

TomoCon 3.0

User's Manual

TatraMed

TomoCon 3.0 Workstation
TomoCon 3.0 Viewer
TomoCon 3.0 Lite

Version 3.0.14

TomoCon PACS 3

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All patient names used in this manual are fictitious.

Table of Contents

1	General note.....	8
1.1	Intended use	8
1.2	Safety precautions.....	8
1.3	Medical device class and CE Mark.....	8
2	Getting started.....	9
2.1	Installing and uninstalling TomoCon.....	9
2.1.1	System installation requirements	9
2.1.1.1	Hardware requirements	9
2.1.1.2	Additional hardware recommendation.....	9
2.1.1.3	Software requirements	9
2.1.2	Installing TomoCon	10
2.1.3	Uninstalling TomoCon.....	10
2.1.4	Installing licenses.....	10
2.2	Starting TomoCon.....	11
2.3	Logging in to TomoCon.....	11
3	Using TomoCon	12
3.1	Working area.....	12
3.1.1	Working area layout.....	12
3.1.2	Organizing your layouts.....	14
3.1.2.1	Save layout.....	14
3.1.2.2	Load layout	15
3.1.2.3	Layouts manager	15
3.1.3	Current view.....	16
3.2	Thumbnail palette	16
3.3	Main menu	19
3.4	Toolbars	19
3.5	Status bar.....	20
3.6	Navigating through the menus	21
3.6.1	TomoCon menu	21
3.6.2	Study menu	21
3.6.3	Tools menu.....	22
3.6.4	Image menu.....	23
3.6.5	Filter menu	24
3.6.6	Annotations menu	24
3.6.7	Flip/Rotate menu.....	25
3.6.8	Layout menu	26

3.6.9	View menu	27
3.6.10	Help menu	28
3.7	Coordinate Systems	28
3.7.1	Image Transformation	29
3.7.2	No Transformation	29
3.7.3	Current point	29
4	Setting up the application - User Preferences	30
4.1	Setting up the application	30
4.2	Mouse actions	31
4.3	Displayed texts in views	32
4.4	Modality settings	33
4.5	Color settings	34
4.6	Application language	36
5	Retrieving and Opening study	37
5.1	Finding studies	37
5.2	Local studies	38
5.3	Opening multiple studies	40
5.4	TomoCon PACS server	40
5.5	DICOMDIR	41
5.6	External data acquisition devices	41
5.7	Send study to external data device	41
5.8	Monitoring and controlling the send/receive process	42
5.9	Settings	43
5.9.1	Local studies properties	43
5.9.2	DICOM receiver settings	44
5.9.3	External DICOM device configuration	44
5.10	Save a patient study	44
5.11	Close a patient study	44
6	Viewing images	46
6.1	Display image in view	46
6.2	Image sequence	48
6.3	Series synchronization	49
6.4	Play multi-frame images	51
7	Manipulating Images	53
7.1	Window and Level manipulations	53
7.1.1	Window/Level dialog	53
7.1.2	Presets	54

7.1.3	Adjusting Window/Level with the mouse	54
7.2	Zooming image views.....	55
7.2.1	Zoom dialog	55
7.2.2	Zooming with the mouse	56
7.2.3	Panning with the mouse	56
7.2.4	Magnifying glass.....	56
7.3	DSA - Digital Subtraction Angiography.....	57
7.3.1	Automatic DSA mode.....	57
7.3.2	Manual DSA mode	58
7.4	Cutlines	59
7.4.1	Delete cutlines.....	60
7.4.2	Auto mode.....	61
7.4.3	Print and save cutlines	61
7.5	Image fusion.....	61
7.6	Key image notes.....	63
7.6.1	Add key image note	63
7.6.2	Review and edit key image note	63
7.6.3	Load and save key image note	64
7.7	Exporting images	65
7.7.1	Export images	65
7.7.2	Export images to AVI format video file	66
7.8	Insert new image to series.....	67
8	Hanging protocols.....	68
8.1	Apply hanging protocol	68
8.2	Importing and exporting of hanging protocols	69
8.3	Creating and modifying hanging protocol	70
8.3.1	Hanging protocol properties dialog	70
8.3.2	Identification of applicated criteria and properties	72
9	Annotations and measurements	73
9.1	Text annotations.....	75
9.2	Marker annotations	75
9.3	Distance.....	76
9.4	Distances and angle.....	76
9.5	Probe	76

9.6	Density spot	77
9.7	Density profile	77
9.8	Ellipse	78
9.9	Rectangle.....	79
9.10	Free area.....	79
9.11	Cobb angle	80
9.12	Calibration.....	80
9.13	Hide / show annotations.....	81
9.14	Discard annotations.....	81
9.15	List of annotations.....	82
10	Contouring the patient – create ROIs	83
10.1	Adding new ROI	84
10.2	ROI algebra.....	85
10.3	Simplify ROI.....	85
10.4	Copying ROIs	86
10.5	Export ROI to DXF or VTK file.....	86
10.6	Edit ROI properties	87
10.7	Edit contours	88
10.8	Automatic contouring	90
11	MPR - Multi Planar Reformatting.....	92
11.1	Arbitrary MPR	93
11.2	Online MPR	93
11.3	Interactive moving and rotating.....	94
12	MIP - Maximum Intensity Projection.....	95
13	DRR Reprojection	96
14	Three-Dimensional Visualization.....	97
14.1	3D View settings.....	97
14.2	Rotation, spatial orientation.....	99
14.3	Moving MPR plane.....	99
14.4	Volume rendering	100
15	Registrations	102
15.1	Defining the registration	102
15.1.1	Identity	103
15.1.2	Patient-related (CA-CP).....	103
15.1.3	Surface matching	104
15.1.4	Landmark	104

15.1.5	Manual	105
15.1.6	MIR.....	107
16	Print images	109
16.1	MS Windows printer.....	109
16.2	DICOM printer.....	111
16.2.1	DICOM print working area.....	111
16.2.2	DICOM print thumbnail palette.....	112
16.2.3	DICOM print menu.....	112
16.2.4	DICOM print standard toolbar.....	113
16.2.5	DICOM print status bar	113
16.2.6	DICOM printer installation.....	114
16.2.7	Setting up DICOM print interface properties	115
16.2.8	Edit images.....	116
16.2.9	Images for print.....	116
16.2.10	Edit and move films	117
16.2.11	Monitoring and controlling the print process.....	117
17	Touch screen mode	119
17.1	Open a patient study.....	120
17.2	Close a patient study	120
17.3	Window, level, shape settings.....	121
17.4	Move and zoom images	122
17.5	Working area layout.....	122
17.6	Play multi-frame images	123
18	Structured reports	124
18.1	Create a new template	124
18.2	Create a new report	124
18.3	View report	127
18.4	Edit a report.....	128
18.5	Save a report	128
18.6	Delete a report.....	128
19	Study anonymization	129
20	Create a new patient study/series.....	130
21	Archive images on CD	132
22	Contact.....	136

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 Windows 2000 or Windows XP Professional, 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 IIa medical device*, according to the directive MDD 93/42/EEC and has been certified so. Written declaration of conformity is available on request (see **22 Contact**).



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, min. 1 GHz clock speed (Pentium 4 2.5 GHz and higher),
- **Memory** 256 MB (512 MB),
- **CD-ROM,**
- **Hard Disk** 100 MB free disk space for software installation (at least 10 GB for patient image data),
- **Display** 19" CRT or 17" LCD color monitor (21" CRT or 19" LCD monitor, two monitors with dual-head graphics adapter),
- **Graphic Card** 1024x768 pixel resolution, True color (32 bit color depth), (dual-head graphics adapter, 3D-accelerated graphics).

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, XP, Vista,
- **Microsoft Internet Explorer** version 5.5 or higher,

TomoCon Viewer, TomoCon Lite:

- **Operating System** Microsoft Windows 2000, XP, Vista,
- **Microsoft Internet Explorer** version 5.5 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 WS provides the following licenses:

- MIR registration licence (see **15.1.6 MIR**),
- Volume Rendering licence (see **14.4 Volume rendering**),
- licence for saving RT structures in DICOM format.



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

To install a licence to TomoCon follow these steps:

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

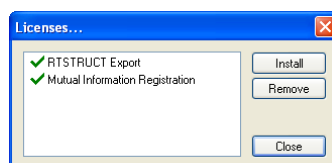


Figure 1 – Licenses... dialog

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 **17 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 (see Figure 3) consists of the following parts:

- Working area (see **3.1 Working area**),
- Thumbnail palette (see **3.2 Thumbnail palette**),
- Main menu (see **3.3 Main menu**),
- Toolbars (see **3.4 Toolbars**),
- Status bar (see **3.5 Status bar**).

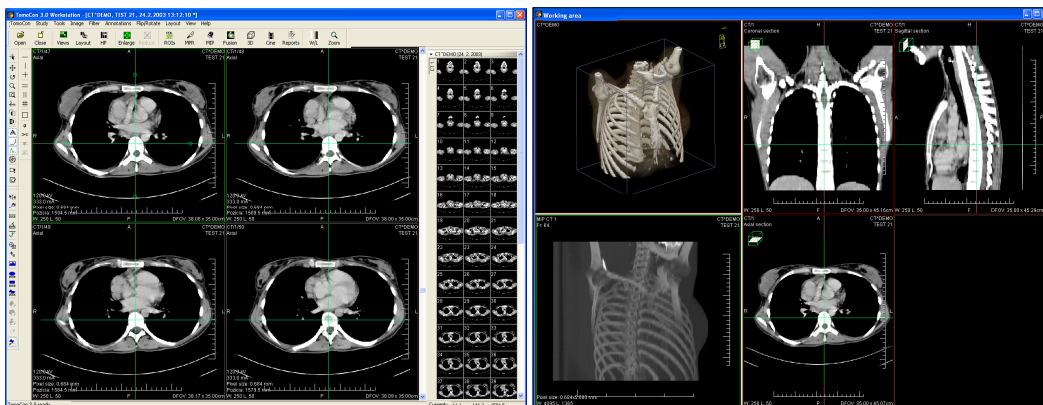


Figure 3 – Application TomoCon

3.1 Working area

Working area is an area for visualization and diagnostics of patient data (displays slices 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 another smaller segments. After you have created new working area, you can divide it to the desired layout by dividing segments and defining views layout for each of them. You can also change the

existing layout anytime by resizing or deleting segments, which have been defined previously.


To divide existing segment into another smaller segments (see Figure 4 a):

1. Select requested type of dividing from the **Layout** toolbar,
2. Click with left mouse button to the segment, which you want to divide.

Segments are divided by thick separation lines, which you can move and change bound of adjacent segments. To change boundaries of adjacent segments (see Figure 4 b):

1. Move cursor on the boundary line, which you want to move,
2. Press left mouse button, move line to requested place and release mouse button,

To remove existed segment/segments (see Figure 4 c):

1. Select  **Delete segments** item in **Layout** toolbar,
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.

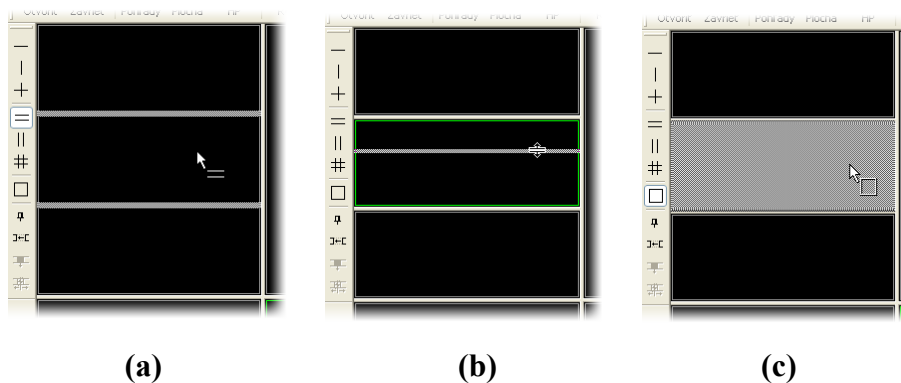



Figure 4 – Definition of segments in working area, divide segment (a), move bound of segment (b), delete segment (c)

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 5):

1. Click with left mouse button on the selected segment,
2. Select  **Views** item in main toolbar,
3. Select requested layout of views in grid, which has been displayed.

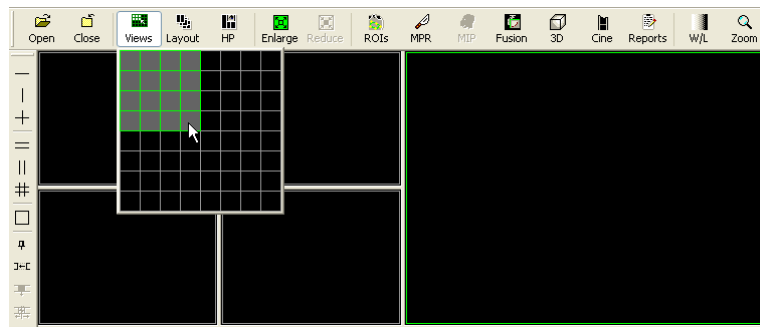


Figure 5 – Definition of views for segment

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 lets 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 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 6), which will be displayed.

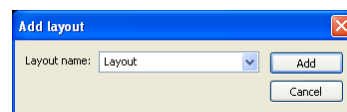



Figure 6 – Add layout dialog

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

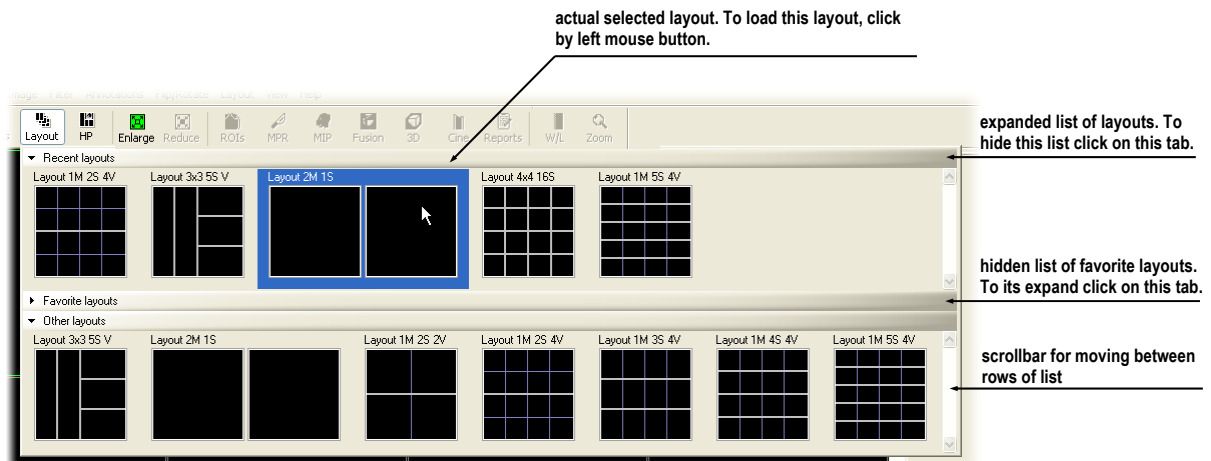


Figure 7 – Layouts list

3.1.2.3 Layouts manager

Layouts manager allows you to change base properties of already saved layouts with **Layouts manager** dialog (see Figure 8). 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).

