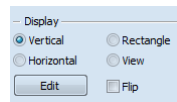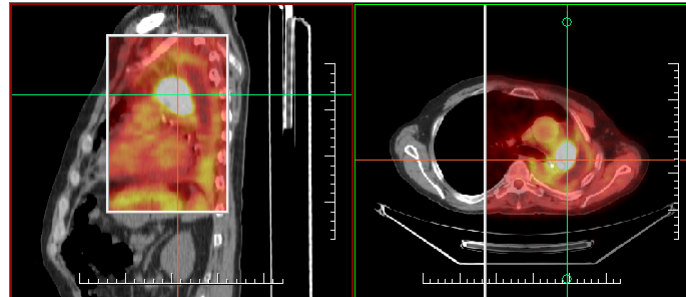
Figure 162 – Display part of Fusion tooltab

Figure 163 – Fusion images between MR and PET series

14.2 Fusion method

TomoCon provides following 5 ways of mixing the primary and secondary series in a multi-modality fusion. For each fusion method the series mixing scale can be changed using the fusion level (**Threshold/Translucency**).

- **Mask** – image data of the secondary series with pixel values above the defined *Threshold* will be displayed as *(primary + secondary color) / 2*.

- **Weighted** – the primary and secondary images are blended from full primary image (*Translucency = 0%*) to full secondary image (*Translucency = 100%*).

- **Merge** – calculated as *(primary + secondary color) / 2*.

- **Threshold** – image data of the secondary series with pixel values above the defined *Threshold* will be displayed in the defined color.

- **Contours** – provides an anatomic image with contours of data from the secondary series having the threshold value.

To change the fusion method type, click on the **Fusion type** combo box and select the method from the displayed list.
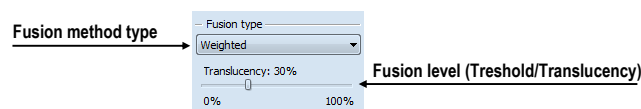

Figure 164 – Fusion type part of Fusion tooltab

14.3 Export a fusion to a series

TomoCon can save a fusion view as an additional series in a study. Also, it is possible to select the speciefied properties of exported new series by selecting parameters for the exported fusion in the **Export to series** dialog. Once saved, the created fusion series can be sent to PACS as new series or reopened for viewing.

To export a fusion view to a new series:

1. Display requested fusion in current view.

2. Click on the **Export to series…** button in the **Fusion** tooltab.

3. The **Export to series** dialog will be displayed, where you can set the parameters for the fusion export.

4. After setting up the parameters, press the **OK** button.
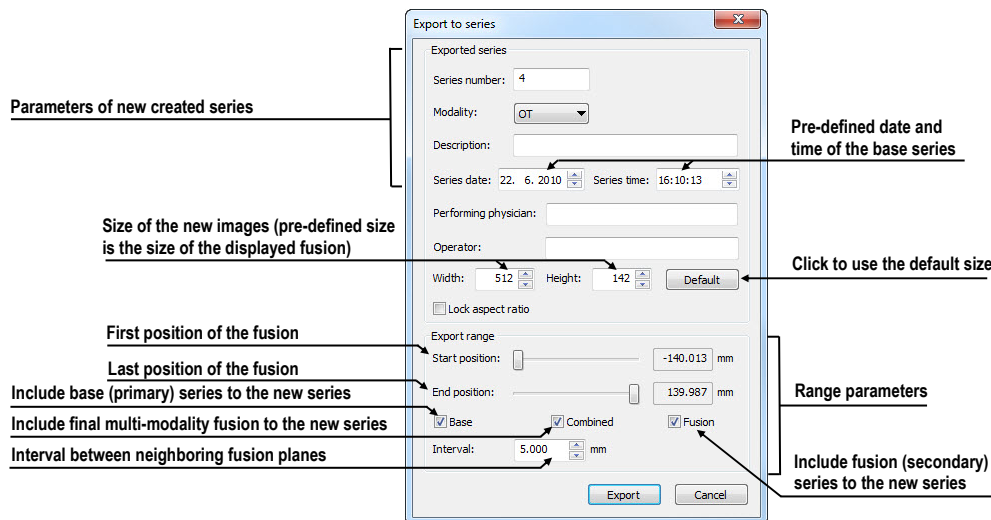
Figure 165 – Export to series dialog (parameters of the created series)

15 Three-Dimensional Visualization

A typical patient data is acquired as a set of two-dimensional (2D) images. Anyway, the data can be interpreted as a three-dimensional (3D) volume. TomoCom provides a possibility to view and navigate through 3D patient data as follows.

- Display interactive MPRs in 3D.

- Display ROI defined by segmentation in 3D (see 10 Contouring the patient – create ROIs).

- Use automatic volume rendering tool for 3D visualization of volume data (see 15.4 Volume rendering).

To define parameters of the 3D view use the **3D** tooltab (see Figure 166) in the **Tools** pane. It is initially docked in tools panel in the sixth tab. You can get to it at any time by clicking the tab with 🔲 icon or by clicking on the 🔲 **3D View** item in the **Tools** menu of TomoCon.
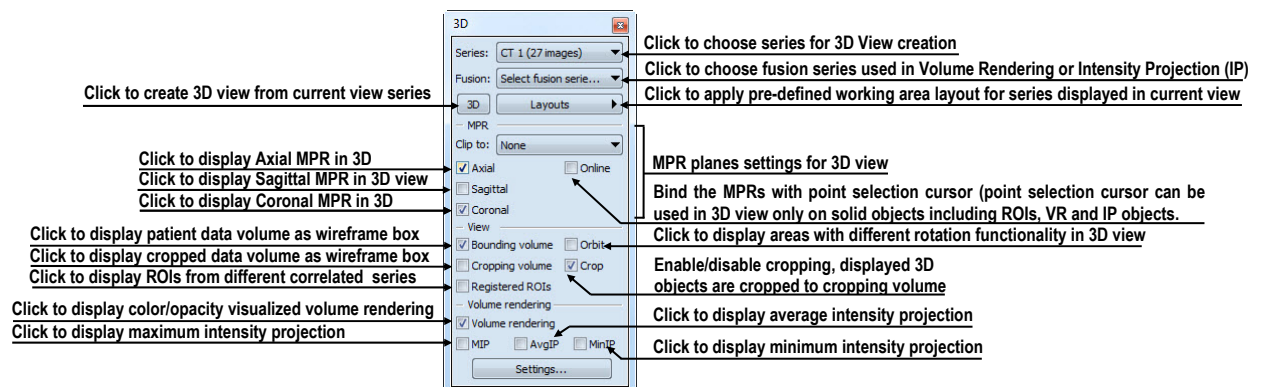
Figure 166 – 3D tooltab

To start using this tooltab, select series, which you would like to view with 3D, in the **Series** combo box or select any image of this series in requested view. Then, to create 3D view click by left mouse button on the requested 3D visualization method in this tooltab:

- To display ROIs in 3D view (see Figure 167) click on **3D** button.

- To create 3D visualization of volume data using Volume rendering click on the **Volume rendering** check box.

- To angiographic display of volume data in 3D click on the **MIP** check box (maximum projection), **AvgIP** (average projection) or on the **MinIP** check box (minimum projection).
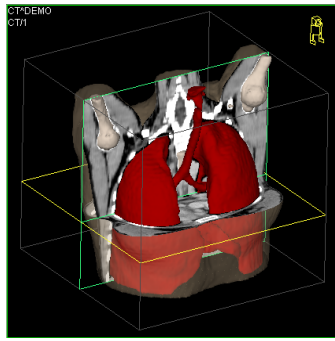
Figure 167 – 3D view

15.1 *Rotation, spatial orientation*

Click on the ↺ **Rotate** item in the 3D view's context menu or to activate rotate action. Mouse cursor will change to ⊕ form. 3D view can be rotated using the left mouse button pressed.

Orbit item in the 3D view's context menu gives visual help to image rotation. 3D view will be overlaid by set of blue translucent spheres (see Figure 168). This marks image areas with different rotation functionality – check the mouse cursor changes when it hovers over these areas (⊖ , ⊕ , ⊙). Though, it describes the rotation axis, which will be used for rotation.
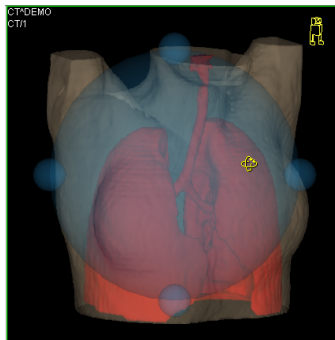

Figure 168 – 3D view with Orbit function

To return to the initial viewing angle and zoom, select the **Reset view** item in the 3D view's context menu.

For better spatial orientation, a small robot-like icon (called Enrico) is displayed in a chosen corner of 3D view. In correctly oriented studies, its orientation should match the patient's orientation. In case it disturbs you, you can hide it in the **TomoCon setup** dialog (see 4.4 Displayed texts in views).

To rotate objects in 3D view, use the **Rotate** tool tab in the tools panel. Two rotation modes are available:

- rotation in screen coordinates (see Figure 169)

- rotation in patient coordinates (see Figure 170)

Screen coordinates rotation mode using buttons is similar to rotation in 3D view, screen coordinates system is used. Patient rotations mode using buttons rotates volume around patient coordinate system axes. Patient coordinates system axes differ by color: x-red, y-green, z-blue. Rotation control with Enrico works in the same manner as rotation in 3D view, for better orientation orbit is always displayed.
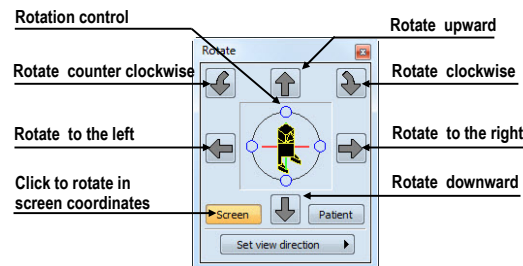

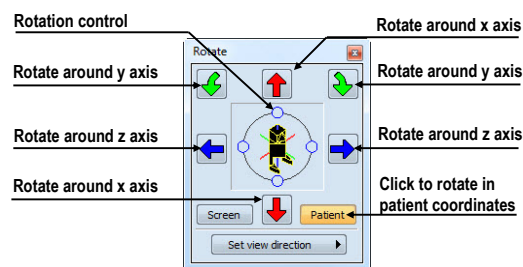**Figure 169 – Rotate tooltab (Screen mode)**

Figure 170 – Rotate tooltab (Patient mode)

15.2 Cropping volume of interest

Initially, 3D view displays the entire series bounding volume. For sake of faster rendering, removing parts out of interest, it might be efficient to view only a partial series volume. Volume cropping (see Figure 171) can be achieved in 3D view as well as in linked image, fusion or section view.
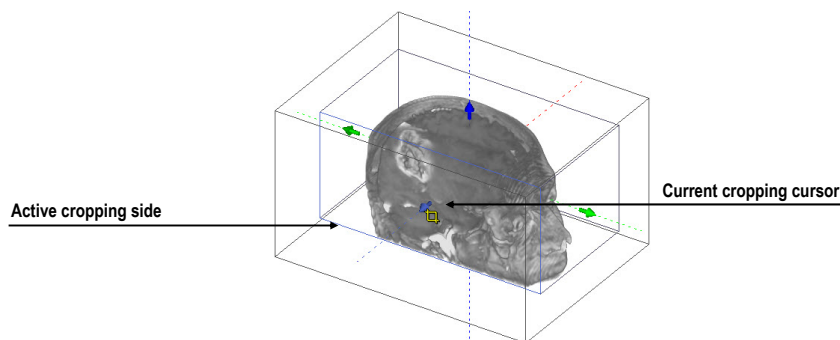

Figure 171 – Active cropping mode

To start cropping select the cropping tool in the 3D view's context menu (see Figure 172). Then drag selected object (cropping arrow, cropping cube edge) on the view and move it to desired position (see Figure 171).
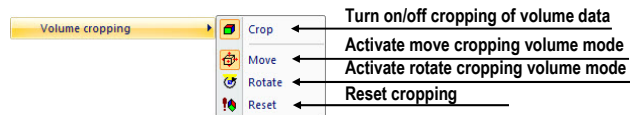

Figure 172 – Cropping menu

Volume cropping can be used in linked 2D views (2D views with the same series). In 2D view drag the edge of cropping volume polygon - an intersection of cropping volume and current image plane.