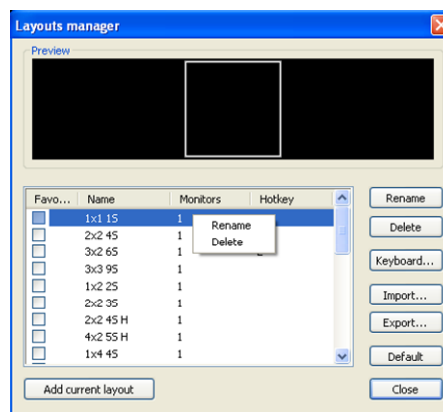


Figure 8 – Layouts list dialog

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 9). Current view is outlined with a coloured frame according to the TomoCon settings (you can change the colour of the frame, see **4.5 Color settings**).

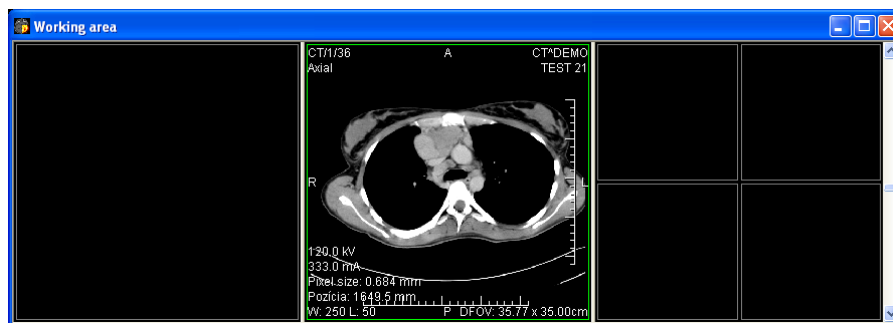


Figure 9 – Working area

3.2 Thumbnail palette

The thumbnail palette (see Figure 10) is placed on the right side of the main application window by default and contains images of opened studies displayed as thumbnail previews.

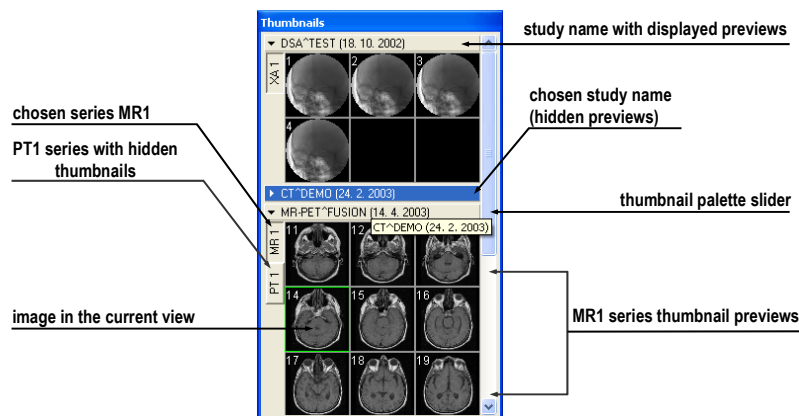


Figure 10 – Thumbnail palette (Tabbed mode)

Each study is displayed in the Thumbnail 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 Thumbnail palette. Selection of this

representation type is possible using the Thumbnail palette's context menu (after pressing right mouse button on the selected study in the thumbnail palette and selecting the **Show series** item). Thumbnail 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 11 a),
- **All - separated**, thumbnails of all series of the study are displayed at once, sorted according to series (see Figure 11 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 12).

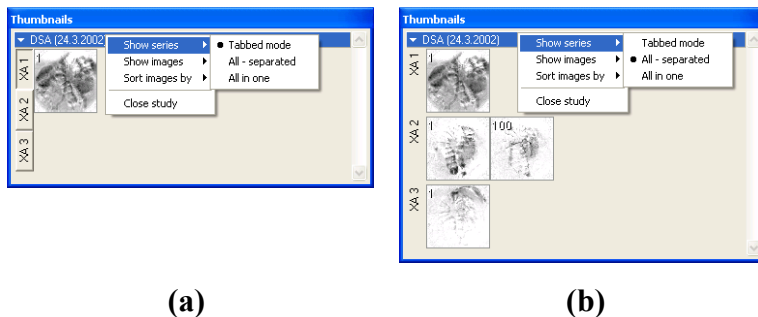


Figure 11 – Displaying series in Tabbed mode (a), All – separated (b)

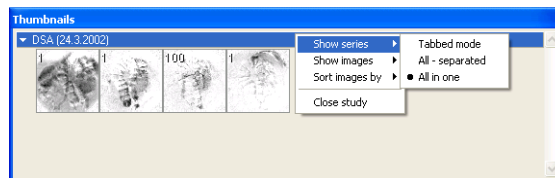


Figure 12 – Displaying series in All – in one mode

Similar to the selection of the series representation type in the Thumbnail palette, it is also possible to select the image representation type in the series. Image representation type is possible using the Thumbnail palette's context menu and selecting the **Show images** item (see Figure 13). Thumbnail palette supports following image representation types for the series:

- **Show all images**, all images of each series of the selected study are displayed,
- **1 image out of**, selected number specifies the image interval of each series of the selected study to display,
- **One image only**, first image of each series of the selected study is displayed,

- **First, middle and last**, first, middle and last image of each series of the selected study is displayed.

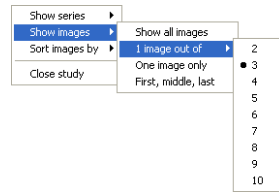


Figure 13 – Context menu for selection of the image representation type

Additionally, image thumbnails from the selected study can be sorted in the Thumbnail palette using the **Sort images by** context menu item (see Figure 14):

- **Index number** - as opened in TomoCon,
- **Instance number** - instance number value in DICOM data,
- **Image position** - image sorted by position,
- Reverse sort mode.

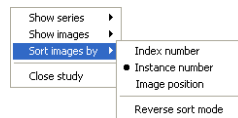


Figure 14 – Context menu for sorting images

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 10).

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 thumbnail palette to choose from the series (thumbnails) that could not be seen on the screen.

The thumbnail palette may be resized and can be docked inside the application border, can be also floating, placed anywhere on the screen. When starting the application the thumbnail palette is docked at the right side border. Afterwards its size and position can be changed. The position can be changed by dragging and moving the palette the same way as moving the toolbars.

It is possible to display multiple thumbnail palettes, e.g. each one with different series displayed (see **3.6.9 View menu**).

3.3 Main menu

The TomoCon main menu (see Figure 15) consists of the following menus:

- **TomoCon** - application settings, image data print (see **3.6.1 TomoCon menu**),
- **Study** - patient study handling (see **3.6.2 Study menu**),
- **Tools** - tools for image data handling (see **3.6.3 Tools menu**),
- **Image** - view images and manipulation with images (see **3.6.4 Image menu**),
- **Filter** - filters to soften or sharpen the current view (see **3.6.5 Filter menu**),
- **Annotations** - create annotations in the current view (see **3.6.6 Annotations menu**),
- **Flip/Rotate** - flip and rotate image in the current view (see **3.6.7 Flip/Rotate menu**),
- **Layout** - layouts and hanging protocol management (see **3.6.8 Layout menu**),
- **View** - display/hide parts of the main menu, image descriptions, change the current view size, delete views, create image sequence, etc. (see **3.6.9 View menu**),
- **Help** (see **3.6.10 Help menu**).



Figure 15 – TomoCon menu

3.4 Toolbars

Following toolbars are available in TomoCon. They contain frequently used tools from the main menu:

- **Context bar** (see Figure 16),
- **Standard toolbar**:
 - Large toolbar (see Figure 17),
 - Small toolbar (see Figure 18),
- **Annotations** (see Figure 19),

- **Flip/Rotate** (see Figure 20),
- **Layout** - toolbar for definition working area layouts (see Figure 21),

All toolbars can be resized and docked anywhere inside the application border, can be also floating and placed anywhere on the screen.

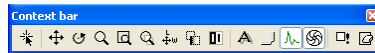


Figure 16 – Context bar



Figure 17 – Standard bar (big version)



Figure 18 – Standard bar (small version)



Figure 19 – Annotations bar



Figure 20 – Flip and rotate

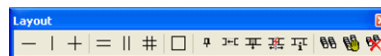


Figure 21 – Layout

3.5 Status bar

The Status bar is located at the bottom part of the application window. If the user selects a menu item or a toolbar button, its description appears on the left side of the Status bar (instead of the text: “TomoCon 3.0 Ready”). On the right side of the Status bar the current point coordinates will be displayed, if user selects current point in the selected view.

In the case, the TomoCon application is receiving or sending studies through queue management, the count of remaining 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.

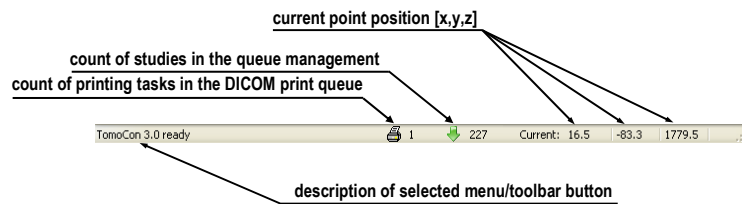


Figure 22 – Status bar

3.6 Navigating through the menus

3.6.1 TomoCon menu

The **TomoCon** menu consists of the following items (see Figure 23):

- **Setup...** - set up the application (see **4 Setting up the application - User Preferences**),
- **Print...** - print patient data on a MS Windows printer (see **16 Print images**),
- **DICOM Print...** - print patient data on a DICOM printer (see **16.2 DICOM printer**),
- **Exit** - close the application.

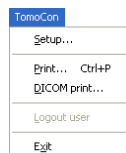


Figure 23 – TomoCon menu

3.6.2 Study menu

Following options are available in the **Study** menu (see Figure 24):

- **Open study...** - open selected DICOM studies retrieved from the external data source or open them from the Local Studies (see **5 Retrieving and Opening study**),
- **Save** - save modified DICOM studies to Local studies (see **5.10 Save a patient study**),
- **Close** - close all open DICOM studies (see **5.11 Close a patient study**),
- **Anonymize study...** - anonymize opened studies (see **19 Study anonymization**),

- **Create new series...** - creates new series in the new or in the selected study (see **20 Create a new patient study/series**),
- **Export images...** - export selected patient image (or series of images) into bitmap file (see **7.7.1 Export images**),
- **Export as AVI video...** - create a video file from a multi-frame image or the series of patient images (see **7.7.2 Export images to AVI format video file**),
- **Create CD...** - archive DICOM study and burn a CD (see **21 Archive images on CD**),
- **Reports...** - view and edit structured reports (see **18 Structured reports**),
- **Study info...** - display information about the current study.

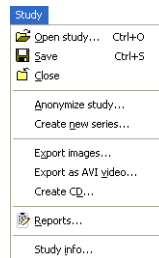


Figure 24 – Study menu

3.6.3 Tools menu

TomoCon contains **Tools** (see Figure 25) for patient image handling:

- **ROIs...** - create and modify ROI (see **10. Contouring the patient – create ROIs**),
- **MPR...** - display **MPRs** through the patient image data (see **11 MPR - Multi Planar Reformatting**),
- **MIP** - display MIP of selected patient series (see **12 MIP - Maximum Intensity Projection**),
- **Image fusion...** - display image fusion of registered series (see **7.5 Image fusion**),
- **3D view...** - display three-dimensional patient image data representation (see **14 Three-Dimensional Visualization**),
- **DRR...** - create **Digitally Reconstructed Radiograph** of the patient image data (see **13 DRR Reprojection**),
- **Window/Level...** - Window and level manipulations (see **7.1 Window and Level manipulations**),

- **Zoom...** - zooming the current view in or out (see **7.2 Zooming image views**),
- **Cine...** - play back multi-frame images or series in multi-frame (Cine) mode (like a movie), (see **6.4 Play multi-frame images**),
- **DSA...** - display XA images with highlighted difference between scans without and with contrast media (see **7.3 DSA - Digital Subtraction Angiography**),
- **Registrations...** - make registration between series of patient image data (see **15 Registrations**),
- **Touch screen mode** - run the touch screen mode (see **17 Touch screen mode**).

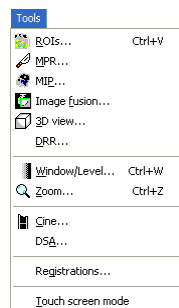


Figure 25 – Tools menu

3.6.4 Image menu

The **Image** menu (see Figure 26) allows simple image manipulations and browsing:

- **Point selection** - a click inside the image selects the current point and obtains coordinates, that will be displayed in the Status bar (see **3.5 Status bar**),
- Turn on/off simple image data modifications in the current view:
 - Change **Window** and **level** settings - **Window/Level**, **Window/Level rectangle** (see **7.1 Window and Level manipulations**),
 - **Invert** current image (reverse black and white colors)
 - **Zoom** in or out, **Zoom rectangle**, **Magnifying glass** (see **7.2 Zooming image views**),
 - **Move** the image,
- **MPR rotate**, **MPR move** - rotate and move MPRs,
- Define rectangle (**Shutter/Rectangle**) or elliptical shutter (**Shutter/Ellipse**) for hiding of some image parts,
- **Previous** and **Next** - scrolling through the series of images or MPRs,

- **DICOM dump...** - display detailed DICOM information about image in the current view.

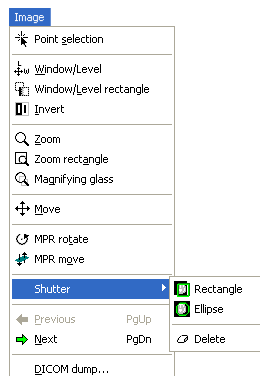


Figure 26 – Image menu

3.6.5 Filter menu

The **Filter** menu (see Figure 27) automatically applies Image processing filters to the image:

- **Soften** image,
- **Sharpen** image,
- Equalize levels using histogram (**Histogram equalization**),
- Turn off the filter (**Original image**).

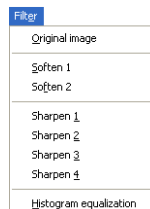


Figure 27 – Filter menu

3.6.6 Annotations menu

The **Annotations** menu (see Figure 28) allows following operations in the image:

- Using annotations and measurements:
 - Freely positioned **Text** in the image,
 - Description **Markers** for specific image points,
 - **Distance** between two points,
 - **Distances and angle** between three points,

- Cobb angle between two independent lines (**Cobb angle**),
- **Probe** - tracking circle tool for display point level values in the specified round area,
- **Density spot** - current point level value,
- **Density profile** over the line between two points,
- Density profile over the elliptical (**Ellipse**), rectangular (**Rectangle**) or freely outlined area (**Area**),
- Change **Value units** of annotations,
- **Unlock all** annotations,
- **Delete/Delete all** annotations,
- Display the list of annotations (**Annotations...**).