15.3 Moving MPR plane

In TomoCon it is allowed to move MPR plane interactively in the view (see Figure 173). When mouse hovers over an MPR edge of the MPR plane, cursor will change to and the border of the MPR plane is highlighted to yellow. Then press the left mouse button and move mouse to move the MPR plane.
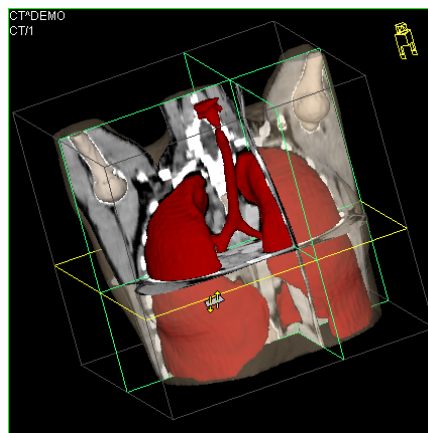

Figure 173 – 3D view with highlighted MPR plane

Moving MPRs can be used in linked 2D views (2D views with the same series). In 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 WS.

To display volume rendering visualization you can use one of the following methods:

- Select series of interest for volume rendering in the **Series** combo box of the **3D** tooltab, and then click on the **Volume rendering** check box (see Figure 174 a).

- Select arbitrary image from series, which is intended to view with volume rendering to requested view, and click on the **Volume rendering** check box in the 3D tooltab.

- Select arbitrary image from series, which is intended to view with volume rendering to requested view and select pre-defined layout in 3D tooltab (see Figure 174 b). Then click on the **Volume rendering** check box.

(a)   (b)
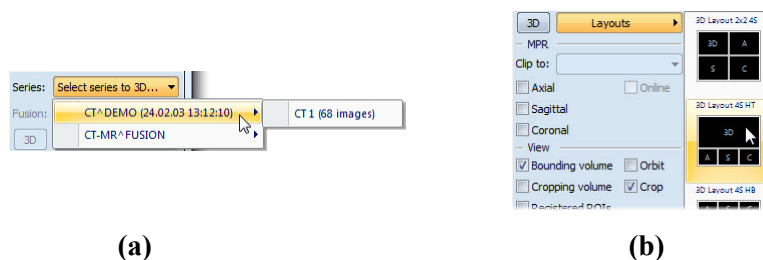
Figure 174 – Select series to volume rendering, (a) select series by combo box, (b) use pre-defined layout

The volume rendering visualization (see Figure 175) with default or latest color preset for given modality will be automatically calculated and displayed in the current view. Applying intensity projections (MIP, MinIP, and AvgIP) is similar to volume rendering.

To change parameters of volume rendering visualization you can use following tooltab and dialogs in TomoCon:

- **Rotate** tooltab, which allows spatial manipulation of current 3D view (see 15.1 Rotation, spatial orientation).

- **Color and opacity** tooltab for defining and using pre-defined color presets (see 15.4.3 Create and use color presets).

- **Volume rendering settings** dialog, which allows you to change basic parameters of volume rendering visualization in the current view (see 15.4.2 Volume rendering settings).
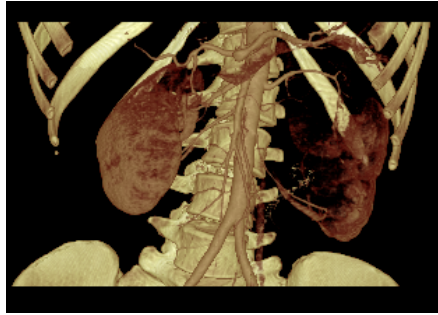
Figure 175 – Volume rendering 3D view

15.4.1 Point selection in volume rendering and intensity projections

Point selection in volume rendering is set to 3D point in cropped data volume, where the summed opacity is opaque. This is dependent on opacity defined for data values. For example, for the CT modality this might be inside bone, because the transfer function used in common presets does not define the whole interval for bones solid (see Figure 176). When solid isosurface is used, the point selection stops on isosurface. If point selection does not hit any solid point along the ray in cropped volume, the point selection is set to back face of the cropped volume.
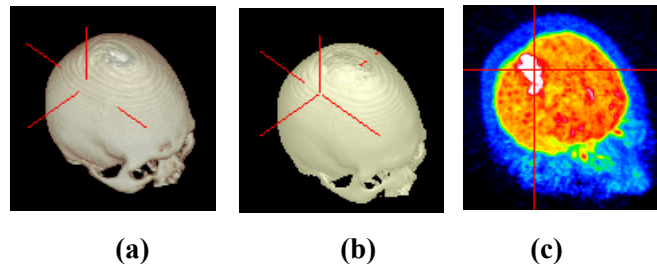

(a)   (b)   (c)

Figure 176 – Point selection, (a) inside, (b) on surface, (c) in MIP

Point selection in MIP and MinIP is set to a point in 3D data volume, where the value is maximum in MIP or minimum in MinIP along the ray. Point selection for AvgIP in 3D view is not defined. Though, it is set to back face of cropped volume.

Point selection cursor in MIP, MinIP, AvgIP is displayed as 2D cross (similarly to image views), in contrary to 3D visualization optionally with volume rendering, where point selection is 3D cross.

15.4.2 Volume rendering settings

This dialog allows you to define custom adjustments of volume rendering quality and lightning in the current view. Following parameters can be set:

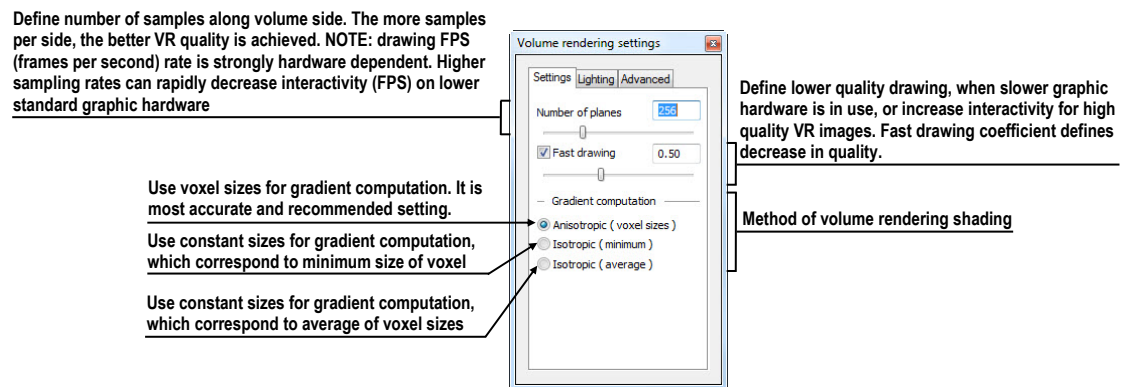- basic volume rendering quality in the first tab (see Figure 177)

Define number of samples along volume side. The more samples per side, the better VR quality is achieved. NOTE: drawing FPS (frames per second) rate is strongly hardware dependent. Higher sampling rates can rapidly decrease interactivity (FPS) on lower standard graphic hardware

Define lower quality drawing, when slower graphic hardware is in use, or increase interactivity for high quality VR images. Fast drawing coefficient defines decrease in quality.

Use voxel sizes for gradient computation. It is most accurate and recommended setting.

Use constant sizes for gradient computation, which correspond to minimum size of voxel

Use constant sizes for gradient computation, which correspond to average of voxel sizes

Method of volume rendering shading

Figure 177 - Volume rendering settings, the first tab

- lighting settings used in volume rendering in the second tab (see Figure 178)

Define the amount of ambient (diffuse, specular) light . Turn ambient light on/off.

Exponential behaviour of fog opacity. Higher values are used for optically dense material; lower values indicate thin fog.

Define width of specular reflection. Higher values produce narrow reflection and small values produce wide reflection.

It is used when isosurface is defined. Inner and outer sides of an isosurface are differently shaded for better recognition. Outer side is in direction from less dense medium toward denser medium.

Figure 178 – Volume rendering settings, the second tab

- settings for color corrections and advanced ray casting settings in the third tab (see Figure 179)

Increase or decrease brightness

Increase or decrease saturation

Faster drawing. Outer parts of view are rendered with lower resolution

Reduction of "planes" effect

Reduction of cube sides effect

Faster and higher quality isosurface rendering

Setting for color correction. It is applied only to volume rendered data. Though, other objects are not affected.

Improve image quality of volume rendering

Figure 179 – Volume rendering settings, the third tab

15.4.3   Create and use color presets

TomoCon allows you to change the color, opacity and lighting of the volume rendering in current 3D view using saved color presets. TomoCon provides predefined color presets gallery. It gives a possibility to define custom color presets for special volume rendering visualization in 3D view.
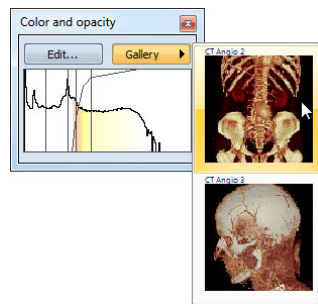
Figure 180 – Gallery of presets

To apply a color preset click the **Gallery** button in the **Color and opacity** tooltab (see Figure 180) in the tools panel. Then select requested preset in the displayed gallery list. Gallery contains default presets, included in installation (default presets cannot be modified), and all your own defined presets.

To create new color preset click on the **Edit…** button in the **Color and opacity** tooltab in the tools panel. **Color/opacity settings** dialog (see Figure 181) will be displayed. Define color, opacity and interval parameters for new preset in LUT control of the **Color/opacity settings** dialog (see Figure 181).

To modify effects use the **Effects** menu.
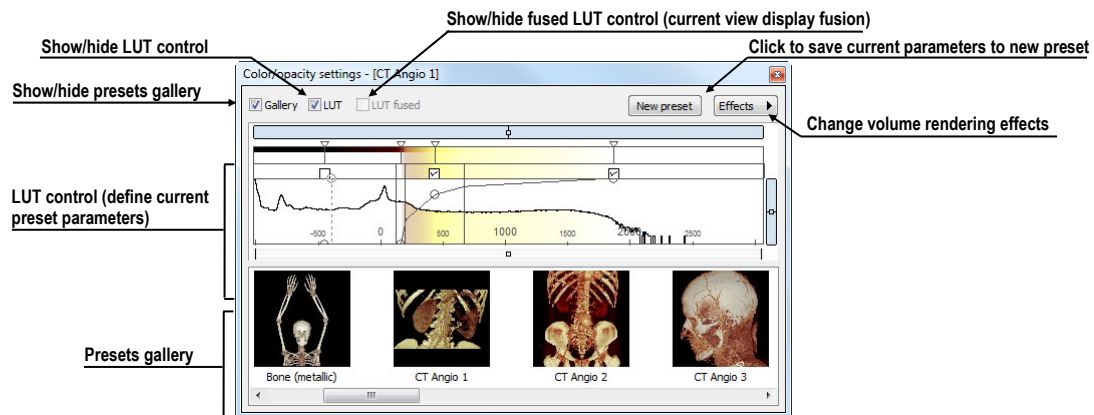
Figure 181 – Color/opacity settings dialog

To save color parameters for new preset click on the **New preset** button. New preset is automatically added to the end of presets gallery (bottom gallery part in dialog), and user is asked to enter a name for new preset (see Figure 182).
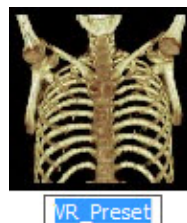
Figure 182 – New saved preset

To rename or delete saved color preset click on the preset in presets gallery control of **Color/opacity settings** dialog. Click the right mouse button to display context menu of selected preset. Then click on the **Rename**/**Delete** item in this menu.
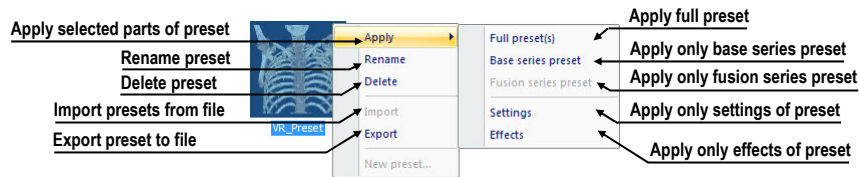
Figure 183 – Context menu of presets gallery

To set color parameters for preset use the LUT control part of the **Color/opacity settings** dialog (see Figure 184). It is control for defining the lookup table and/or isosurfaces used in volume rendering. LUT can be used in simple or advanced mode. In simple mode color ticks and opacity curve is fixed to interval bands. Advanced mode gives more flexibility in defining custom color table, enabling to modify opacity curve and color table independently from interval bands.
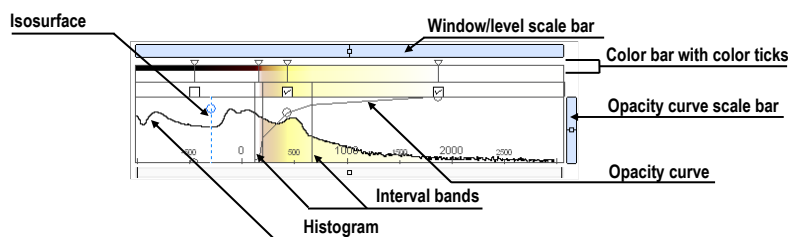
Figure 184 – LUT control part

Window/level scale bar is used to change Window/level of color table. Moving left mouse button changes level, **Ctrl** key + left mouse button moving changes window. Double click inside Window/level scale bar resets Window/level.