For detailed description see **9 Annotations and measurements**.

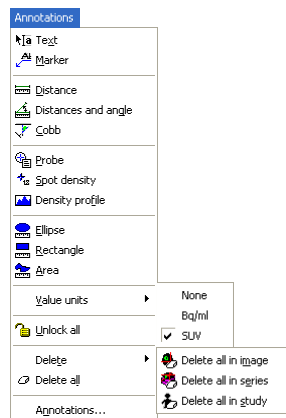


Figure 28 – Annotations menu

3.6.7 Flip/Rotate menu

The **Flip/Rotate** menu (see Figure 29) allows following actions with the current view:

- **Rotate right**,
- **Rotate left**,
- **Flip horizontal**,
- **Flip vertical**,
- **Original orientation**.

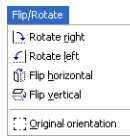


Figure 29 – Flip/Rotate menu

3.6.8 Layout menu

Following functions are available through the **Layout menu** (see Figure 30):

- **Hanging protocol manager...** - display dialog for managing and defining new hanging protocols,
- **Automatically apply** - set type of automatically applied hanging protocol,
- **Add layout...** - save current layout,
- **Layouts manager...** - display dialog for managing already defined layouts,
- **Views** - display grid for defining number of views in current segment,
- **Clear views after layout change** - when new layout will be loaded to application, all views will be erased,
- **Insert segments** - display menu for defining segments in working area,
- **Delete segments** - delete defined segments in working area,
- **Linked segments** - display menu for linking segments in working area,
- **Identify segments** - display color identification of segments in working area,
- **Segments synchronization** - display menu for defining and canceling synchronization between segments,
- **Pin view** - remove current view from sequence in segment.

For detailed description see **3.1 Working area**.

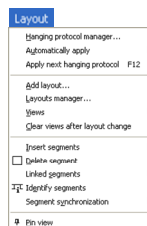


Figure 30 – Layout menu

3.6.9 View menu

Following functions are available through the **View** menu (see Figure 31):

- **Toolbars** - hide or display toolbars:
 - **Large toolbar** (see Figure 17),
 - **Small toolbar** (see Figure 18),
 - **Context bar** (see Figure 16),
 - **Annotations** (see Figure 19),
 - **Flip/Rotate** (see Figure 20),
 - **Masking panel**,
 - **Layout** (see Figure 21),
 - **Status bar** (see Figure 22),
- **Create new working area**,
- **Main thumbnail palette** - display/hide main thumbnail palette,
- **Create new thumbnail palette** - create additional thumbnail palette,
- **Point selection cursor** - display/hide red cross on the current point's position,
- **Text** - display/hide text description in the view,
- **Ruler** - display/hide horizontal and vertical ruler,
- **Curves** - display/hide curves in the image views, e.g. ECG,
- **Shutter** - display/hide image views using predefined shutter mask settings,
- **Annotations** - display/hide annotations and measurements,
- **Overlay** - display/hide overlays if they are available,
- **Color palette** - display/hide image color palette in segment,
- **Cutlines** (see 7.4 Cutlines),
- **Horizontal alignment** - change type of horizontal alignment in the current view,
- **Vertical alignment** - change type of vertical alignment in the current view,
- **Copy to clipboard** - copy image in the current view to the clipboard,
- **Reset view** - reset zoom, window & level, position and rotation settings of the current view to default levels,
- **Clear view** - clear the current view,
- **Clear all views** - clear all views of the current working area.

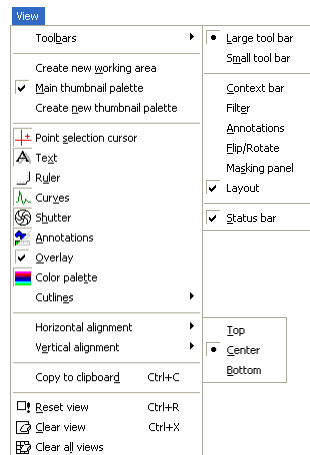


Figure 31 – View menu

3.6.10 Help menu

Use the **Help** menu to obtain the application version or browse the on-line user's manual (see Figure 32):

- **TomoCon manual** - on-line manual will be opened,
- **Licenses...** - the **Licenses** dialog is opened for managing licenses,
- **About...** - the **About...** dialog is opened informing about the current application version.

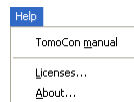


Figure 32 – Help menu

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 have 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:

- Anterior,
- Posterior,
- Left,
- Right,
- Head,

- **Feet.**

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, a corresponding position is calculated and displayed as the current point in the Status bar (see **3.5 Status bar**). If the series is displayed in the Status bar, it informs which series the displayed position belongs to.

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 **3.6.1 TomoCon menu**). The **TomoCon setup** dialog (see Figure 33) allows to:

- Set up the mouse wheel and buttons behavior and the application settings (see **4.1 Setting up the application**),
- Display/hide text types in views (see **4.3 Displayed texts in views**),
- Set up the modality settings (see **4.4 Modality settings**),
- Set up color shades and shape of TomoCon's objects (see **4.5 Color settings**),
- Set up the application language (see **4.6 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 33), the **TomoCon setup** dialog (see **3.6.1 TomoCon menu**):

- **View options** - view settings:
 - Turn on/off non-square views (**Allow non-square views**),
 - 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 slice selection into the current view by left mouse button click on slice in the thumbnail palette (**Allow select slice by click**),

- **Open on patient load** - display selected dialogs after selecting and opening patient:
 - The Gray dialog (see **7.1 Window and Level manipulations**),
 - The Zoom dialog (see **7.2 Zooming image views**),
 - The Cine dialog (see **6.4 Play multi-frame images**),
- **Mouse options**:
 - For more Mouse options using the buttons and the scrolling wheel in the current view see **4.2 Mouse actions**.

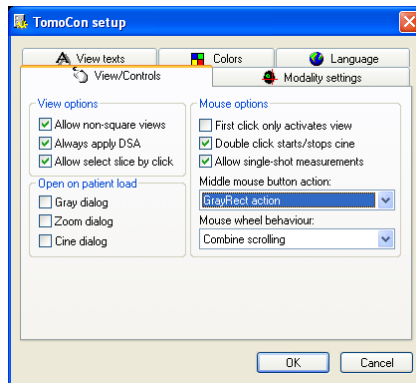


Figure 33 – TomoCon setup dialog, View/Controls tab

4.2 Mouse actions

Actions associated with middle mouse button and the scrolling wheel can be activated in the **View/Controls** tab, the **TomoCon setup** dialog (see Figure 33):

Choose following actions to be associated with middle mouse button:

- **--No action** – the mouse button will not be used in TomoCon,
- **Move action, Zoom action, Rotate action, Gray action, GrayRect action** - the mouse button will do only the selected function.

Additionally, scrolling the mouse wheel (often functional as the middle mouse button) can be used in different ways:

- **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.

It is possible to associate following actions with one and double mouse click on the view:

- **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.
- **Double click starts/stops cine**, double mouse click on the selected view, which displays an image, will start or stop playback of multi-frame image in the active view (see **6.4 Play multi-frame images**).

- **Allow single-shot measurements**, after selecting type of measurement, only one measurement can be defined.

4.3 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 34). In addition, you can also define your own texts, which will be displayed together with the predefined texts in views.

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

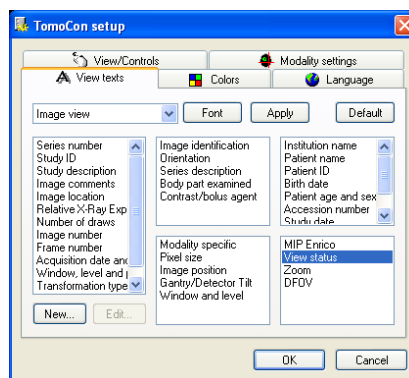


Figure 34 – TomoCon setup dialog, View texts tab

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 35) 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.

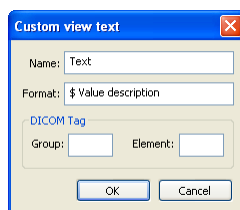


Figure 35 – Custom view text dialog

4.4 Modality settings

Use the **Modality settings** tab in the **TomoCon setup** dialog (see Figure 36) to set up properties separated for each modality:

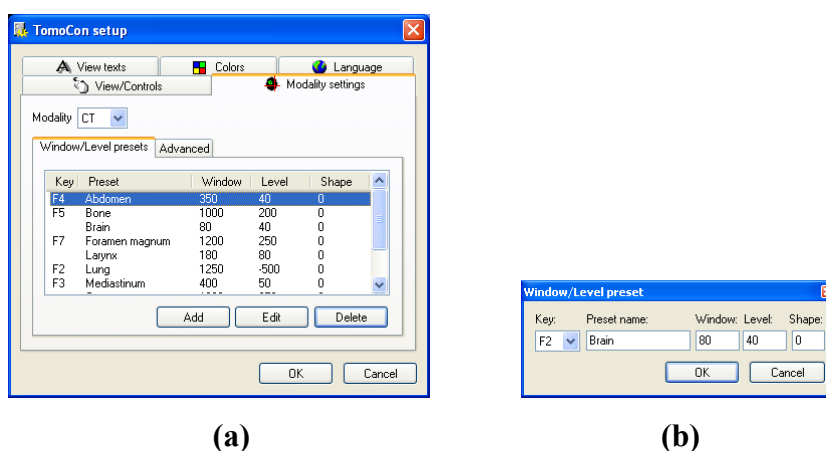


Figure 36 – TomoCon setup dialog, **Modality settings** tab, **Window/Level presets** sub tab (a), **Window/level preset** dialog (b)

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

- **Window/Level presets** sub tab (see Figure 36 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 36), which allows you to make the changes, will be opened.

- **Advanced** sub tab (see Figure 37) 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.

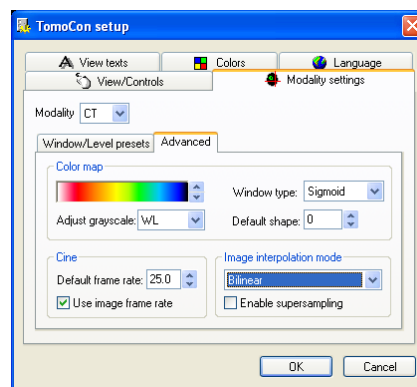


Figure 37 – TomoCon setup dialog, Modality settings tab, Advanced sub tab

4.5 Color settings

Default colors of certain displayed objects in TomoCon can be changed in the **Colors** tab, the **TomoCon setup** dialog (see Figure 38). It is possible to change colors for:

- **Cutline:**
 - Standard,
 - Current,
- **Point selection cursor**,
- **Overlay**,
- **Curves**, e.g. ECG,
- **Window frame**
 - **Standard** - frame views in the working area and in the thumbnail palette,
 - **Selected** - frame the chosen current view in the working area and in the thumbnail palette,

- **MPR** - frame view in the working area with actual editing MPR,
- **Pin** - frame view, which is pinned in segment in the working area,
 - **Image sequence** - frame image sequence views,
- **View frame space** - color and size of space between frames views,
- **Background** - background of all views in the working area,
- **MPR intersection** - current view's MPR position in other views and in the thumbnail palette,
- **Text** - text information in the views,
- **Key image note** - color identification of the key image note in the thumbnail palette,
- **View splitter** - type of splitter between segments in the working area.

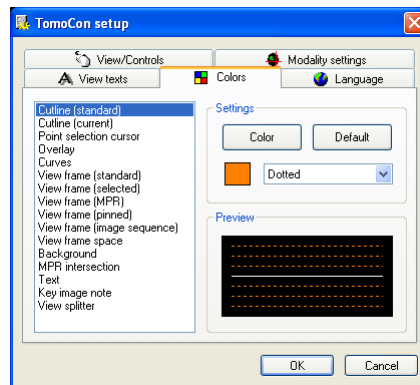


Figure 38 – TomoCon setup dialog, Colors tab

Click on the **Color** button or the current object's color box in **Settings** to choose a color. A dialog will be opened with default color palette or a palette created by the user. Click at the selected color; press **Default** to return to the default color.

Change the line types:

- **Solid,**
- **Dashed,**
- **Dotted,**
- **Dash-dot.**

Change the text type:

- **Simple,**
- **Extended.**

In **Preview** the subject with changed color or shape will be displayed.

4.6 Application language

TomoCon allows to select the application language using the **Language** tab in the **TomoCon** dialog (see Figure 39):

- **Slovenčina (Slovak),**
- **Čeština (Czech).**
- **English.**
- **Deutsch (German).**

The language will be changed after restarting the application.

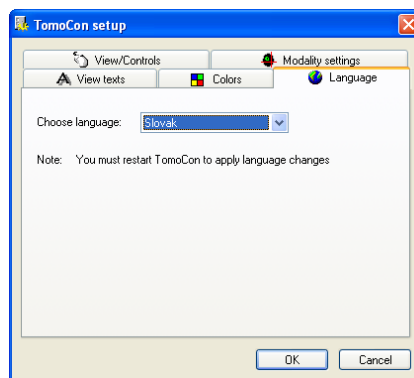



Figure 39 – TomoCon setup dialog, Language tab

5 Retrieving and Opening study

TomoCon application provides to you with studies management on all available storages in one clearly-arranged dialog (see Figure 42). You can display this dialog clicking on the  **Open** icon in main toolbar or by select **Open study...** item in the **Study** menu (see 3.6.2 Study 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 40):

Following criteria are available:

- **Patient name**,
- **Accession number**,
- **Patient ID**,
- Examination date:
 - **Today**,
 - **Yesterday**,
 - **From - To**,
- **Date of birth**,
- **Sex**,
- **Modality**:
 - **All Modalities**,
 - Choose 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.

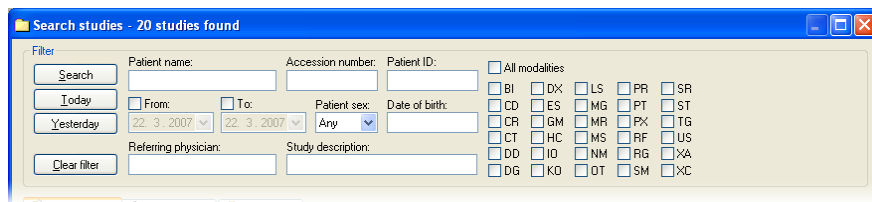


Figure 40 – Filter condition for searching studies

In addition, it is possible to search studies according to the selected study (see Figure 41). 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).

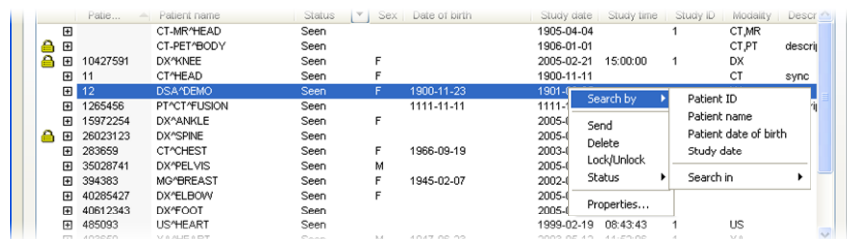




Figure 41 – Search study by selected study

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 42) and after select they can be opened.

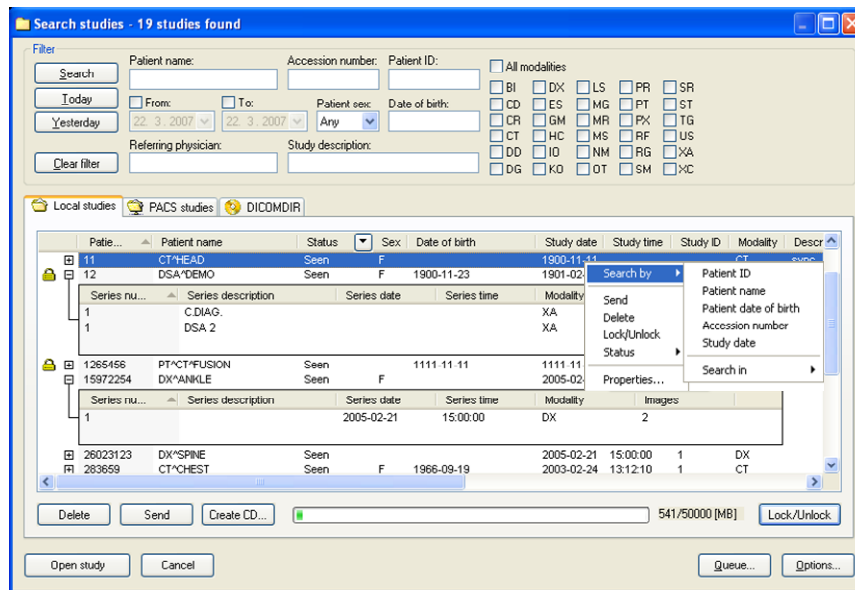



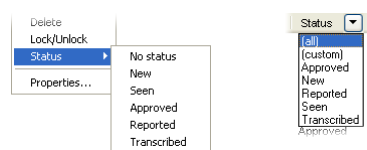
Figure 42 – Search studies dialog

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).

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 **21 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 43 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 43 b).



(a)

(b)

Figure 43 – 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 44). Choose the **No** button if you want to keep the currently opened studies. Press **Yes** to close the studies.

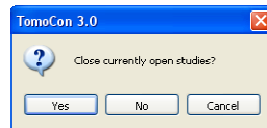


Figure 44 – “Close currently opened studies?” message box

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 45).

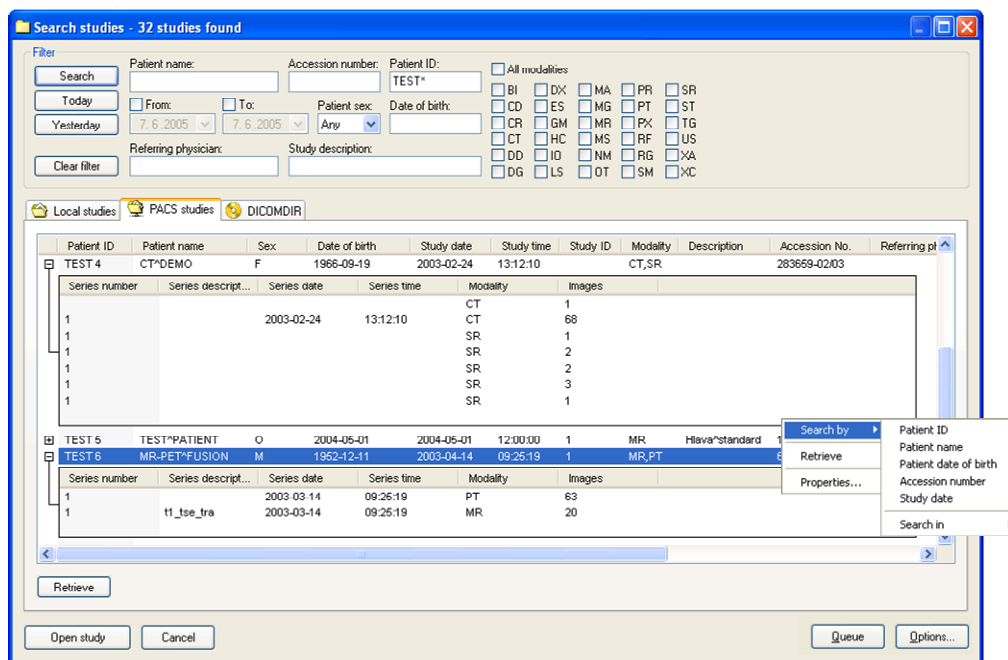


Figure 45 – Search studies on PACS server dialog

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

Any data stored in DICOM format, whether on CD, HD or shared network server directory, can be accessed over the **DICOMDIR** selection (see Figure 46).

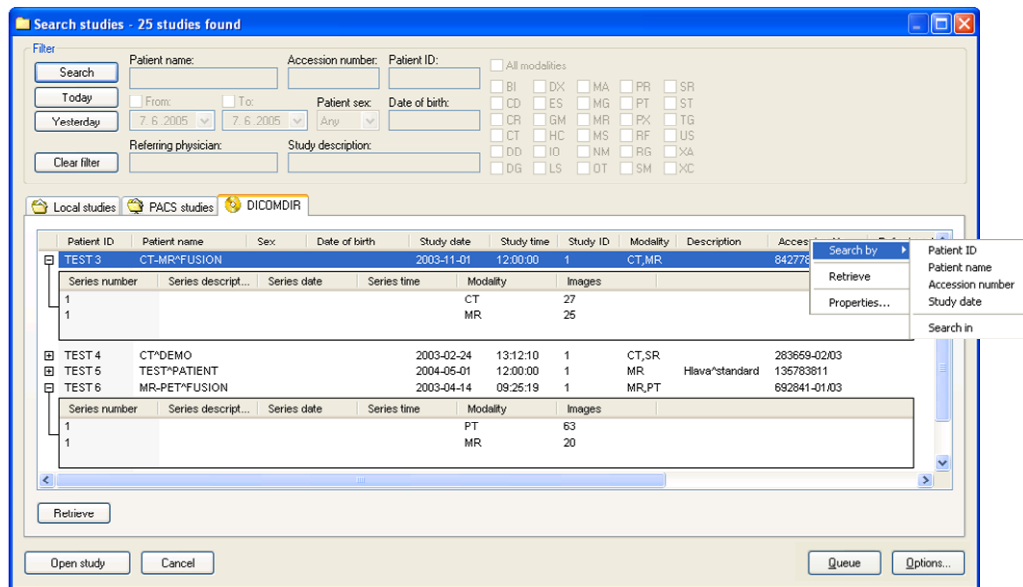


Figure 46 – Search studies in DICOMDIR dialog

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.

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 47) 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**).

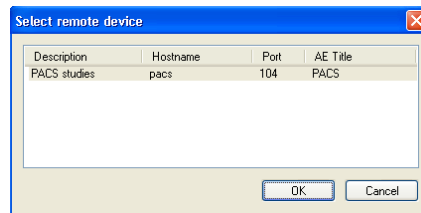


Figure 47 – Select remote device dialog

5.8 Monitoring and controlling the send/receive process

TomoCon allows with dialog **Queue management** (see Figure 48) monitoring and controlling the send or receive processes of studies between local studies storage and external data storages include the PACS system. This dialog will be displayed after click on the **Queue** button in the **Search studies** dialog. In this dialog you can monitoring 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.

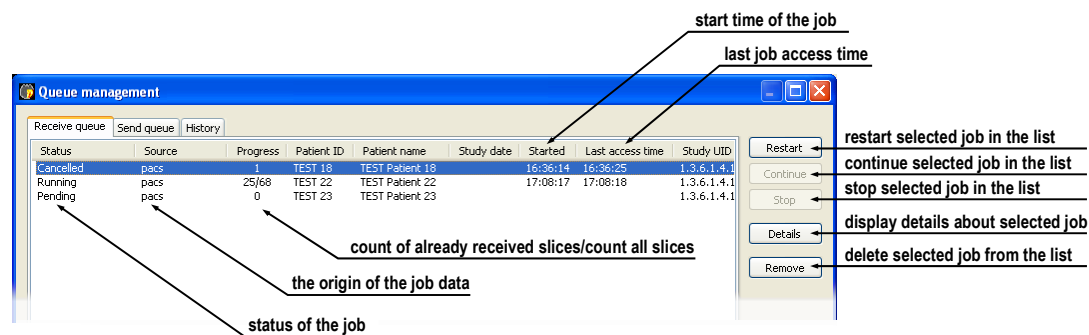


Figure 48 – Queue management, Receive queue tab

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 49). Consequently, receive/send process will be moved to Receive/Send queue.

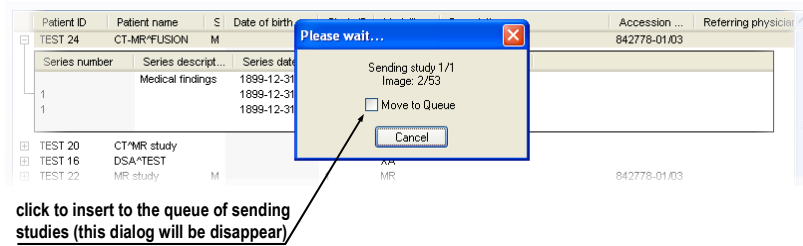


Figure 49 – Search studies dialog, sending of selected study from Local studies

5.9 Settings

Following settings are available through the **Options** dialog (see Figure 50 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**).

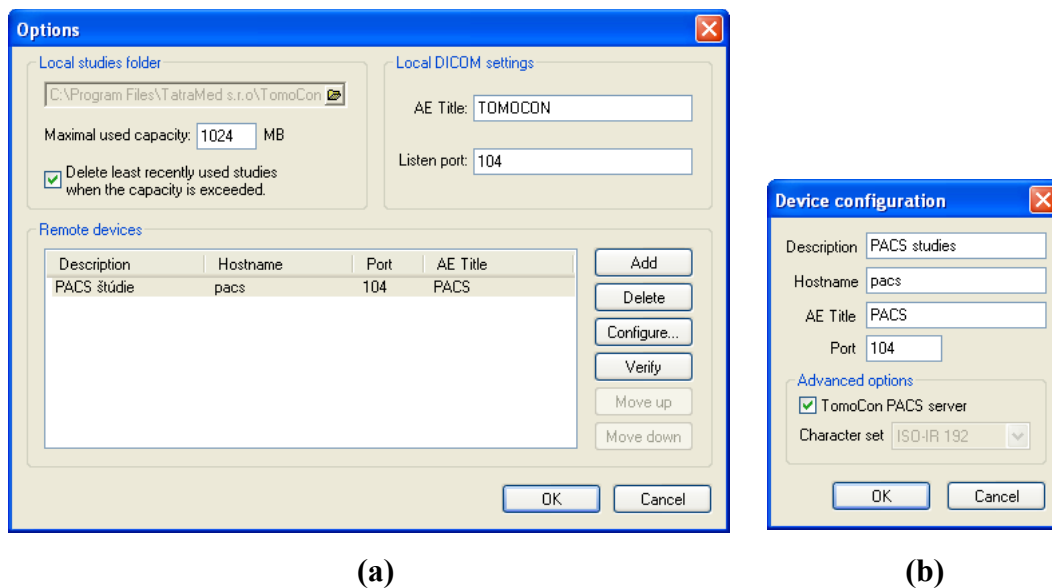


Figure 50 – Options dialog (a), Device configuration dialog (b)

5.9.1 Local studies properties

It is possible to define a folder for Local Studies in the **Options** dialog (see Figure 50 a). If local saved data size exceeds **Maximal used capacity** and check box **Delete**

least recently used studies when the capacity is exceeded is checked, the oldest studies will be deleted.

5.9.2 DICOM receiver settings

TomoCon has its own local DICOM receiver that saves patient data automatically to Local studies. 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 50 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 51) will inform you about the ongoing progress.

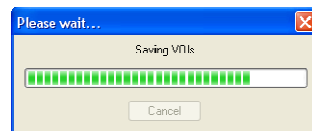



Figure 51 – Saving modified study data in progress...

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 52) allowing you to save unsaved changes (ROIs, registrations, annotations).

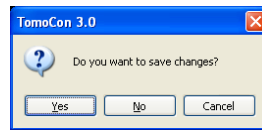


Figure 52 – "Do you want to save changes?" dialog

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

To display image in selected view:

1. Move mouse cursor over the requested image in thumbnail 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 53 a).

or

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 thumbnail palette and click by left mouse button (see Figure 53 b). The image will be displayed in the current view.

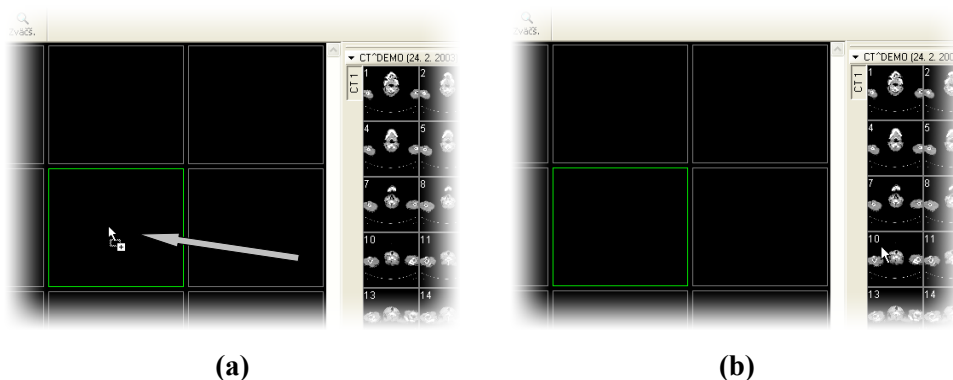


Figure 53 – Display image in view by drag&drop (a) Select image to display in current view (b)

When you select image in the current, non-pinned view, application will automatically create a sequence (see Figure 54), which will contains 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.