Window/level scale bar menu is displayed by clicking by right mouse button on bar. It defines which objects shall be moved simultaneously with W/L scale bar (**Color**, **Opacity**, **Check**, **Iso**). Each of the selected objects can be moved separately, or all the selected objects can be moved together.

Color bar with color ticks shows the current color palette. Colors can be modified by double clicking on color tick when cursor changes to ◇ or ↔. In advanced mode you can move color ticks, when cursor changes to ↔ and insert new color tick by double clicking inside color bar. Right button click inside color bar opens color table context menu, where you can insert new color tick and change interpolation between color ticks. Right button click on color tick (cursor is ↔) displays color tick menu for delete and change color of current tick.

Turn on/off simple mode; In simple mode opacity curve point is horizontally fixed to center of the color band. Advanced mode gives more flexibility in defining opacity and color of LUT. Though, transparency curve, and color ticks are completely independent from interval bands.

Show/hide color ticks (when hidden, colors cannot be modified)

Show/hide opacity curve (when hidden, opacity curve cannot be modified)

Show/hide ruler

Draw transparent or opaque histogram

Show/hide histogram outline

√	Simple mode
	Background color
√	Color intervals
√	Intervals
√	Opacity curve
√	Tooltips
√	Ruler
√	Interactive update
√	Transparent histogram
√	Colored histogram
√	Histogram outline
	Insert isosurface

Click to use background color of view in control

Show/hide interval bands (when hidden, band intervals cannot be modified)

Enable/disable tool tips

Allow interactive update in 3D view (when interactive update is disabled, changes in LUT are updated after a mouse button is released)

Draw colored or gray histogram

Insert isosurface at given mouse position

Figure 185 – LUT context menu

LUT context menu (see Figure 185) contains base properties of LUT control part. Display LUT context menu by right mouse button clicking inside LUT control.

Interval bands define custom interval band. Move interval band, when cursor changes to⊹. When interval is turned off, opacity for given interval is considered zero. To add interval band, double click inside colored interval band, or right click inside colored interval bend select **Insert**. To delete interval right click on interval line, when cursor changes to ⊹, and select **Delete** item in context menu. Color palette inside interval bend is always shown with defined transparency.

Opacity curve defines opacity used in volume rendering. In simple mode the opacity curve is fixed to the center of an interval band, and automatically moved together with interval band. Modify opacity using mouse when cursor over opacity curve point changes to ↕ or ⊹. Press **Alt** key, and after the cursor over opacity curve changes to ⤳, using mouse modify the curve sharpness. Advanced mode: Opacity curve can be moved when **Alt** + **Shift** key is pressed and cursor over opacity curve changes to ⤳. Opacity curve can be moved/scaled using opacity curve scale bar (see Figure 185).

Isosurface is displayed in histogram area. To insert isosurface, use right button click on desired isosurface position and select **Insert isosurface** item in displayed context menu. Isosurface transparency is defined by circle position. Move isosurface, when cursor changes to ⊹. Change isosurface transparency, when cursor over circle changes to ↕. Circle diameter can be adjusted using + and – keys (control window must have focus).

16 Registrations

To map one series onto another and define a relation between them, they have to be registered (matched one to another). It is then possible to transfer coordinates between the series bi-directionally, to check the same position in two series and to display the data overlaid from both series in the **Image fusion** mode (see 14 Multi-modality fusion).

To open the **Registrations** dialog (see Figure 186) click on the **Registrations…** item the **Tools** menu.
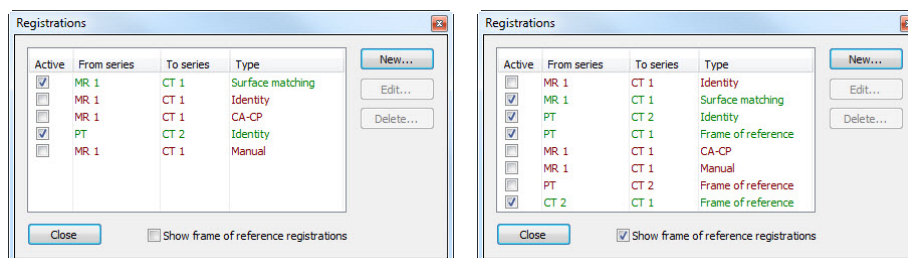
Figure 186 – Registrations dialog

The following actions are available in the **Registrations** dialog:

- **New…** - define a new registration between two series (16.1 Defining registration).

- **Edit...** - edit the selected registration.

- **Delete… -** delete selected registration from the list of registrations.

- **Show Frame of reference registrations** - hide/display registrations between two series - if a Frame of reference is defined in patient data. When opening patient study (with the Frame of reference) the registration will be created automatically between the two series.

It is possible to define multiple registrations between two series. In this case, only one of them may be active (marked with green color and checked). Other registrations between the series are inactive (marked with red color and unchecked). Using the checkbox, it is possible to undefine temporarily a registration or to select one of the registrations defined for a pair of series.

16.1 Defining registration

Press the **New…** button in the **Registrations** dialog (see Figure 186) to define the relation between two series. The **Define registration** dialog will be opened (see Figure 187).
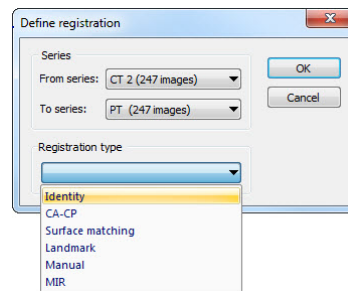
Figure 187 – Define registration dialog, selecting Registration type

The **Define registration** dialog (see Figure 187) specifies:

- **Series** - 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

Identity registration assumes the coordinate systems of the two image series are identical. Use this option, if patient coordinate systems have been established in both image series (Frame of reference has been defined) or if with other means the coordinate systems were kept identical.

16.1.2 Patient-related (CA-CP)

CA-CP registration (see Figure 188) uses the coordinates of patient's CA, CP and Median points to establish a series registration.

The distance between **CA** and **CP** points must lie between 21.0 and 28.5 mm.
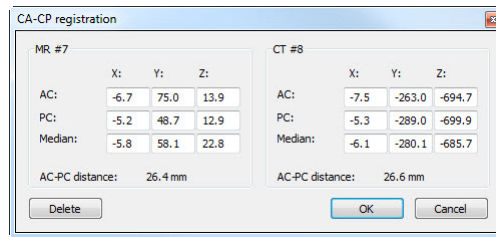
Figure 188 – CA-CP Registration dialog

16.1.3 Surface matching

Surface matching registration (see Figure 189) uses ROIs to establish a series registration. It is suitable for cases where the same structure ROI was defined in both image series. These two ROIs will then be matched.
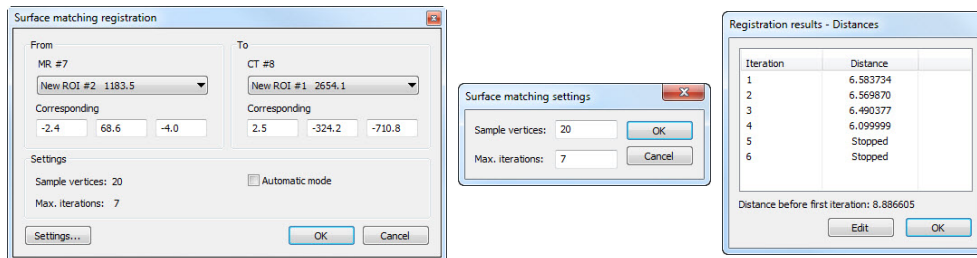
Figure 189 – Surface Matching Registration dialog, Surface matching settings dialog, Registration results - Distances dialog

16.1.4 Landmark

Landmark registration (see Figure 190) uses the coordinates of several landmarks to establish a series registration.
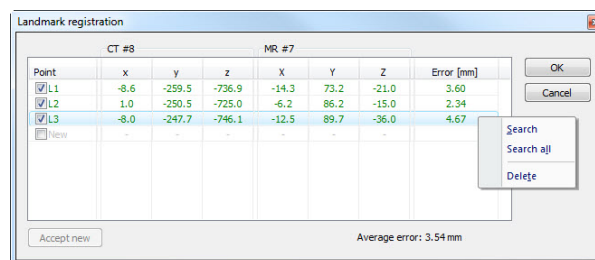
Figure 190 – Landmark Registration dialog

Wrong landmark couple with error exceeding an acceptable value can be disabled without deleting them from the list by unmarking ☑ in the check box.

Landmarks may be renamed according to the names of the marked significant points. To do so, click at the landmark name (default automatic names are **L1**, **L2**, etc.) and overwrite it to match the marked structure or pin (e.g. **Marker2**). All enabled landmarks are displayed in the image ⚓Marker2 with their respective name.

16.1.5   Manual

Manual registration of two different series uses relative manual movement of their three base planes. After selecting manual registration in the **Define registration** dialog, the **Manual registration initialization** dialog will be displayed (see Figure 191) for initial settings of manual registration. In this dialog, you can define one of these starting relations between the series:

- **Use existing registration** (select existing registration from list)

- **Automatic** (centers of 3D coordinate systems of both series will be assumed identical)
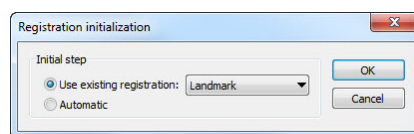
Figure 191 – Manual registration initialization dialog

After confirming the initial step with **OK** button three views for manual registration will be displayed in workspace (see Figure 192) together with the **Manual registration** dialog (see Figure 193).
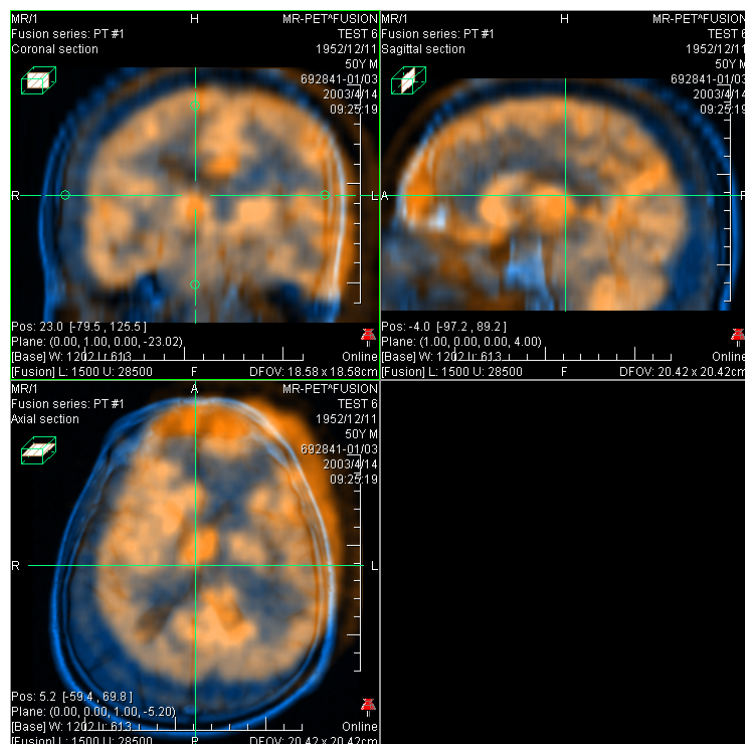
Figure 192 – Manual registration working area layout

The registration layout contains three independent views, each view displaying a pair of MPRs (each MPR is for different series) in one base plane (axial, sagittal, coronal).