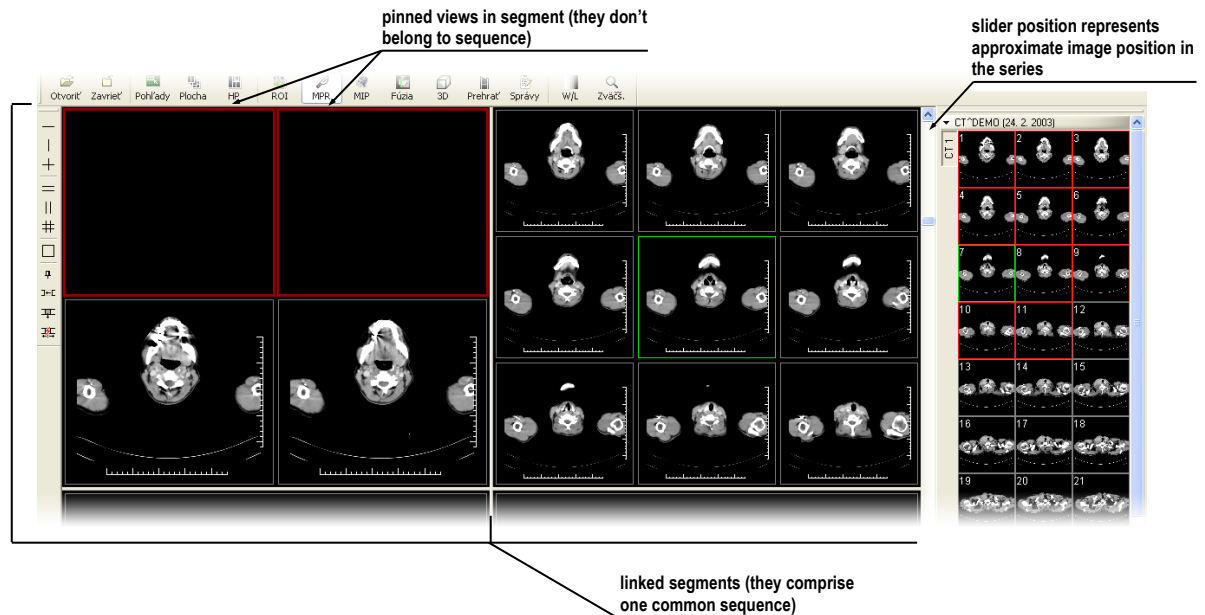


Figure 54 – Working area with non-multiframe image in current view

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 55).

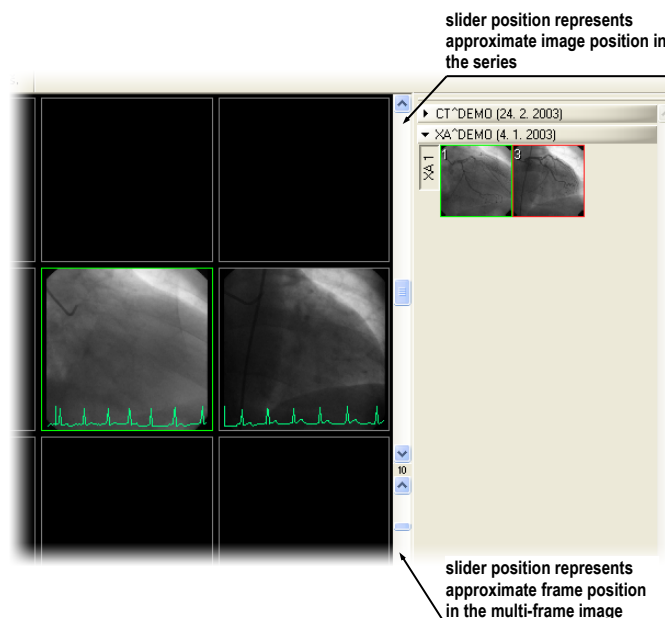



Figure 55 – Working area with multiframe image in current view

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 you select image in the current view, application will automatically create sequence of images in current segment. 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 **4.5 Color settings**).

To manually pin/unpin current view click on the  icon on the **Layout** toolbar. Status of this icon is displaying the pin status of current view (see Figure 54).

If you want to create sequence, which will contain more than one segment, application allows you to link selected segments (see Figure 56). Follow these steps:

1. Click with left mouse button on the first segment in sequence,
2. Click on the  icon in the **Layout** toolbar,
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.

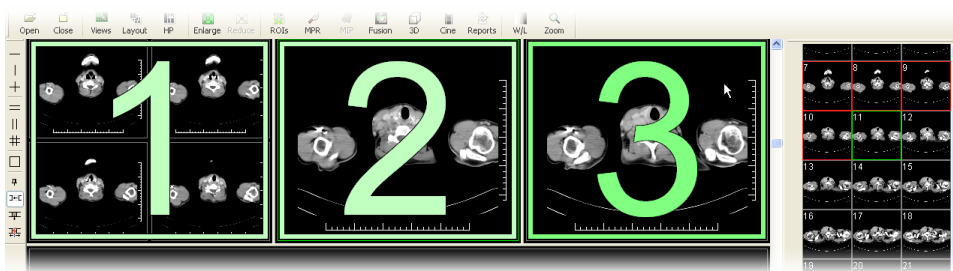



Figure 56 – Linking of segments to sequence

To remove linked segment from sequence (see Figure 57):

1. Click on the  icon in the **Layout** toolbar,
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.

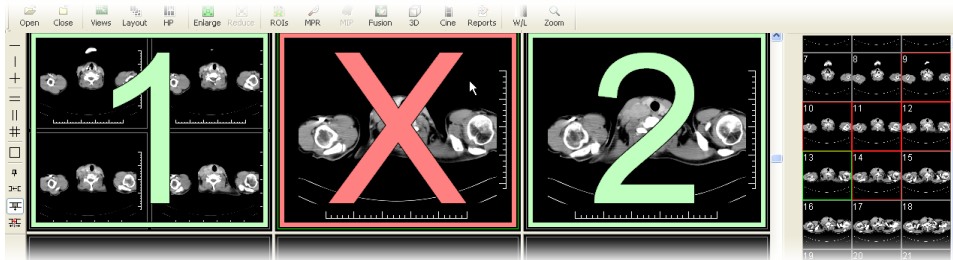



Figure 57 – Removing segment from sequence

To divide already existing sequence (see Figure 58):

1. Click on the  icon in the **Layout** toolbar,
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.

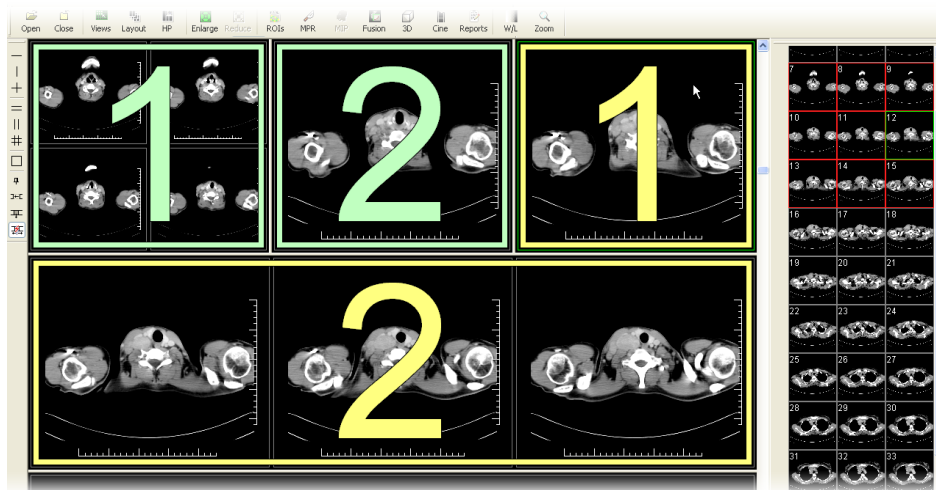


Figure 58 – Dividing existed sequence

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** submenu (see Figure 59) in the **Layout** menu.

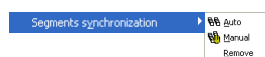


Figure 59 – Segments synchronization

Two synchronization modes are available:

- **Automatic,**
- **Manual.**

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 (see Figure 60):

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 **Segment synchronization/Auto** item for automatic synchronization or **Segment synchronization/Manual** item for manual synchronization and move mouse cursor over the working area.
5. Click on the 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.

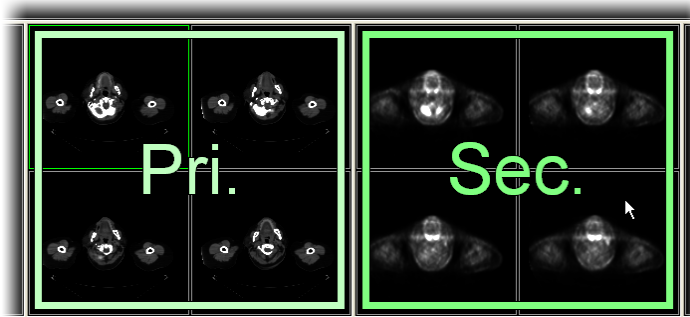


Figure 60 – Definition of synchronization

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 61).

To define the location of these icons in the view see **4.3 Displayed texts in views**, text type **View status**.

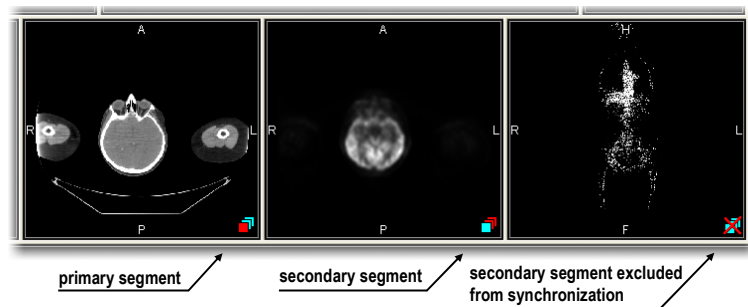



Figure 61 – Segment status in synchronization

To cancel synchronization:

1. Click on the **Segment synchronization/Remove** item 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.

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).

TomoCon is capable of displaying the image either frame-by-frame or playing back in multi-frame mode (like a movie). To play back multi-frame images in multi-frame mode, open the **Cine** dialog by clicking on the  **Cine** icon in the Standard toolbar or the **Cine...** item in the **Tools** menu (see Figure 62).

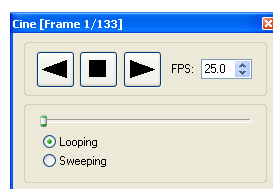





Figure 62 – Cine dialog

Using this dialog it is possible to control playback of images or a multi-frame image in any current view of the workspace (we select the current view and in the dialog we

choose the playback mode, then we select another view and in the dialog we choose the playback mode independently for this view). During selection of another current view the playback in the view will be kept.

The **Cine** dialog allows:

- To play images in selected direction :
 - forward ,
 - reverse ,
- To stop playing ,
- To play images repeatedly:
 - in one selected direction (**Looping**),
 - back and forth (**Sweeping**),
- To change the frame rate - **FPS** (frames per second).

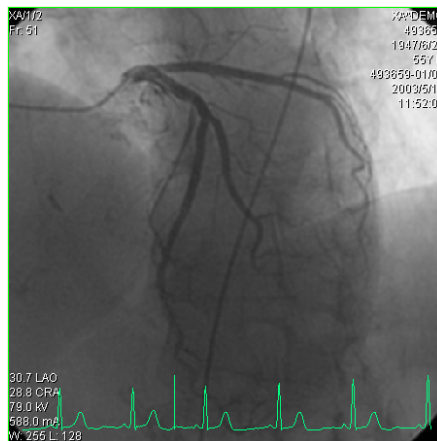


Figure 63 – Cine view playing multi-frame image with ECG curve

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 63). 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 **4.2 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 allows you to see patient image data with correct contrast and image details in some particular grayscale range. To change these values you can use grayscale functions in the context menu, predefined window/level presets or the **Window/Level** dialog.

Changes of window and level in the current view are automatically applied to all images in current sequence (if current view is not pinned) and to other linked segments.

7.1.1 Window/Level dialog

Window/Level dialog (see Figure 64) will be opened by clicking on the  **Window and Level...** icon in the Standard toolbar or **Window/Level...** submenu in the **Tools** menu (see 3.6.3 Tools menu).

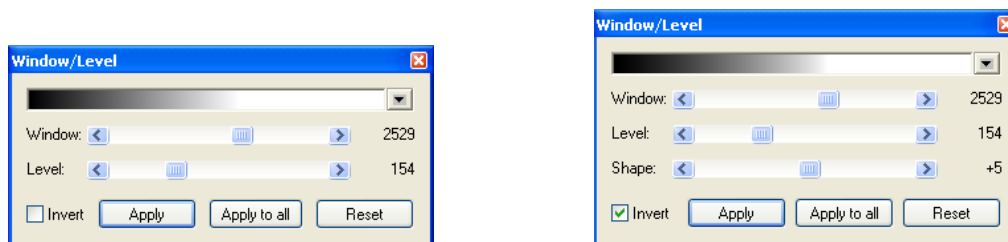


Figure 64 – Window/Level dialog variants


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

After pressing the **Apply** button the changes are applied and stored to the image in the current view (it can be seen in the thumbnail palette). After pressing the **Apply to all** button, the same changes are applied and stored to all images from the current series, including all 3D, MPR, fusion and other view types.

Pressing the **Reset** button will restore original window and level settings (these settings are from the imaging device and are never discarded from the patient data) in all views of the current series (series that the current view belongs to).

The palette gradation **Shape** modifies the black-gray-white gradation curve of the selected palette. It can be used after a non-linear color map palette **Window type** has been selected (see **4.4 Modality settings**).

7.1.2 Presets

Users can create and use their own “predefined window, level and shape settings” in the **Window/Level** dialog (see **7.1.1 Window/Level dialog**). Clicking at a small triangle at the right side of the black-gray-white bar  in the **Window/Level** dialog and selecting the **New preset...** menu. The **Window/Level preset** dialog will be opened (see Figure 65). Old presets can be changed and a new own preset for the selected modality can be described with its own name (**Preset name**) and stored for later use. Choose any keyboard shortcut F2 to F9 from the **Key** combo box to be bound with the selected presets. The new presets will be activated by pressing the keyboard shortcut or by clicking at the preset in the list of presets.

Use the same process to set up window, level and shape for each modality in **Modality settings** tab, the **TomoCon setup** dialog (see **4.4 Modality settings**).

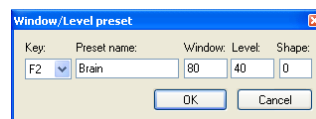







Figure 65 – Window/Level dialog – defining new Window/Level/Shape preset

7.1.3 Adjusting Window/Level with the mouse

To modify window and level simultaneously without opening the **Window/Level** dialog, click on the  **Window/Level** icon in the **Image** menu or at the Context toolbar (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.


The window and 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.

7.2 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, magnifying glass tool or the **Zoom** dialog.

Changes of zoom in the current view are automatically applied to all images in current sequence (if current view is not pinned) and to other linked segments.

7.2.1 Zoom dialog

Zoom dialog (see Figure 66) will be opened by clicking on the  **Zoom** icon in the Standard toolbar or **Zoom...** submenu in the **Tools** menu (see 3.6.3 **Tools** menu).

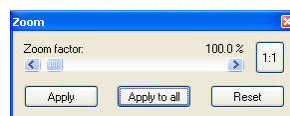





Figure 66 – Zoom dialog




The **Zoom factor** can be changed by moving the slider in this dialog and it can be varied between 50% and 1600%. It applies immediately to the current view. 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 apply the zoom to image opened in more views and to the thumbnail preview, click on the **Apply** button in the **Zoom** dialog. To apply the zoom to all images, views and thumbnail previews of the same series, click on the **Apply to all** button in the **Zoom** dialog.

To set pixel-for-pixel spacing in the current view, click on the  button. The slice in the current view will be centered and displayed in this ratio (one slice pixel will be identical to one display pixel). To cancel pixel-for-pixel spacing, click on the **Reset** button and **Zoom factor** will be restored to 100%.



7.2.2 Zooming with the mouse


To modify the zoom factor using the mouse (without opening the **Zoom** dialog), click on the  **Zoom** icon in the **Image** menu or on the Context toolbar (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 immediately zoomed 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.

The zoom 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.

7.2.3 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.

The 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.

7.2.4 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  **Magnifying glass** icon in the **Image** menu or in the Context toolbar (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 67).
4. To close the magnifying glass window release the mouse button.



Figure 67 – Magnifying glass window

7.3 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 **7.3.1 Automatic DSA mode**),
- Manual - the image separation has to be made manually (see **7.3.2 Manual DSA mode**).

7.3.1 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 68).

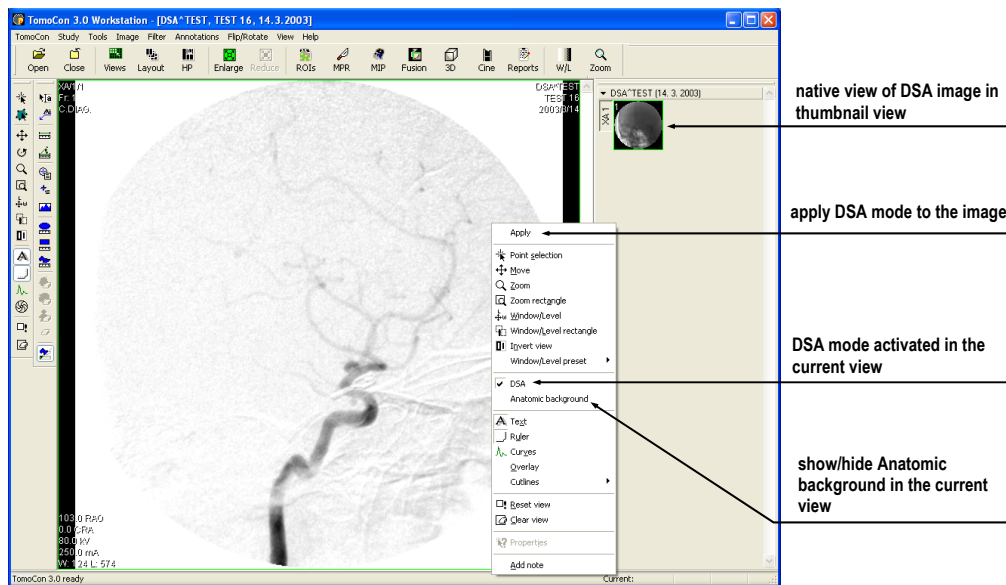


Figure 68 – Automatic DSA mode

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.

7.3.2 Manual DSA mode

Open a patient study containing a multi-frame image without DICOM information about DSA examination. Choose the multi-frame image in the current view. Click on the **DSA...** item in the **Tools** menu to open the **DSA** dialog. Choose the **DSA Manual mode**. A dialog will be opened for DSA parameters settings (see Figure 69):

- **Mask frame** - starting image number in the mask (image sequence without the contrast media):
 - **Static mask** - mask frame is static for all chosen frames,
 - **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):
 - **Start** - first sequence image number,
 - **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 will be applied to the image in the current view immediately. Similarly to the automatic DSA mode, the DSA settings in the manual DSA mode can be applied to the image and the thumbnail preview.

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

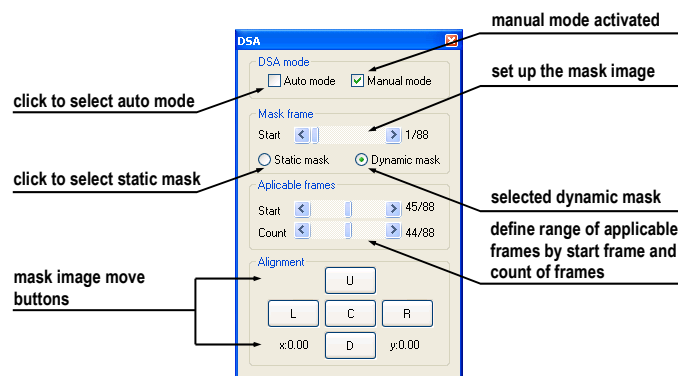


Figure 69 – Manual DSA mode

7.4 Cutlines

Cutlines are intersections of image planes in one series with 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 **15 Registrations**).

Open a patient study with more series and registrations between them. Choose an image in the thumbnail 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 70).

Choose a patient series from the **Cutlines** menu. The Cutlines of chosen series will be immediately displayed in the current view, called standard Cutlines (if the planes are not parallel). Standard cutlines are displayed as lines with series and image description (see Figure 71). Set up the Cutlines color and the line shape in the application settings (see **4.5 Color settings**).

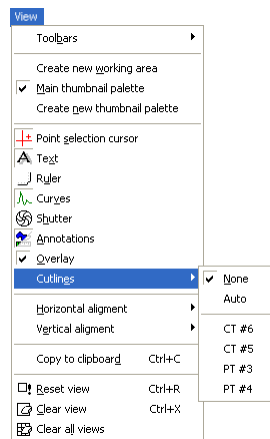


Figure 70 – View/Cutlines menu

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 **4.5 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. Choose 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 71). In each view, click on the context mouse button; choose **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).

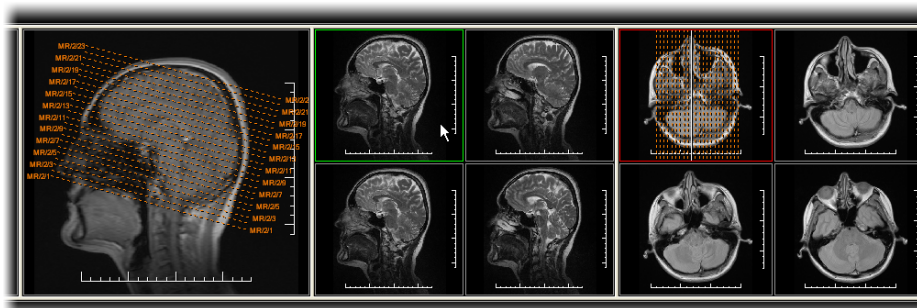


Figure 71 – Displayed cutlines at the working area

7.4.1 Delete cutlines

The **None** option in the **Cutlines** menu (see Figure 70) 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, choose **Cutlines/None**).

It is also possible to turn **Cutlines** off by clicking on the chosen series in the **Cutlines** menu.

7.4.2 Auto mode

Click on the right mouse button in the current view and choose **Cutlines/Auto** from the context menu (see Figure 70). 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 outline. Current cutlines will be changed automatically when changing an image in the current view.


7.4.3 Print and save cutlines

Defined cutlines can be printed out with the image on a standard MS Windows printer (see **16.1 MS Windows printer**) and a DICOM printer (see **16.2 DICOM printer**). When closing a patient study, cutlines will not be saved.

7.5 Image fusion

Image fusion allows displaying the data from two registered series combined or overlapped in one image view (see **15 Registrations**).

These series may contain different kinds of information, for example CT scans with contrast media and without it, MRI series taken with different parameters, scans before the treatment and after the treatment, PET scans and others.

The **Image fusion** dialog (see Figure 72) will be opened by either clicking on the  **Fusion** icon in the Standard toolbar or **Image fusion...** submenu in the **Tools** menu.

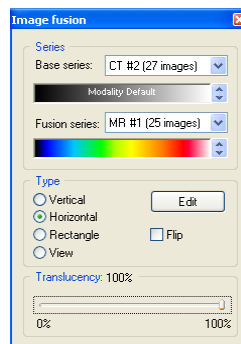


Figure 72 – Image fusion dialog

Fusion settings using the **Image fusion** dialog:

- **Series** - registration series:
 - **Base series** - the base series with palette color map,
 - **Fusion series** - the overlaid series with palette color map,
- **Type** - type of image fusion between base and fusion series:
 - **Vertical** - the view is divided by a vertical line, image from the fusion series is on the right side (see Figure 73, right),
 - **Horizontal** - the view is divided by a horizontal line, image from the fusion series is at the bottom,
 - **Rectangle** - the image from overlaying series is inside the rectangle (see Figure 73, left),
 - **View** - the image from overlaying series is covering whole view,
 - **Edit** - after choosing this option (or double-clicking on the separating 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,
 - **Flip** - invert fusion,
- **Translucency** - basic fusion transparency settings using a slider from 0 % (the fusion series is transparent) to 100 % (the fusion series is opaque).

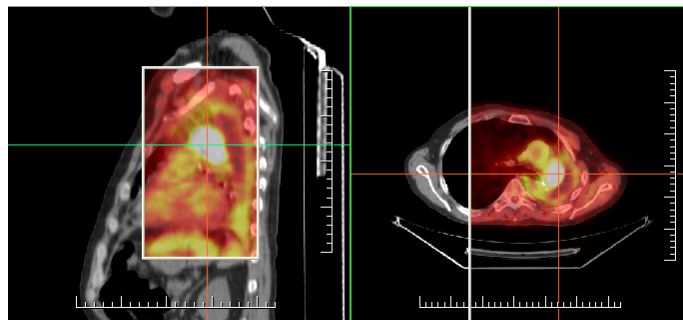


Figure 73 – Fusion images between MR and PET series

7.6 Key image notes

Key image notes provide a mechanism for indicating the significance of an image to a particular viewer or 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 pallets,
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 74 a) and click on the **Next** button. Next fill information about creator (see Figure 74 b) and click on the **Next** button. In the end write description about new note in this dialog (see Figure 74 c) and click on the **Finish** button. New note will be automatically added to the image.

Figure 74 consists of three panels illustrating the 'Key image note' dialog. Panel (a) shows a dropdown menu for 'Select key image note title' with 'For Teaching' selected. Panel (b) shows the 'Created by' section with fields for Name (MKK), Role in Procedure (Performing), Role in Organization (Radiographer), and Organization. Panel (c) shows the 'Description' section with a text area labeled 'Desc.....'.

Figure 74 – 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 77). If the image has more than one note, **Key image notes** dialog (see Figure 76) will be displayed to select concrete note by double click.

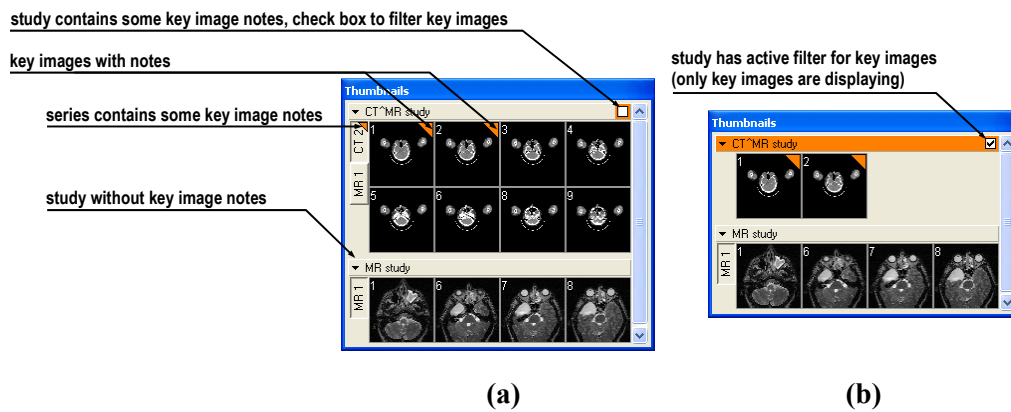


Figure 75 – Key image notes in thumbnail palette, (a) filter for key images is disabled, (b) filter for key images is enabled

Patient ...	Date-Time	St...	Title
Study	10.07.06 15:50:56	Partial	For Teaching
Study	10.07.06 15:51:13	Partial	For Conference

Figure 76 – Key image notes dialog to chosen concrete note

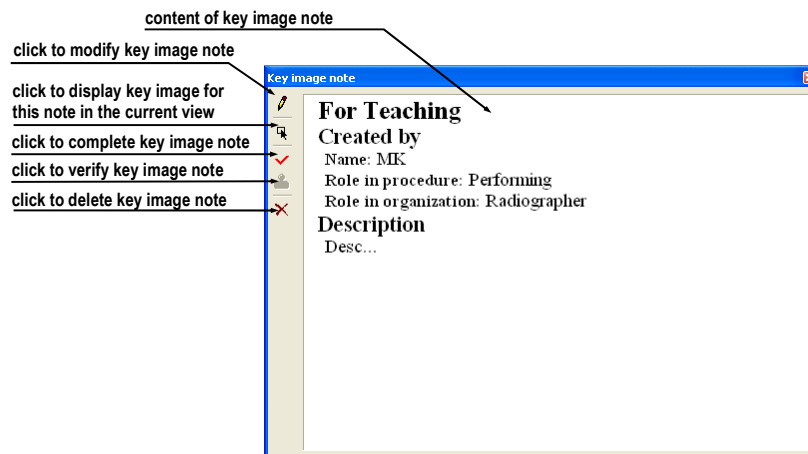


Figure 77 – Key image note dialog

7.6.3 Load and save key image note

TomoCon allows 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 78). When study with some key image notes will be opened, associate key image notes to this study also will be automatically opened.

Patient ID	Patient name	Sex	Date of birth	Study date	Study time	Study ID	Modality	Description
CT/MR study								
Series number	Series descript...	Series date	Series time	Modality	Images			
1				KO	1			
1				KO	1			
1				KO	1			
1				MR	4			
2	COUPES CT			CT	8			

3 objects of key image notes

Figure 78 – 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 79).

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.

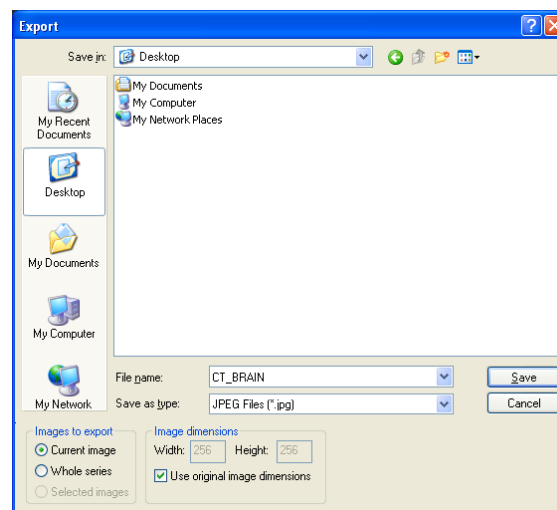


Figure 79 – Export images dialog

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 80).