MPRs of registered series have different colors and they are transparent. The color of MPR of each series is displayed in **Manual registration** dialog and you can change it at anytime.
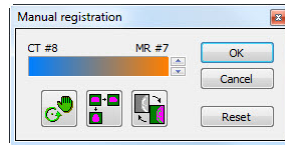
Figure 193 – Manual registration dialog

Activate the first view. A circle for moving and rotating the MPR will be displaying in this view. When the mouse cursor lays inside the circle, we can move the MPR (cursor is displayed as). Press the left mouse button, move the MPR to required position in view and release the mouse button (see Figure 194 a). Out of this circle we can rotate MPR around the centre of view (cursor is displayed as). Press the left mouse button, rotate the MPR to required orientation in view and release the mouse button (see Figure 194 b). We can only move/rotate MPR of one series. MPRs of the second series (called Base MPR) are left unchanged in view. After releasing mouse button the registration is automatically recalculated and the other views are redrawn automatically.

While editing the manual registration, it is anytime possible to enter the move and rotate mode by pressing the button (e.g. other operation type is used in the view).

(a)   **(b)**
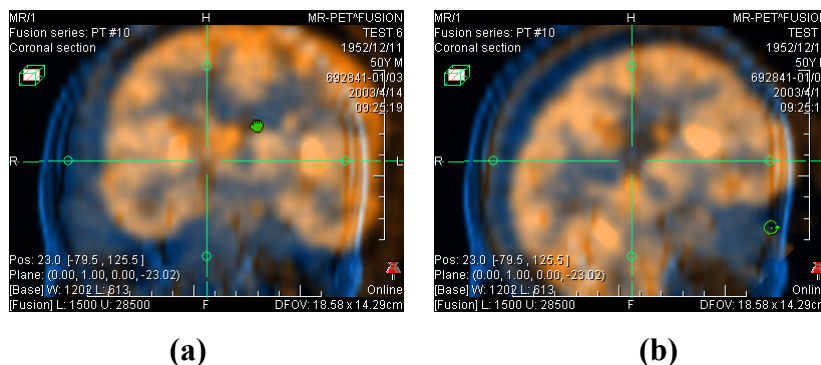
Figure 194 – Pan (a) and rotate (b) MPR during manual registration

If necessary it is possible to modify the plane of the Base MPR in any view. To do so, activate the view, where the MPR plane should be changed and press the button in the **Manual Registration** dialog. MPR will be displayed in the current view (see Figure 195 a), which can be moved and rotated (standard MPR display, see 11 MPR - Multi Planar Reformatting). After pressing the button once more it is possible to continue editing the manual registration view (see Figure 195 b).

While editing the manual registration, it is anytime possible to revert to initial registration settings by pressing the **Reset** button in the **Manual Registration** dialog.

After the manual registration being successfully defined, press the **OK** button to add the registration to the list of existing registrations. Otherwise, after pressing the **Cancel** button, the registration will be discarded and will not be used.

| (a) | (b) |
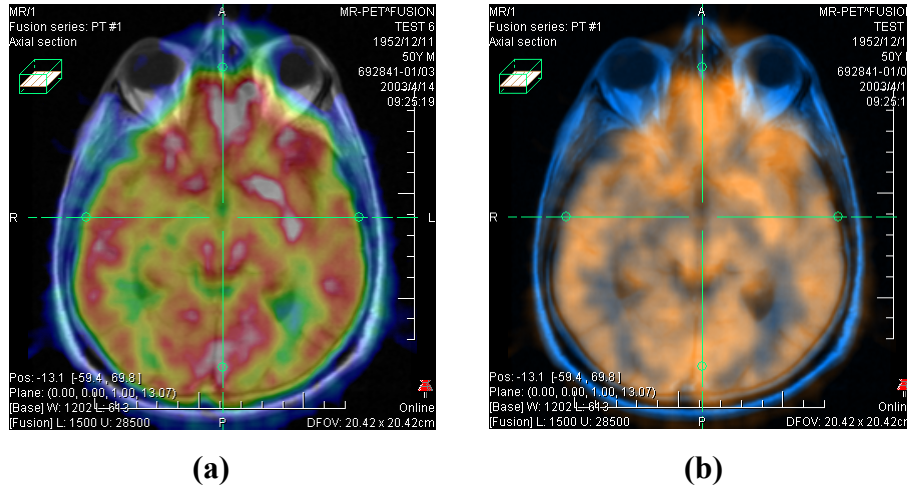
Figure 195 – Moving the Base MPR's plane (a), manual registration with shifted plane of the Base MPR (b)

16.1.6   MIR

This functionality is available only with MIR license in TomoCon WS.

MIR (**M**utual **I**nformation **R**egistration) is probability method for calculation of registration between two series, where the final registration is calculated automatically.

After selecting MIR registration in the **Define registration** dialog, the **Registration Initialization** dialog will be displayed (see Figure 196) for initial settings of MIR registration. Initial transformation can be defined as:

- **Use existing registration** (select existing registration from list)

- **Automatic** (centers of 3D coordinate systems of both series will be assumed identical)
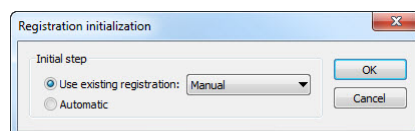
Figure 196 – MIR registration initialization dialog

After confirming the initial step with **OK** button, the **Mutual Information Registration** dialog will be displayed (see Figure 197). Calculation of the registration starts automatically. Registration progress is displayed in log window. By clicking

Stop level button calculation for current level can be stopped manually, if the desired accuracy is reached (changes in translation or rotation components are below 0.01; in log translation components are denoted *tx[y, z]*, rotation versor components *vx[y, z]*). To stop registration process click on the **Stop** button. Checking **Close when finished** check box causes, that registration dialog is automatically closed, when registration is finished.
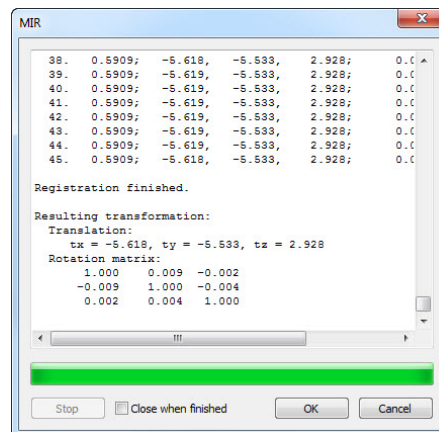
Figure 197 – MMR Registration dialog

17 Print images

17.1 MS Windows printer

Patient image data can be printed on an MS Windows printer using the **Print** dialog (see Figure 198) that will be opened by clicking at **Print…** in **TomoCon** menu.
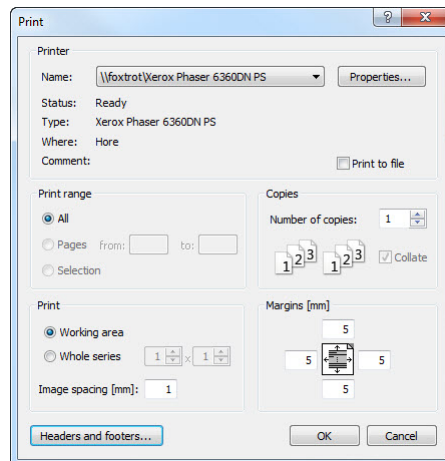
Figure 198 – Print dialog

It is possible to choose from following settings in the **Print** dialog:

- **Printer Name**
- **Margins**
- **Print**:
    - **Working area**
    - **Whole series**:
        - Number of **rows**
        - Number of **columns**
- Header and footer, which will be inserted to each printed paper. To define header and footer, press **Headers and footers** button. In **Page headers and footers** dialog, which will be displayed, you can define following types of text for 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 are formatting the text, which shall be printed. On the Figure 199 you can see an example of this text, where header contains name of the organization in the middle and name of the doctor on the right side. When you have finished with your definition, press **OK** button to confirm.
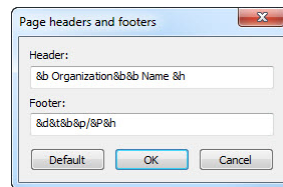
Figure 199 – Page headers and footers dialog

Note! Do not forget to select an appropriate paper orientation and other preferences in the **Properties…** dialog.

Set up the parameters, press the **OK** button; the printing process will start.

17.2 DICOM printer

Patient image data can be printed on a DICOM printer using the DICOM print interface (see Figure 200) that will be displayed after pressing the **DICOM print...** submenu in **TomoCon** menu.

DICOM print interface consists of:

- Working area (see 17.2.1 DICOM print working area)
- Thumbnail palette (see 17.2.2 DICOM print Thumbnail palette)
- Print queue (see 17.2.11 Monitoring and controlling the print process)
- Menu (see 17.2.3 DICOM print menu)
- Standard toolbar (see 17.2.4 DICOM print standard toolbar)
- Status bar (see 17.2.5 DICOM print status bar)
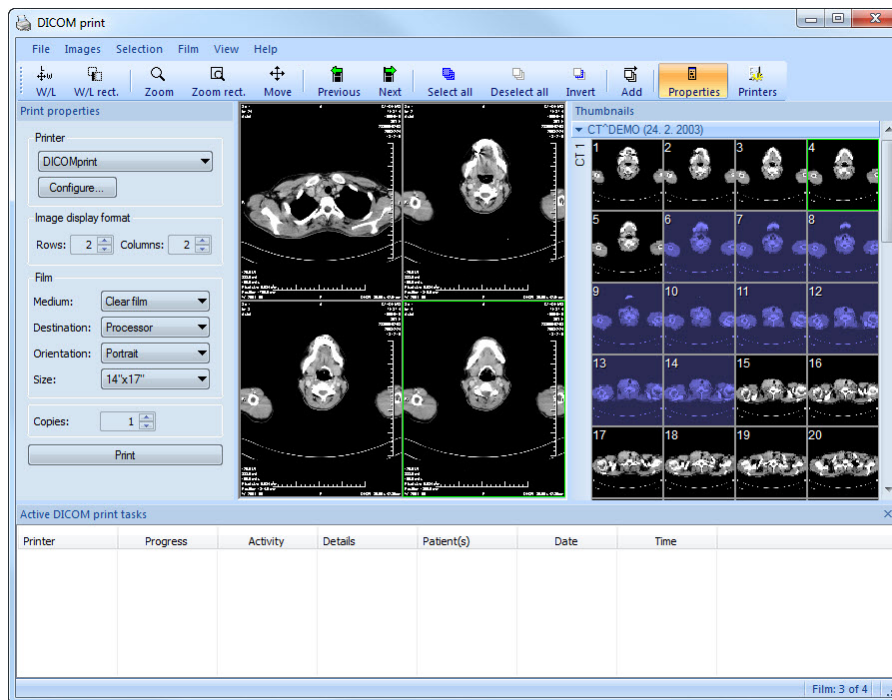
Figure 200 – DICOM print interface

17.2.1 DICOM print working area

DICOM Print working area is a big black area representing one print film. It is similar to the TomoCon's working area. It is divided into smaller windows (views) depending on row and column settings in the **Print properties** dialog, **Image Display Format** (see 17.2.7 Setting up DICOM print interface properties).

Use the mouse to move between the views, the current view is highlighted in a colored frame (see 4.6 Color settings). Use the actions in the DICOM Print view's context menu, **Standard** toolbar (see 17.2.4 DICOM print standard toolbar) or program menu (see 17.2.3 DICOM print menu) to operate with the image in the current view.

17.2.2 DICOM print Thumbnail palette

The thumbnails palette is located at the right side of the DICOM print interface (see Figure 200) and it is a copy of a thumbnails palette in the application. All series of opened studies in TomoCon are displayed in the palette and the work with it is identical to the work with thumbnails palette in TomoCon (see 3.3 Thumbnails palette).

17.2.3 DICOM print menu

DICOM Print menu is located as a DICOM Print window system menu (see Figure 200). It has following sub menus:

- **File -** DICOM printer installation (the **Printers…** submenu, see 17.2.6 DICOM printer), stop working in DICOM Print interface (**Exit**)

- **Images -** image modification in the current view (see 17.2.8 Edit images)

- **Selection –** select images from the thumbnails palette to the working area (see 17.2.9 Images for print)

- **Film -** edit and move between the films (see 17.2.10 Edit and move films)

- **View -** hide/display: **Toolbar**, **Status bar**, **Thumbnail palette**, **Print properties** dialog, **Print queue** list,

  and following information in all images of the films: **Text, Ruler, Curves, Shutter, Overlay, Annotations, Help**

17.2.4 DICOM print standard toolbar

The **Standard** toolbar (see Figure 201) is located under the DICOM Print interface system (to display/hide the dialog see 17.2.3 DICOM print menu, **View/Toolbar**). The **Standard** toolbar contains:

- Tools for changing gray, window and level in the current view (**W/L**, **W/L rect.**).