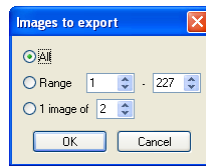


Figure 80 –Images to export dialog

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 81) will be opened by clicking on the **Export as AVI video...** submenu in the **Study** menu.

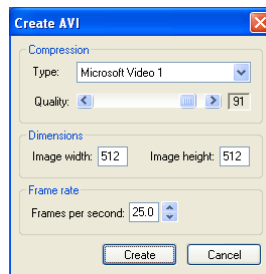


Figure 81 – Create AVI dialog

The **Create AVI** dialog allows 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 82), you can define the range of images to be exported.



Figure 82 – Frames to export dialog

7.8 *Insert new image to series*

Selected image in the current view or screenshot of the current view can be inserted to the existing series by context menu of thumbnail palette (see Figure 83).

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 83) 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 screen shot of the current view:

4. Prepare image for screen shot in the current view,
5. Move mouse cursor over the thumbnail previews of images from series, which is dedicated to insert new image,
6. Press right mouse button to display context menu (see Figure 83) 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 83) 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 mouse cursor over the thumbnail preview of image, which is dedicated to be deleted,
2. Press right mouse button to display context menu (see Figure 83) and select **Delete image** item. Image will be automatically deleted from series.

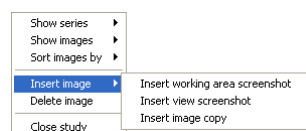


Figure 83 – Context menu of thumbnail palette

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 84.). To display **Hanging protocol manager** dialog click on the **Hanging protocol manager...** item in **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.

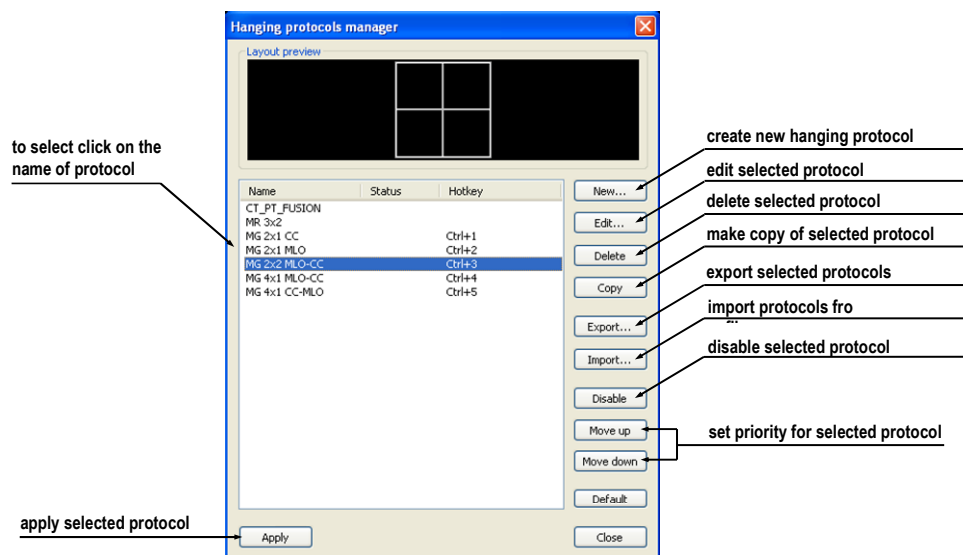


Figure 84 – Hanging protocol manager dialog

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 conform 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 85):

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.

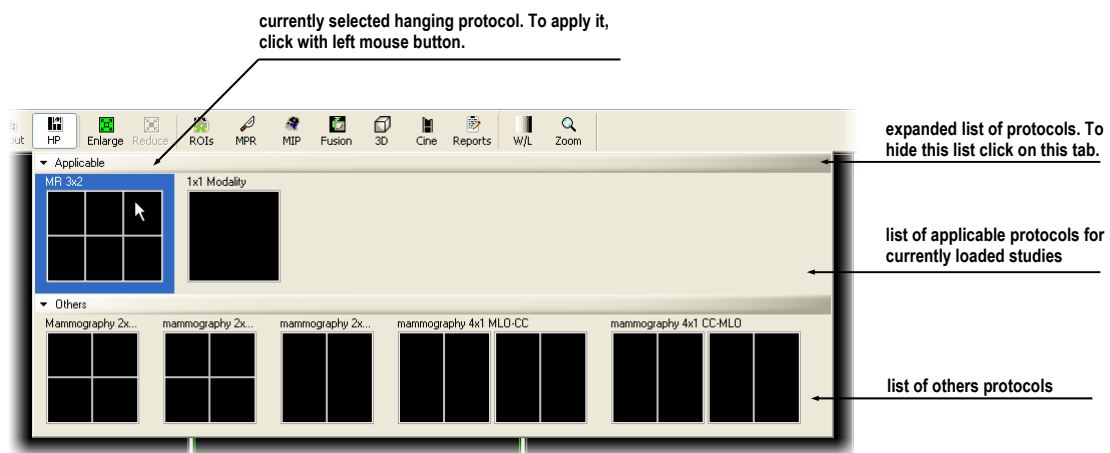


Figure 85 – Hanging protocols list

8.2 Importing and exporting of hanging protocols

For transferring 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).

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 future 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 86) you can attach some criteria and properties to selected hanging protocol.

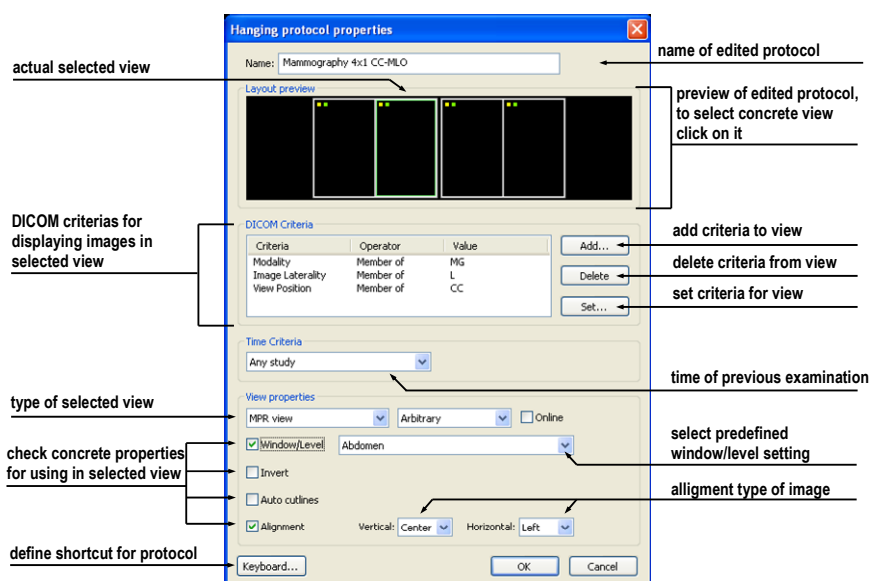


Figure 86 –Hanging protocol properties dialog

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 concrete 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 by specifying a 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 87).

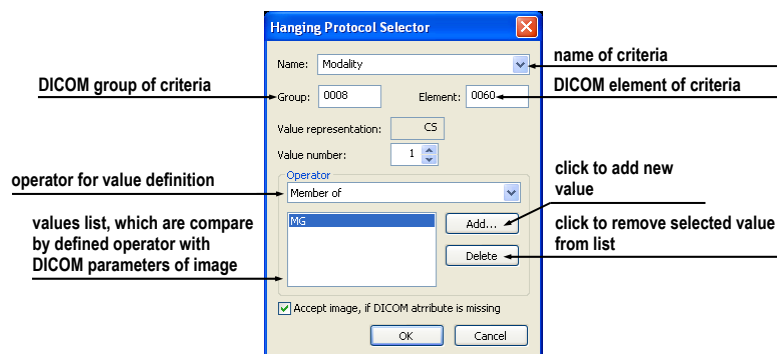


Figure 87 – Hanging protocol selector dialog

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 some view has this time constraint defined, all images, which should be displayed in this view, has to meet it.

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 86). 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 applied 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 88), describing it's properties. The colors signify:

- yellow - view has defined DICOM criteria,
- red - view has defined time criteria,
- green - view has defined some properties.



Figure 88 – 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 chosen parts of patient image 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 point (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 covered by the elliptical area (see **9.8 Ellipse**),
- **Rectangle** - characteristics of all image points covered by 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 **3.6.6 Annotations menu**). It is also possible to activate them in the Annotations toolbar (see **3.4 Toolbars**).

After using an annotation and measurement tool, it is possible to set up its properties through the annotations and measurements context menu (see Figure 89). It will appear when moving the cursor over the tool (it will be highlighted and cursor will change from an arrow to a cross) and pressing the mouse context button. The following actions are available:

- **Font** settings,
- **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,
- **Locked** a tool in the image against moving, deleting or above mentioned actions.



Figure 89 – Annotations and measurements context menu

When using a tool covering an area (Ellipse, Rectangle, Free area), the **Show text** option is added (see Figure 90), which allows to show or to hide **Size** of the outlined area, **Min value**, **Max value**, **Mean value** and **Deviation**.

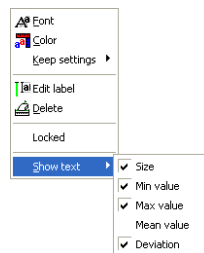


Figure 90 – Context menu for ellipse, rectangle and free area

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 92). 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 immediately recalculated.

With every 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 (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. Conversion from pixels to length units (mm) or area units (cm²) can be done manually using calibration (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  **Text** item in the **Annotations** menu.

Click at the point in the image, which should be annotated. Small white text line editing box will be opened (see Figure 91). Type in the description text and press Enter.



Figure 91 – 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.

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 92).

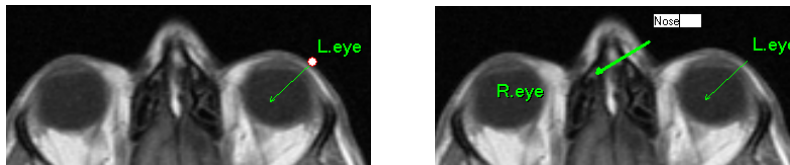



Figure 92 – Image with Marker annotations

9.3 Distance

Distance measurement can be used after clicking on the  **Distance** item in the **Annotations** menu.

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 93).

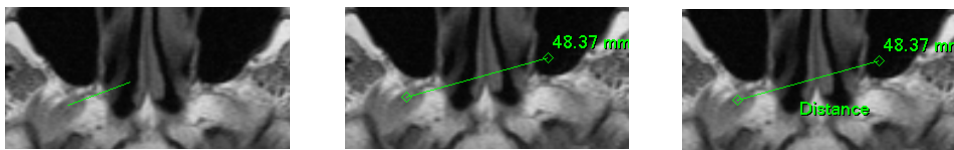



Figure 93 – Distance between 2 points

9.4 Distances and angle

Distances and angle measurement can be used after clicking on the  **Distances and angle** item in the **Annotations** menu.

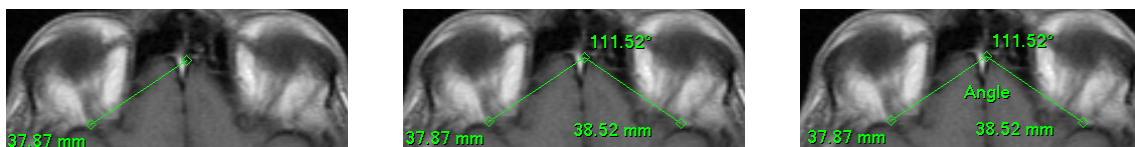



Figure 94 – Distances and angle between 3 points

It acts like Distance measurement, except that additional third point has to be defined. Both distances and an angle between distance-lines are displayed (see Figure 94).

9.5 Probe

Probe is the 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. Press left mouse button at the desired point and move measurement through image within selected view and Probe will be displayed actual minimal pixel value, maximal pixel value and mean value from pixels, which are lying within probe's circle at actual place (see Figure 95). 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.

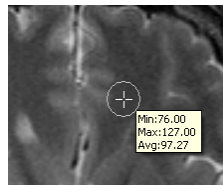



Figure 95 – Probe measurement

9.6 Density spot

Density spot measurement can be used after clicking on the  **Density spot** item in the **Annotations** menu. Click at the desired point. The value in the image point is displayed near the defined point (see Figure 96).

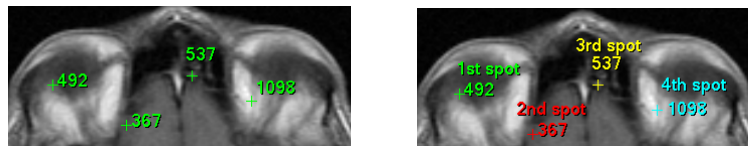



Figure 96 – Density spot at various points

9.7 Density profile

Line Density profile can be measured after clicking on the  **Density profile** item in the **Annotations** menu.

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 97).

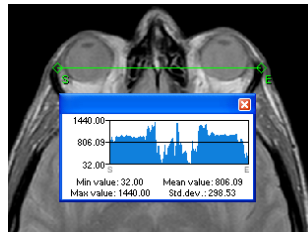



Figure 97 – Density profile over a line between 2 points

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 98).

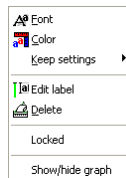



Figure 98 – Density profile's context menu

9.8 Ellipse

Ellipse drawing will be activated by clicking on the  **Ellipse** item in the **Annotations** menu.

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 99).

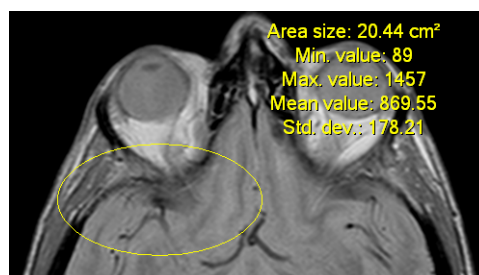



Figure 99 – Elliptical area profile

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.

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 100).

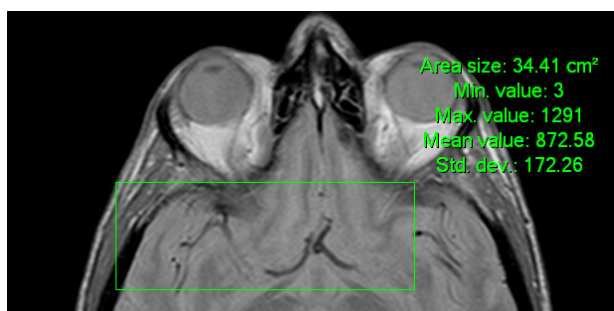



Figure 100 – Rectangular area profile

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.