- Tools for image zooming in the current view (**Zoom**, **Zoom rect.**).

- Tools for moving the image in the current view (**Move**).

Activation and using the tools is identical to the tools of TomoCon toolbars (see 3.5 Toolbars):

- Move to the previous film (**Previous**)

- Move to the next film (**Next**)

- Select all images in the thumbnails palette (**Select all**)

- Deselect all chosen images in the thumbnails palette (**Deselect all**)

- Invert the chosen images from the thumbnails palette (**Invert**)

- Add all chosen images from the thumbnails palette to the working area (**Add**)

- Display/hide the **Print properties** (**Properties**) dialog

- Display DICOM printers installation dialog (**Printers**)

Figure 201 – DICOM print standard toolbar

17.2.5 DICOM print status bar

The **Status** bar is located at the bottom of the DICOM Print interface (to hide/display the dialog see 17.2.3 DICOM print menu, **View/Status bar**). If the user selects a menu or a button from the toolbar, its description appears on the left side of the **Status** bar (instead of the "TomoCon 3.0 Ready" text). The number of the current film is displayed on the right side of the **Status** bar which represents the DICOM Print interface working area.

17.2.6 DICOM printer installation

Use the **Printers** dialog (see Figure 203) to install a DICOM printer. Click on the **File/Printers...** in the DICOM print interface program menu to open the dialog (see Figure 202).
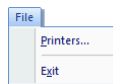
Figure 202 – File menu

The **Printers** dialog contains a list of installed DICOM printers. It is possible to configurate them using the Configuration dialog of a chosen printer (see Figure 204) that will be displayed after clicking on the **Configure...** button. Using the **Verify** button it is possible to test the connection between TomoCon and the chosen DICOM printer. Use the **Delete** button to delete a printer from the list.
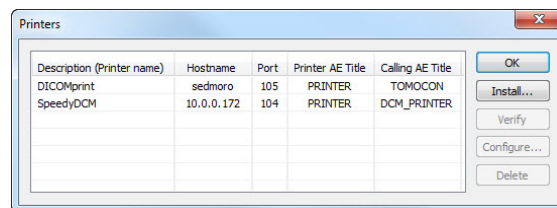
Figure 203 – Printers dialog

To install a new DICOM printer click on the **Install...** button to open the **Printer installation** dialog (see Figure 205). Then, specify the new printer's properties (**Printer name**, **Hostname**, **Port**, **Printer AE title**, **Calling AE title**).
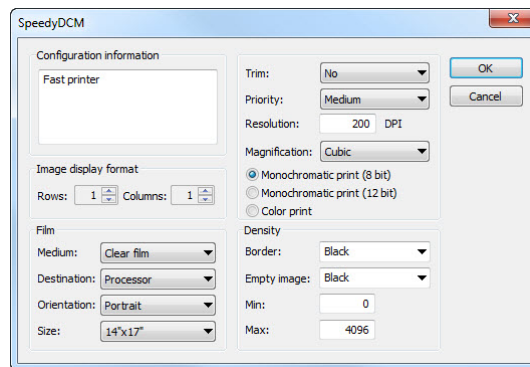
Figure 204 – Printer configuration dialog
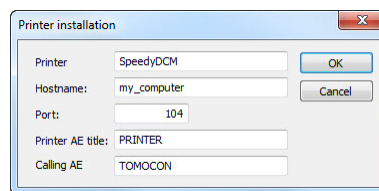
Figure 205 – Printer installation dialog

17.2.7   Setting up DICOM print interface properties

Use the **Print Properties** dialog to set up DICOM Print interface preferences (to display/hide the dialog see 17.2.3 DICOM print menu**, View/Print properties**). This dialog (see Figure 206) is placed on the left side of the working area. It can be docked anywhere inside the area in the same way as the thumbnails palette.
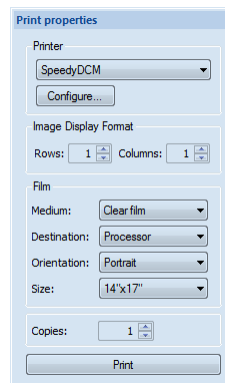
Figure 206 – Print properties dialog

Using the **Print properties** dialog (see Figure 206) it is possible to set up the following DICOM Print interface properties:

- **Printer** – the printer can be selected from a drop-down list of installed printers and configured after pressing the **Configure…**button.

- **Image Display Format** (**Rows, Columns**) – the number of rows and columns in the working area that match the image layout in the film.

• **Film** (**Medium**, **Destination**, **Orientation**, **Size**) - film properties.

Press the **Print** button when the film is ready for printing. The current state of process will be displayed in **Preparing data** dialog (see Figure 207) and when this process will be finished, a new print task will be added to the print queue (see 17.2.11 Monitoring and controlling the print process).
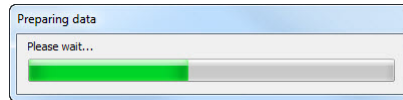
Figure 207 – DICOM printing…

17.2.8 Edit images

Images in the working area can be edited in the same way as the images in TomoCon. To modify the image data in the current view, use the **Images** menu (see Figure 208) containing the following tools:

• **Window/Level**

• **Window/Level rectangle**

• **Zoom**

• **Zoom Rectangle**

• **Move**

Activation and using the modifications is identical to the options of TomoCon's **Image** menu (see 3.4 Main menu).
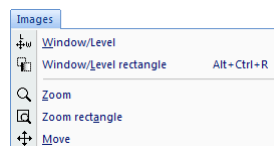
Figure 208 – Images menu

17.2.9 Images for print

Select images for print in the DICOM Print interface from the thumbnails palette where all series are located. Use the **Selection** menu to select the images and add them to the film (see Figure 209).
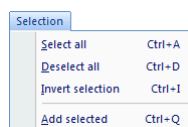
Figure 209 – Selection menu

The **Selection** menu allows to:

- Select all images displayed in the thumbnails palette (**Select all**).

- Cancel the choice of all images from the thumbnails palette (**Deselect all**).

- Invert the selected images (**Invert selection**).

- Add chosen images from the thumbnails palette to the film (**Add selected**), the images will be added to the end of the film/films behind the already chosen images.

17.2.10 Edit and move films

When starting the DICOM Print interface an empty film without images is available. After adding the images these are placed one after another to the required number of films. The DICOM Print working area represents one film. Number of images on the film is specified by number of rows and columns in the **Print properties** dialog in the **Image Display Format** option.

Use the **Film** menu to edit and move films (see Figure 210):

- Move to the next film (**Next**).

- Move to the previous film (**Previous**).

- Delete an image in the current view (**Delete image**). Images following the deleted image will be replaced in one position.

- **Delete film** and **Delete all films**.
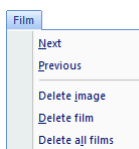
Figure 210 – Film menu

17.2.11 Monitoring and controlling the print process

Using the **Active DICOM print tasks** list (see Figure 211), which you can show/hide by clicking on item **Print queue** in the menu **View**, you can see if and how many studies are waiting to be printed out (pending), whether any are currently being printed and whether any errors have occurred. Besides the current state of each task displayed in **Activity** column, there are displayed information of each task like name of the printer (**Printer** column), progress of the current task's state (**Progress** column), task's **Details**, etc.

The context menu of each task displayed in the list let you restart, remove, stop or delete your jobs. To do these actions with a job in your printer queue, firstly select the job in the list, click right mouse button, that displays context menu and then select requested action.

Figure 211 – Active DICOM print tasks list

18   ECG/HD

TomoCon also provides a way to review and enter measurements and diagnoses for ECG waveforms, stored in patient DICOM data. Therefore it is very simple to join diagnostic images of patient with ECG diagnostic waveforms. The clinician has full access to comprehensive ECG/HD information in TomoCon using **Waveforms** workspace that will be displayed automatically after opening a patient with stored ECG/HD information, or manually after pressing the **ECG/HD...** item in the **Tools** menu.

The **Waveforms** workspace consists of the following three parts (see Figure 212):

- toolbar with all applicable tools for ECG/HD diagnostic (upper left corner)

- list of all opened ECG/HD waveforms in TomoCon (left side)

- preview window for viewing and diagnosing of selected waveform
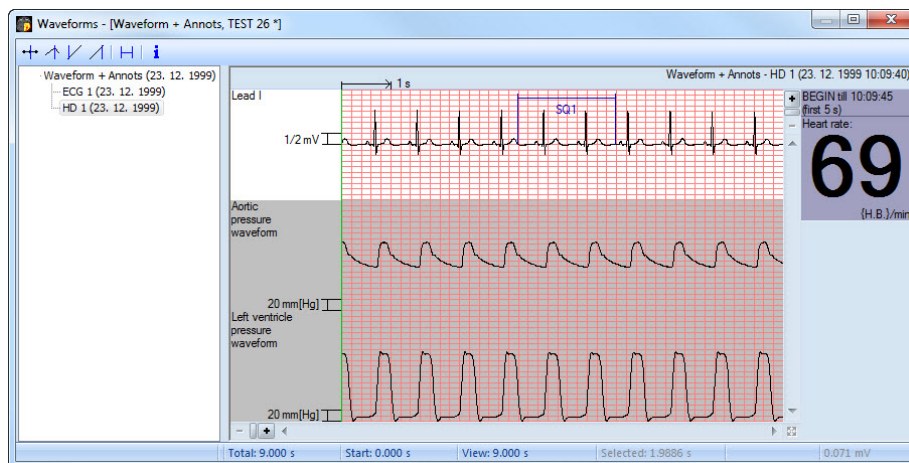
Figure 212 – Waveform workspace

18.1 *Navigating through opened ECG/HD waveforms*

All opened ECG/HD waveforms are listed on the left side of **Waveforms** workspace in TomoCon. All waveforms are grouped according to the studies they belong to.

To display a preview of a waveform:

1. Look through the all studies groups in the list on the left side of the workspace.

   To see which waveform belongs to a study, click on the [+] symbol in front of the study name. A complete list of all waveforms of the selected study will be displayed.

To collapse the list of study waveforms, click on the [–] symbol in front of the study name.

2. When you find a waveform in the list, select it with a mouse click.

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 display a desired ECG/HD waveform immediately (see Figure 213). Simply left-click on the waveform name in the list on the left side and the selected waveform will be displayed in the preview window on the right side immediately. Use of the preview window is quite easy and intuitive. It provides a set of comprehensive and flexible tools for reviewing and diagnosis of ECG/HD in TomoCon.
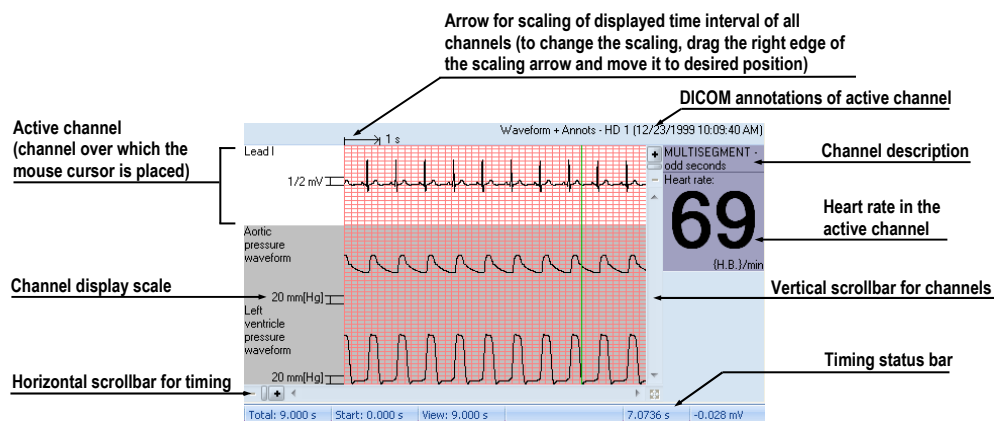
Figure 213 – Preview window for viewing and diagnosing of ECG/ HD

18.2.1 Status bar

Timing status bar (see Figure 214) is the bar at the bottom of the waveform workspace. It displays main time and value parameters from displayed ECG or HD channels.
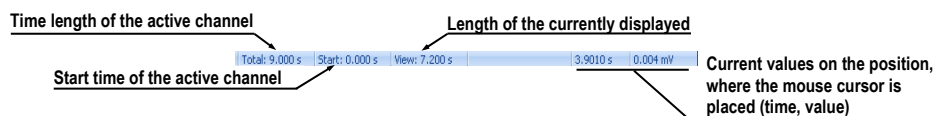
Figure 214 – Timing status bar

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 215).

To customize the number of displayed channels, use the vertical scrollbar on the right side of channels grid preview (see Figure 215).
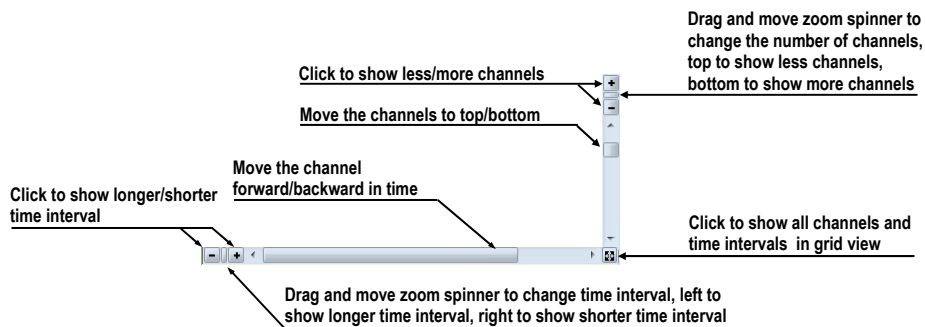
Figure 215 – Waveform workspace scrollbars

To customize the value scaling just for the active channel (the channel where the mouse 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. Active channel is immediately vertically adjusted to the selected scale position (see Figure 216).
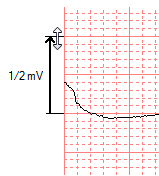
Figure 216 – Active channel value scaling

18.2.3 Time cursor in ECG/HD

During preview of 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 contains a time cursor tool (see Figure 217). It is a special mouse cursor, which is activated when the mouse cursor hovers over the grid view. While moving the mouse, the Status bar automatically displays time and value from the current cursor position. Moreover it is also possible to find 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 corner of the waveform workspace) and move the mouse cursor over the desired channel.

Figure 217 – Time cursor

To activate snapping to:

- the nearest sample around the cursor, click on the ✛ button
- the nearest extreme around the cursor, click on the ↑ button
- the minimum in range around the cursor, click on the ∨ button
- the maximum in range around the cursor, click on the ∧ button

18.2.4   Marker measurement in ECG/HD

While diagnosing an ECG/HD examination it is often necessary to measure or mark just a particular range of a selected channel. For this purpose TomoCon contains a manual measurement tool of type **Marker** (see Figure 218). Using this tool it is possible to graphically write the measured time interval into the examination along with the description. Moreover TomoCon allows 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.
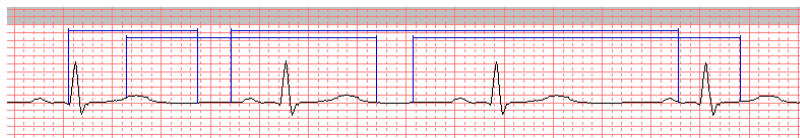
Figure 218 – Markers in selected channel

To create new range measurement:

1. Click on the ⊢ button on the toolbar in the waveform workspace or context menu.

2. Move the mouse cursor to the desired start location in a channel.

3. Press the left mouse button at the start location and move the mouse cursor to the second location where you want the measurement to end.

4. Release the left mouse button. The **Marker properties** dialog will be displayed automatically (see Figure 219).

5. Fill in the **Marker properties** dialog and press the **OK** button. A newly defined range measurement will be automatically created and displayed in the active channel with a blue color and labeled with specified title.
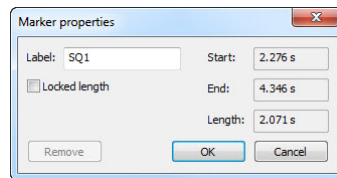
Figure 219 – Marker properties dialog

To edit the start and the end location of a defined range measurement:

1. Move the mouse cursor over the vertical start or end line (the measurement will be highlighted).

2. Press the left mouse button and move the cursor to a new location (see Figure 220). The measurement border will be moved with the mouse cursor.

3. Release the left mouse button.
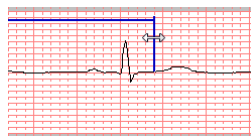
Figure 220 – Editing a defined Marker

To edit measurement properties or remove a defined measurement:

1. Move the mouse 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 click on the **Properties…** menu item in the displayed context menu (see Figure 221).

To remove the measurement click on the **Remove** menu item in the displayed context menu.
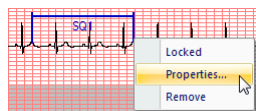
Figure 221 – Marker context menu

19   Touch screen mode

TomoCon offers a special touch screen mode for touch screens used in operating rooms. The touch screen mode will be activated directly when starting TomoCon (see 3 Using TomoCon) or during the work with the application choosing the **Touch screen mode** item in the **Tools** menu. The mode offers chosen functions from the application; these are operated using enlarged control buttons.

The touch screen mode window consists of two parts (see Figure 222):

- Working area (left)

- Panel with control buttons (right)

When starting the mode the working area has only one view, the current view. Press the ▦ button to change the working area layout (see 19.5 Working area layout). If there are more views in the working area, select any view to become the current one. If patient studies were opened in TomoCon before switching to the touch screen mode and the current view was empty, the working area will be filled with the image sequence. The first image will be the first image from the last series of last opened study in TomoCon. If there was an image chosen in the current view, the working area will be filled with the image sequence from the current image series beginning with this image. If no patient study was open, the working area will be empty.
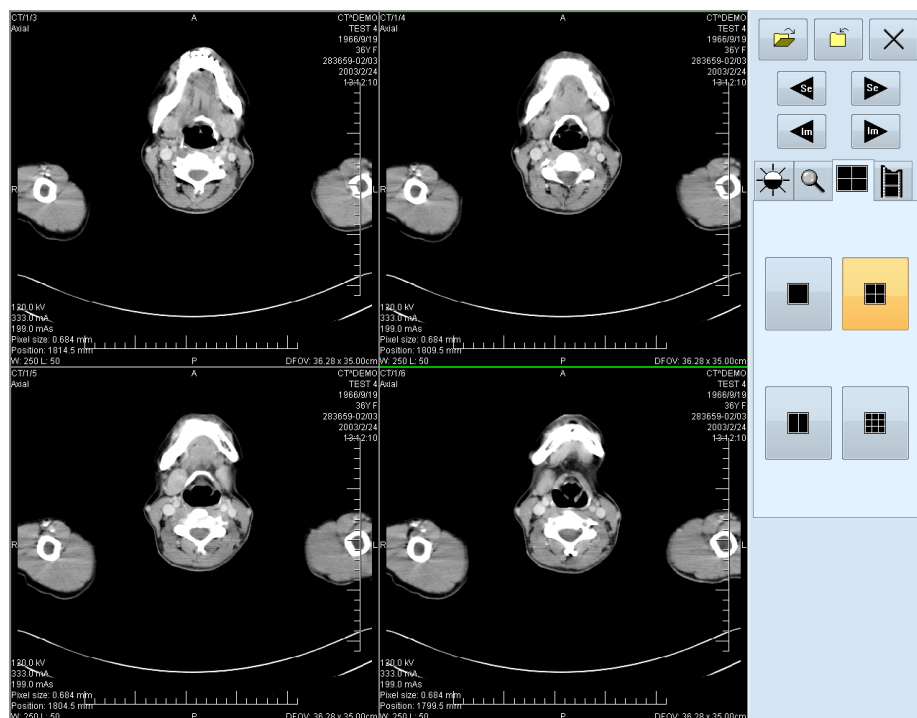
Figure 222 – Touch screen mode – layout

Control buttons panel is divided to 3 parts:

1. The top part of the panel contains the following buttons:

   - Open a patient study [icon] (see 19.1 Open a patient study)

   - Close a patient study [icon] (see 19.2 Close a patient study)

   - Exit the touch screen mode [icon]

   - Select image series: [icon] - Move to the previous series, [icon] - Move to the next series (the series are in the same order as they were opened in TomoCon)

   - Move the images within the series: [icon] - Move to the previous image, [icon] - Move to the next image

2. The middle part of the panel contains the following tabs:

   - [icon] - Window, level, shape settings (see 19.3 Window, level, shape settings)

   - [icon] - Move and zoom images (see 19.4 Move and zoom images)

   - [icon] - Working area layout settings (see 19.5 Working area layout)

   - [icon] – Switch to the Cine mode (see 19.6 Play multi-frame images)

3. The bottom part of the panel contains buttons connected to the action chosen.

19.1 Open a patient study

In the Touch screen mode a patient study will be open after pressing the [icon] button. The **Search studies** dialog will be opened (see 5 Retrieving and Opening study).

19.2 Close a patient study

All studies opened in TomoCon can be closed by pressing on the [icon] button. If the Touch screen mode was activated while working with the application and changes were made (ROI, registrations, annotations), a dialog will be open allowing saving the changes before closing the studies (see 5.11 Close a patient study).

19.3 Window, level, shape settings

Choosing the [icon] tab the following buttons will be displayed at the bottom part of the panel (see Figure 223):

- ▲ - accelerating level increase
- ▼ - accelerating level decrease

The following levels will be changed in the all images of the working area:

- **Window** - ☼
- **Level** - ◐
- **Shape** - ◢

Level changing process is indicated by the slider and numeric values under the sliders.

At the bottom of the panel, the button allowing following actions are located:

- ▮▮ - invert the colors in the image
- Reset - reset default values of window, level a shape in the series
- Apply to all - apply new values of window, level and shape to the series
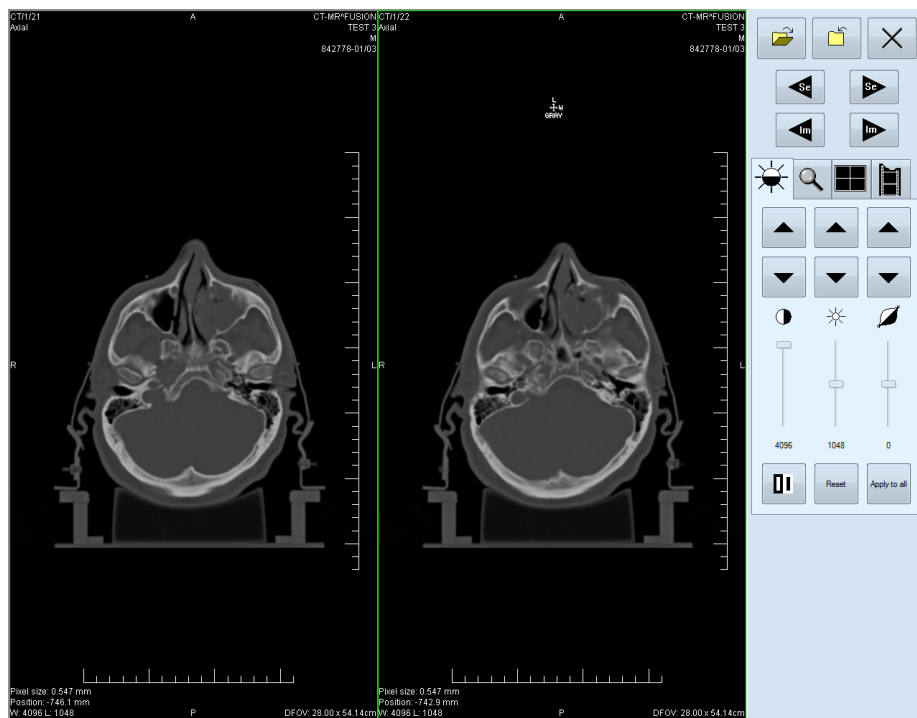
Figure 223 – Touch screen mode - gray, W&L settings

19.4 Move and zoom images

Choosing the [🔍] tab the following buttons will be displayed at the bottom part of the panel (see Figure 224):

- Zoom the image in the working area from 50 % to 800 %: [🔍] - zoom out, [🔍⁺] - zoom in (the current image size is listed under the zooming buttons)

- Move the image: [▲] - up, [▼] - down, [◀] - left, [▶] - right

- Return to the default size and position - [Reset]
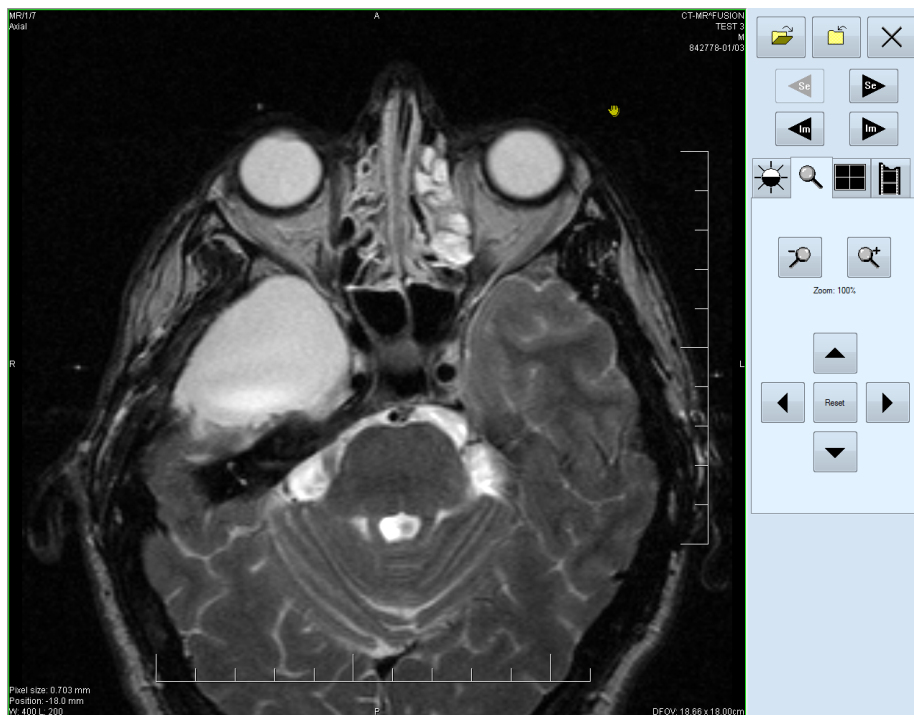
Figure 224 – Touch screen mode - move and zoom images

19.5 Working area layout

Choosing the [▦] tab the buttons representing the working area layout will be displayed at the bottom part of the panel (see Figure 222).

19.6 Play multi-frame images

Choosing the [▤] tab the following buttons will be displayed at the bottom part of the panel (see Figure 225):

- Play back the images: ◄ - play backward, ► - play forward, ■ - stop playing back the images (When playing back the images, only one view will be displayed in the working area where the images starting with the current image will be played back; the slider and numeric value under the buttons indicates the displayed image position in the series).

- Playing mode: ⟳ - looping, ⊢⊣ - sweeping

- Change frame per second (fps) from 0 to 50 fps with 2,5 step: **+** - increase fps, **−** - decrease fps (the current speed value is listed between the buttons).
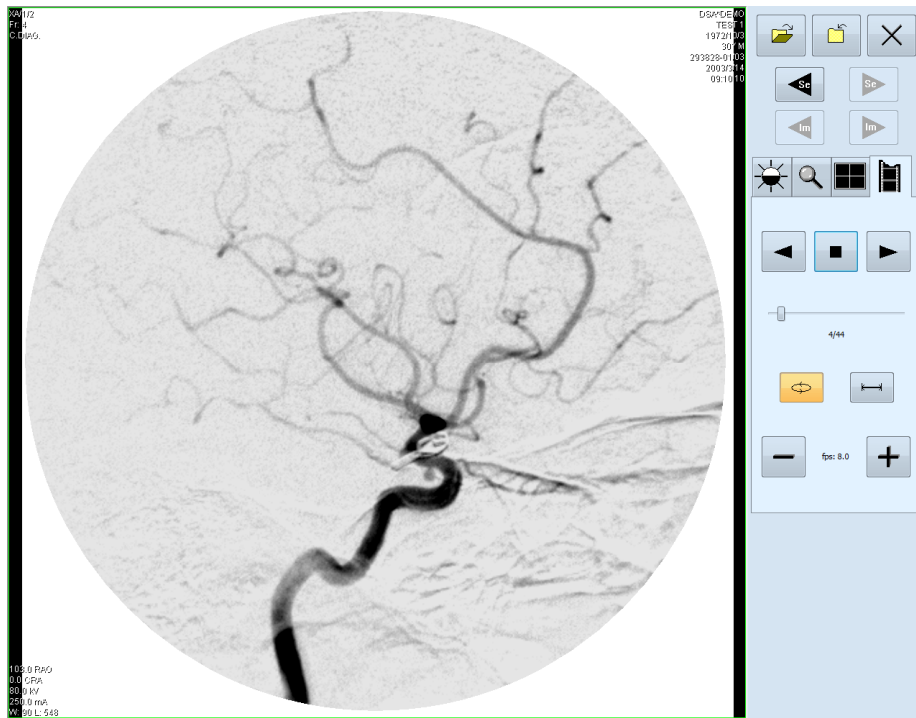
Figure 225 – Touch screen mode - playback multi-frame images

20   Structured reports

Structured reports are used to write medical reports, findings and other reports referring to a patient study or an image.

Click on the **Study** menu, **Reports...** to open the **Reports...** dialog (see Figure 226).

The **Reports...** dialogs can be resized and relocated anywhere inside the application.
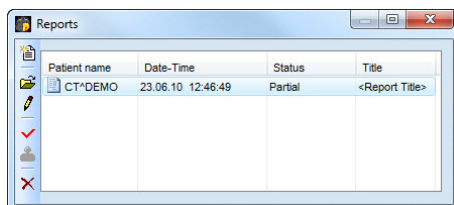
Figure 226 – Reports dialog

20.1 Create a new template

TomoCon provides possibility to use template to create new structured report. Click on the 📄 **Create new report** icon in **Reports** dialog to open the list of existing templates (see Figure 227).

To create a new template click on the **New** button and enter the name of the report. There will be the dialog **Report** (see Figure 228) displayed afterwards for writing new template.

To edit already existing template click at **Edit** button (to editing contents of selected template) or click on the **Rename** button (to change name of the selected template).

To delete already existing selected template click on the **Delete** button.

20.2 Create a new report

To create a new report click at the **Study** menu, **Reports…**.

A new report will be created only if there is a study opened in TomoCon.

If opening study of patient with no image data available (**Open study**, **Search studies**) and already created structured report, the **Reports...** dialog will be opened automatically. When there is study of another patient opened in TomoCon, the **Reports...** dialog will be opened after clicking on the **Study** menu, **Reports…**.

If there is only one patient opened in TomoCon, after clicking on the 📄 **Create new report** icon in the **Reports...** dialog an editing dialog will be opened with the patient's name in the heading. When there are more studies opened in TomoCon, the **Select**

study... dialog will be opened. After choosing a patient and pressing the **OK** button, the **New Report** dialog will be opened (see Figure 227) for selection of the template, which will be used to create new report. TomoCon application provides to you with following types of templates:

- Voice report - when you select 🔊 **Voice report** icon, you can speak your report in recording dialog, which will be displayed.

- PDF report - when you select 📄 **PDF report** icon, you can create report from PDF document stored on disk.

- Text report - when you select 📄 text type report icon, you can write text report in the **Report** dialog, which will be displayed (see Figure 228).

You can also select and open the template by double-clicking on its template's icon.
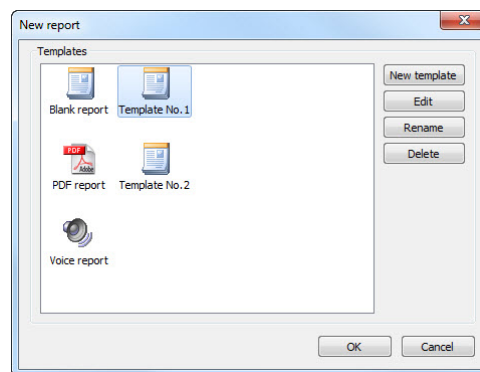
Figure 227 – Template choice dialog
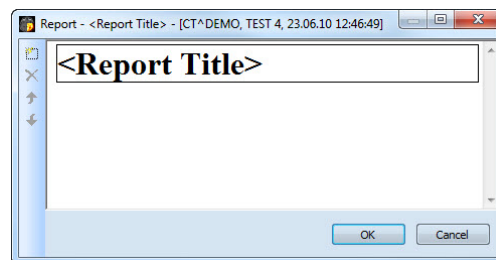
Figure 228 – Report dialog

Click on the 📄 **Add new section** icon on the left side of the dialog or select **Add new section** item in the **Report** dialog context menu (click the right mouse button inside the dialog). A menu will be displayed with paragraph types that can be added to the text of the edit dialog (see Figure 229):

- **Text -** subtitle, report text
- **Container** - contains text or another container (max 64 elements)
- **Concept modifier** - specifies the report heading
- **Observation context** - report information (author, examining surgeon etc.)
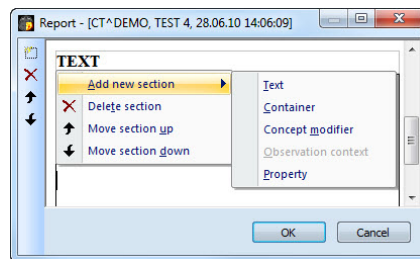- **Property** - physical properties of medical finding

Figure 229 – Report dialog – context menu

In the **Report** dialog, it is possible to move the paragraphs up and down within the levels using ↑ and ↓ **Move section up/down** icons (container, text, etc.).

Click on the ✗ **Delete section** icon to delete a paragraph. A dialog will be opened, press the **OK** button to delete the paragraph from the report (see Figure 230).
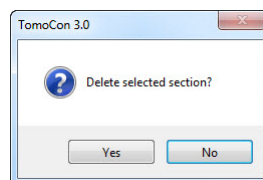

Figure 230 Are you sure you want to delete selected section? dialog

The reports have three statuses:
- **Partial** - open to editing
- **Complete**
- **Verified** (verifying person + organization)

Click on the ✔ **Complete report** icon to finish editing the report. It is possible to add a note to the report in the **Complete report** dialog before closing the report (see Figure 231). The dialog will be opened after clicking on the ✔ icon. When clicking on the **Cancel** button or the cross at the right top corner of the dialog, the report will be closed without saving the changes. After pressing the **OK** button, the report will be closed and it will not possible to edit it.

Click on the ⚒ **Verify report** icon, the **Verify report** will be opened (see Figure 231). Fill in the name and the organization of the verifying person. Reports can be verified by more persons. The data about verifying persons will be displayed when viewing reports.
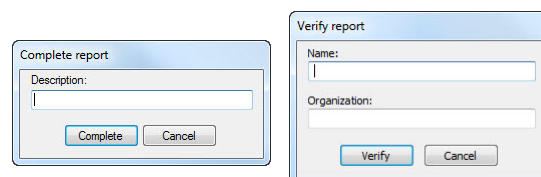

Figure 231 – Complete report and Verify report dialog

20.3 View report

Click on the ⛃ **View report** icon in the **Reports** dialog or click with the right mouse button on the report and select the ⛃ icon. The report will be opened. The report heading (see Figure 232) contains following information:

- **Patient** - name, date of birth and other predefined identification data
- **Manufacturer**
- **Completion flag** - report status (partial, complete, verified)
- **Predecessor Docs -** link to the original document
- **Verification Flag** - report verification (verified, unverified)
- **Content Date/Time -** date and time of creating the document. When editing a partial document, the time is not changed, the date and time of the primary document is displayed.
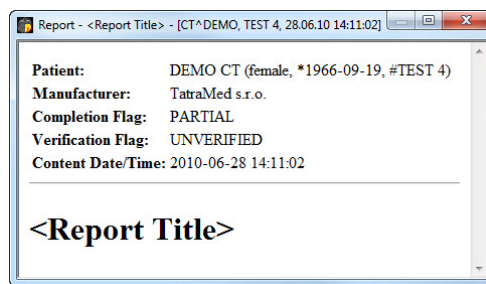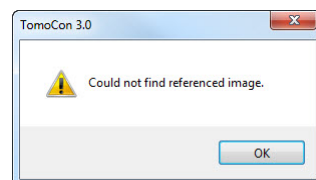
Figure 232 – Report heading

Figure 233 – "Could not find referenced image" dialog

If there is a link to a patient image in the report, click on the link to display the image in the current view. When the study with this image is not opened in TomoCon a dialog will be opened informing that the referenced image can not be found (see Figure 233).

It is also possible to copy the report text to the clipboard or to a text file (MS Word for example). Using the mouse or keyboard shortcut **Ctrl+A** select the text, press **Ctrl+C** to copy and **Ctrl+V** to insert the text into the document.

Open a report and press **Ctrl+P** keys. A standard MS Windows dialog for print will be opened. Using the **Print** dialog the report can be printed on a standard MS Windows printer.

Click on the [X] button at the right top corner of the dialog or press **Esc** key to close the report.

20.4 Edit a report

Select a report from the **Reports** and click on the 🖉 **Edit report** icon to edit the existing report. Partial documents can be edited anytime. When editing a complete and verified document a new report will be created with identical contents. Before editing a dialog will be open informing about creating a revised version (see Figure 234).
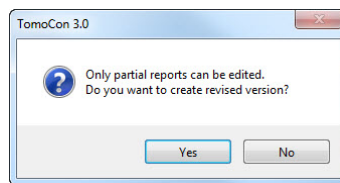

Figure 234 – "Only partial reports can be edited. Do you want to create revised version?" dialog

The original document will not be changed a link to the original document will be added (Predecessor Docs) in the heading of the revised version. If the original report was not loaded into the application, it is not possible to open it.
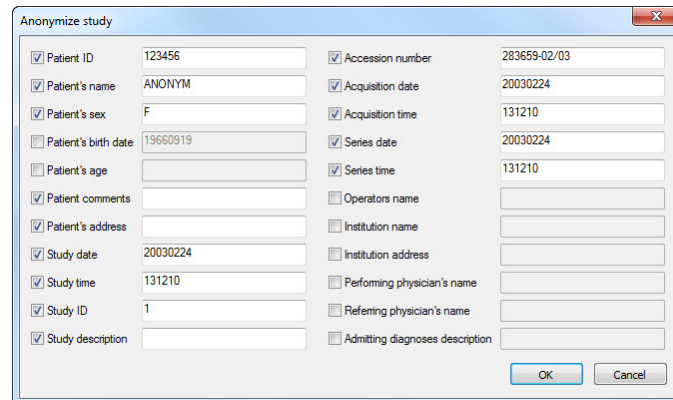
20.5 Save a report

Open the **Study** menu and select **Save** item to save the report. When closing TomoCon, a dialog will be opened to assure if you really want to to save unsaved changes.

20.6 Delete a report

Select a report in the **Reports** list and click on the ✖ **Delete report** icon or select **Delete** item in the context menu. A dialog will be opened to assure if you really want to delete the report. Click on the **Yes** button to delete the report from the **Reports...** list.

21 Study anonymization

TomoCon allows you to save the series of all opened studies as a new anonymized study to the Local studies. Use the **Anonymize study** dialog (see Figure 235) that will be opened after clicking on **Anonymize study...** item in the **Study** menu.

Figure 235 – Anonymize study dialog

The items in the dialog are filled with DICOM data received from the first opened study. Click on the checkbox next to the item you want to change. This will allow you to write in the text box of the item. Press the **OK** button to save the new anonymized study. Follow the saving process in the **Saving anonymized study...** dialog (see Figure 236).
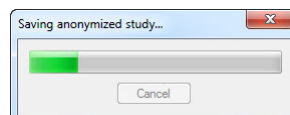

Figure 236 – Saving anonymized study … dialog

22   Create a new patient study/series

New study or new series can be added by **Select study** dialog, which will be displayed after clicking at the **Create new series…** item in the **Study** submenu in the **TomoCon** menu (see 3.4 Main menu).

To create new series in the existing study:

1. Select existing study for insertion of new series from studies list in the **Select study** dialog (see Figure 237).

2. Click on the **OK** button in the **Select study** dialog (**New series** dialog will be opened).

3. Fill information about new series in the **New series** dialog (see Figure 239) and click on the **OK** button.

4. New series will be automatically added to selected study.
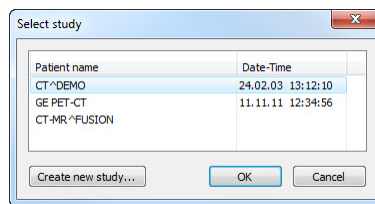

Figure 237 – Select study dialog

Figure 238 – New study dialog

To create new series in the new study:

1. Click on the **Create new study…** button in the **Select study** dialog (**New study** dialog will be opened).

2. Fill information about new study in the **New study** dialog (see Figure 238) and click on the **OK** button (**New series** dialog will be opened).

3. Fill information about new series in the **New series** dialog and click on the **OK** button.
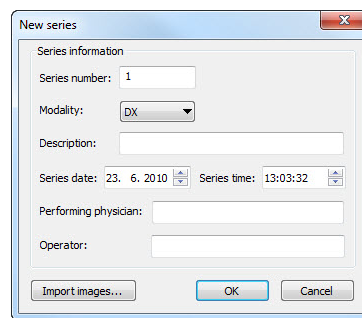
4. New study with new series will be automatically added.

Figure 239 – New series dialog

23 Archive images on CD

Patient studies in TomoCon can be archived on a CD medium using the **Create CD** dialog. To write this data on a CD is necessary to meet one of the following requests:

- Operating system (minimal) Microsoft Windows XP with started "`Windows IMAPI`" or "`Windows IMAPI2`" service.

- Installed Nero Burning ROM 6.3 or higher.

In case that the system doesn't meet any of these requirements, the data can be archived to the chosen directory on the disk.

The **Create CD…** dialog (see Figure 240) will be opened by clicking on the **Create CD…** submenu in the **Study** menu. The **Create CD…** dialog will display the set of patient data prepared for backup at the CD. Press the **Add** button to add the currently opened studies to the prepared data set. To remove a study, series or an image from the set press the **Remove** button or **Delete** button on the keyboard. After pressing the **Remove all** button all studies from the prepared data set will be removed.
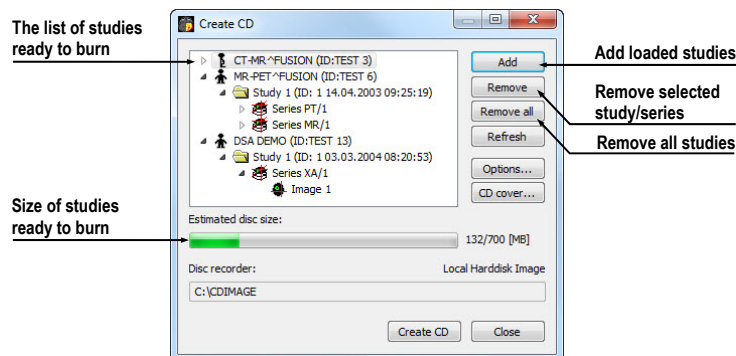

Figure 240 – Create CD dialog

Press the **Create CD** button to write the prepared data set onto a CD or to the chosen directory on the disk (depending on the **Disc recorder** settings).

The **Create CD** dialog will be closed after pressing the **Close** button; the created data set will be kept for archiving. When re-opening the dialog (e.g. when loading new patients to the application), the set will be available and new studies can be added by pressing the **Add** button.

It is possible to add patient studies to a CD with already archived patient data. The **Create CD** dialog will display the newly added studies/series with the already archived studies. It is not possible to remove them (see Figure 241).
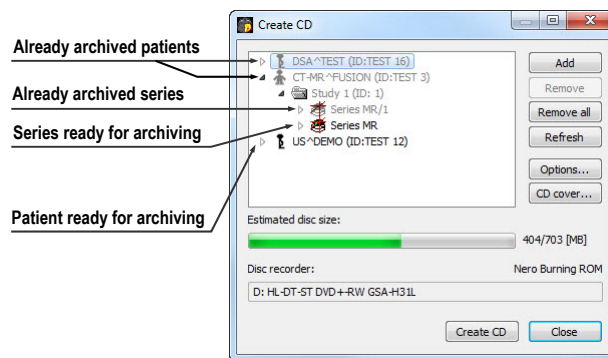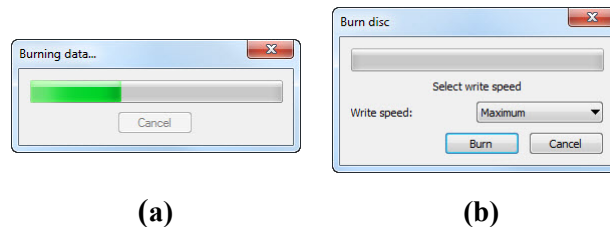
Figure 241 – Create CD dialog (add a study/series to the CD)

Press the **Create CD** button to start the archiving process. Process of burning will be displayed in dialog (see Figure 242).

(a)   (b)

Figure 242 – Archive patient image data in progress, IMAPI CD-Burning COM (a), Nero Burning ROM (b)

Press the **Options…** button to specify the archiving settings. The **Create CD options** dialog will be opened (see Figure 243).

The following settings are available:

- **Disc recorders** - select one of the available type of burning and select **Disc recorders** to be used for archiving.

- **Maximal CD capacity** - user specified CD capacity.

- **Temp directory** - created automatically in the user's temporary disk region for temporal archiving.

- **Export directory** - directory for export image of CD in case of choosing Local Hard disk Image recorder.

- **Template directory** - directory, which will be copy to CD during burn CD.

- **Clear temp directory after burning directory** - if this option is checked, user's temporary disk region for temporal archiving will be deleted after burn process.

- **Include** - image data format to be archived:
  - If JPEG images are to be copied, the archive will contain html file structure similar to the archived patient-series-images structure (to allow

simple viewing). Microsoft Internet Explorer is required to display the archive.

- o If DICOM images are to be copied, TomoCon Lite viewer will be added to the archive. It contains full TomoCon functionality except the data import. Only the DICOM image archive on the CD can be viewed with it.
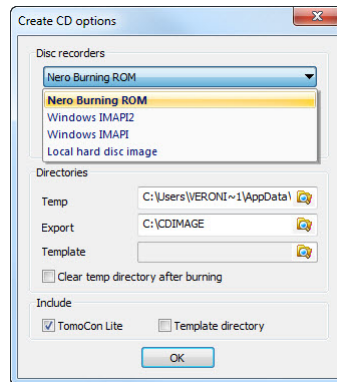

Figure 243 – Create CD options dialog

To create and print the cover for the created CD use the **CD cover** dialog (see Figure 244). Press the **CD cover…** button to open the dialog. The list of the patients from the **Create CD** dialog will be automatically added to the front and the back page of the cover.

Following settings are available in the **CD cover** dialog:

- **Print Setup** tab:
  - Type of CD cover (**Classic cover**, **Slim cover**)
  - Margins
- **Front page** tab:
  - Setting up the picture that will be laid behind the text on the front page (**Bitmap**). Press the **Change** button to select a picture and click on 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 on the check box to print the title on the front page.
- **Back page** tab - the settings are the same as the front page settings.

Press the **Print** button to print the CD cover. A standard MS Windows dialog for print will be opened (the **Print** dialog). Select a printer, specify parameters for print and press the **OK** button to start printing.
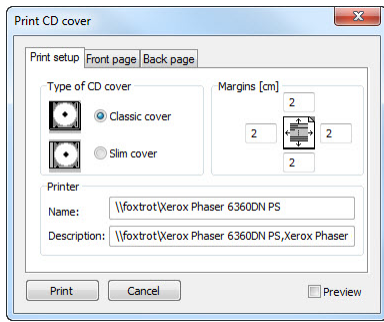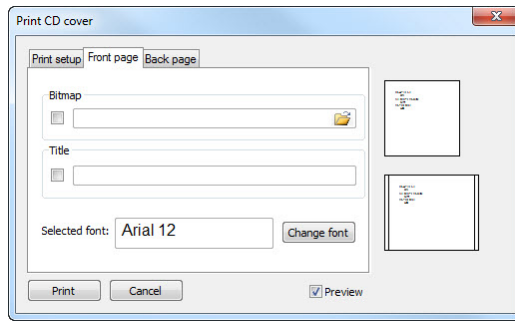
(a)   (b)

Figure 244 – CD Cover dialog, Print setup tab (a), Front page and Back page tabs (b)

24   Contact

If you have any questions or comments, please contact our headquarters:

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