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 101).




Figure 101 – 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 angle** item in the **Annotations** menu. It measures angle between two independent lines.

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 102).



Figure 102 – Cobb 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.

Choose **Calibration** (see Figure 103) in the Annotations context menu to activate calibration. The context menu will be displayed when pressing mouse context button at the distance type annotation.

Two options are available:

- **Calibrate measurement** - open the **Calibration** dialog to define the calibration (see Figure 103),
- **Apply to whole series** - apply the defined calibration to the series.



Figure 103 – Calibration context menu and Calibration dialog

The **Calibration** dialog allows 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 104).

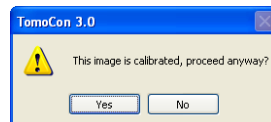


Figure 104 – Calibration dialog; This image is calibrated, proceed anyway?

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 105).

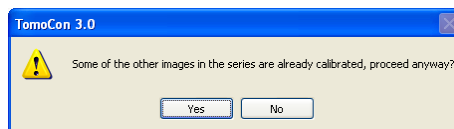



Figure 105 – Some of the other images in the series are already calibrated, proceed anyway?


NOTE! Calibration can not be used for images with 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.

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 choose the **Annotations...** dialog 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 to open a dialog with the list of all annotations defined in the open studies (see Figure 106).

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.

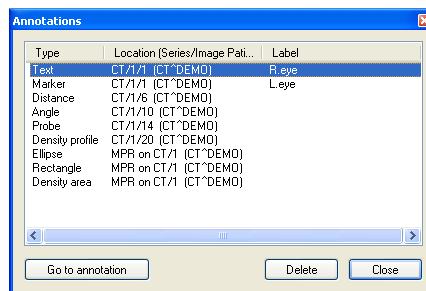


Figure 106 – Annotations dialog

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 107). 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**).

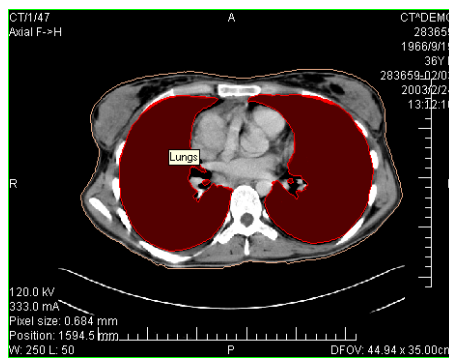



Figure 107 – Defined contour

Contours and ROIs can be defined using the **ROI properties** dialog (see Figure 108). It can be opened by clicking on the  ROI icon in the Standard toolbar or the **ROIs...** submenu in the **Tools** menu.

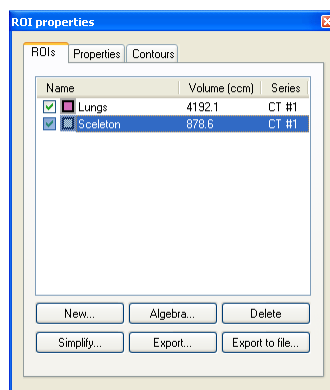


Figure 108 – ROI properties dialog, ROIs tab

The **ROI properties** dialog allows:

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

- To realize based algebraic operations between two selected ROIs - the **ROIs** tab, the **Algebra...** button (see **10.2 ROI algebra**),
- To delete the specified ROI from the ROIs list - the **ROIs** tab, the **Delete** button,
- To simplify selected ROI - the **ROIs** tab, the **Simplify...** button (see **10.3 Simplify ROI**),
- To copy ROI between any two registered series - the **ROIs** tab, the **Export** button (see **10.4 Copying ROIs**),
- To export selected ROI into a file - **ROIs** tab, the **Export to file...** button (see **10.5 Export ROI to DXF or VTK file**),
- To define chosen ROI properties - the **Properties** tab (see **10.6 Edit ROI properties**),
- To 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 108). If the current view is empty, the **New ROI** dialog will be opened with the list of series (see Figure 109).

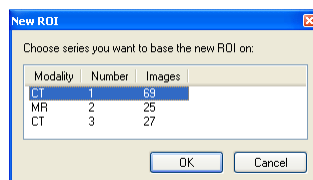


Figure 109 – New Region of Interest dialog

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

Name	Volume (ccm)	Series
<input checked="" type="checkbox"/> New ROI #1	0.0	MR #1

The volume calculation is not 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 based 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 110) you have to click on the **Algebra...** button in the **ROIs** tab of the **ROI properties** dialog (see Figure 108).

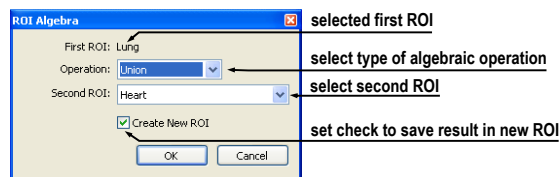


Figure 110 – ROI algebra dialog

When you have specified the parameters, select the **OK** button to start calculation of the specified operation (actual progress of calculation will be displayed in bottom part of the **ROI properties** dialog (see Figure 111)), or select **Cancel** button to close this dialog.

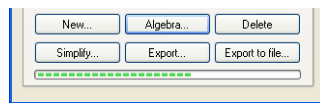


Figure 111 – Progress of the algebra computation

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 this by **Simplify ROI** dialog (see Figure 112), which allows you to select one type of these 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 every image,
- **Reduce number of vertices** - all polygons of every 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 108).

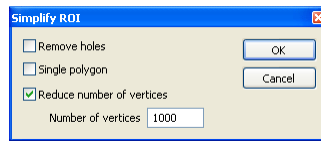


Figure 112 – Simplify ROI dialog

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 111)), or select **Cancel** button to close this dialog.

10.4 Copying ROIs

ROIs can be copied between any two registered series (see **15 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.

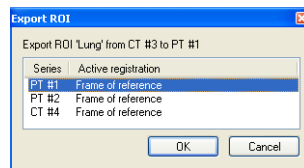


Figure 113 – Export ROI dialog

10.5 Export ROI to DXF or VTK file

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

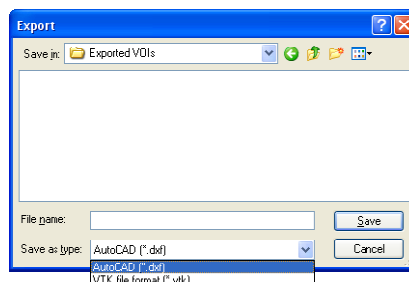


Figure 114 – Export dialog

To export ROI you have to select ROI in the **ROIs** tab and click on the **Export to file...** button. Next, you select desired file format, file name and target folder in the **Export** dialog (see Figure 114), which will be opened.

10.6 Edit ROI properties

Choose ROI from the **ROIs**, the **ROI properties** dialog. ROI properties can be changed in the **Properties** tab in the **ROI properties** dialog (see Figure 115).

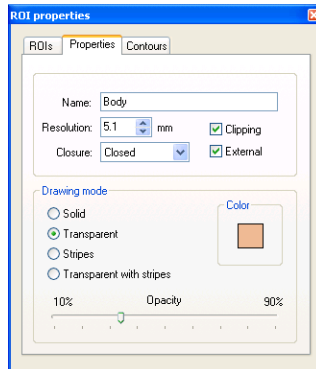


Figure 115 – ROI properties dialog, Properties tab

The **Properties** tab has following options:

- **Name** - change ROI's name,
- **Resolution** - specifies how fine or coarse the contours are that the ROIs consist of. 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 isn't 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 **14.1 3D View settings**). There can be only one "Master" ROI per series,
- **Drawing mode** - specifies the art of displaying the ROI in 3D view:

- **Solid** - ROI will be displayed as an opaque object. Clicking at the ROI object surface delivers a new current point position.
- **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.
- **Stripes** - ROI will be displayed as a set of contours (wire-frame model).
- **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 116), **ROI properties** dialog.

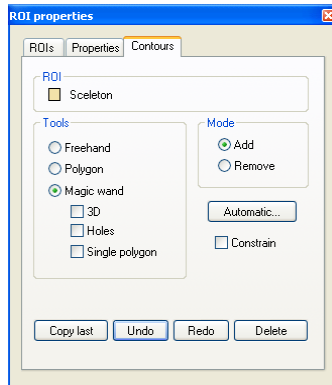


Figure 116 – ROI properties dialog, Contours tab

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:

- **3D**, contour with selected gray level values in selected image will be applied to remaining images in the series,
- **Holes**, image areas inside the region with different gray values will be contoured to mark holes in the final contoured area,
- **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. Choose 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 108) the **Threshold** dialog for automatic contouring will be opened (see Figure 117).

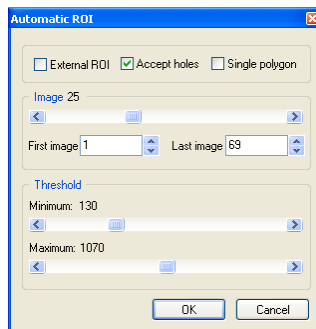


Figure 117 – Automatic contouring, Automatic ROI dialog

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

- **Slice** box - select the range of images, which are to be used for automatic contour search, by selecting an appropriate **First slice** and **Last slice** values.
- **Threshold** box - 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 118).
- Type of Automatic contouring:
 - **External ROI** - only one object in every image with maximal area according to setting of minimal treshold value is used,

- **Accept holes** - looks for holes in every slice according to setting of minimal and maximal threshold value,
- **Single polygon** - only one polygon in every image without holes according to setting of minimal and maximal threshold value is used.

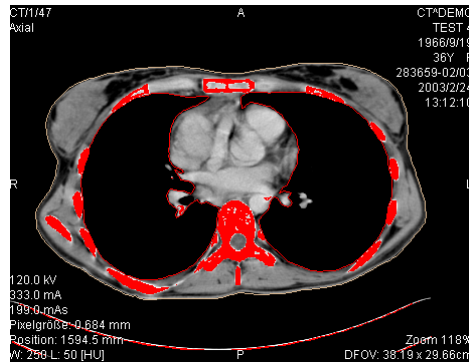


Figure 118 – Segmented image with threshold selection, contouring bones

It is advisory to check the whole image range by dragging the **Slice** 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 119).

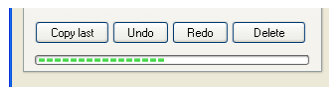



Figure 119 – ROI properties dialog, Automatic contouring

11 MPR - Multi Planar Reformatting

MPRs show sections in patient's body using the defined plane. They are calculated from the original images of the selected series. The **MPR** dialog (see Figure 120) allows defining MPR plane in the current view.

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.

The **MPR** dialog (see Figure 120) can be opened by clicking on the  **MPR** icon in the Standard toolbar or the **MPR...** submenu in the **Tools** menu.

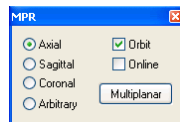


Figure 120 – MPR dialog

MPR dialog allows displaying MPR in the current view using the following characteristics (in the current view an image from the series must be displayed for the MPR calculation):


- **Series** selection,
- **MPR plane** selection:
 - **Axial** - xy plane,
 - **Sagittal** - yz plane,
 - **Coronal** - xz plane,
 - **Arbitrary** (see **11.1 Arbitrary MPR**),
- Display a rotation tool to help with the MPR rotation - **Orbit** (see **11.1 Arbitrary MPR**),
- **Online** - MPR to be bound to the current point (see **11.2 Online MPR**),




The **MPR** dialog, using the **Multiplanar** button, allows to create a set of three mutually perpendicular online MPR views.

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. In additionally, plane position of each displayed MPR is indicated

by a colored line (see 4.5 Color settings) in all views, which are intersected by this plane.

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 dialog**.

To help with the image rotation, select 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 dialog** defines the online MPR to be bound to the current point (see Figure 121). 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 immediately shifted.

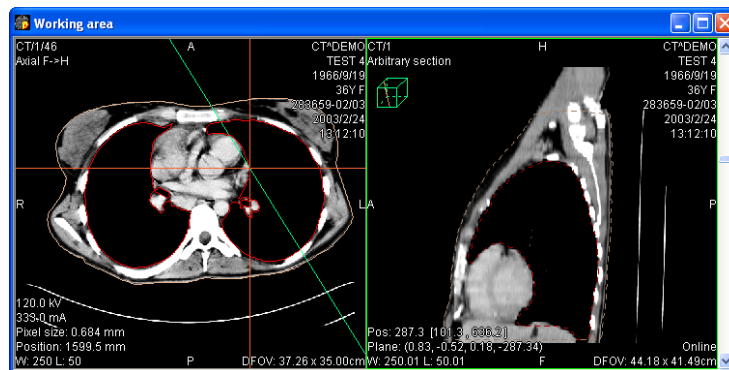


Figure 121 – Arbitrary MPR view and intersected axial MPR plane

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. For moving and rotating (see Figure 122):

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 coloured 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 colored with blue color). To finish rotating of plane, release mouse button.

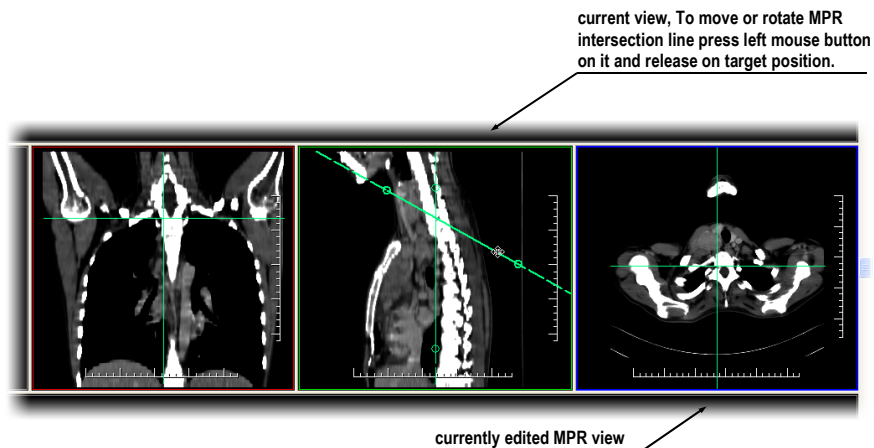



Figure 122 – Interactive moving of MPR

12 MIP - Maximum Intensity Projection

MIP is the spatial method for displaying patient data. This method displays projection of maximum values from particular images to 3D space. Result of this projection is a multiframe image, which parameters you can define in MIP/MinIP dialog.

The **MIP/minIP** dialog (see Figure 123) will be opened by clicking on the  **3D** icon in the main toolbar or the **MIP...** item in the **Tools** menu.

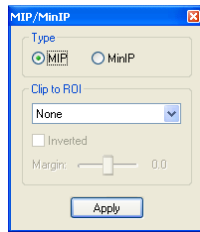


Figure 123 –MIP/MinIP dialog

When you have finished with definition of parameters for MIP, press **Apply** button to start calculation. Series for calculation will be used from current view and calculated result will be displayed in the current view, too (see Figure 124).

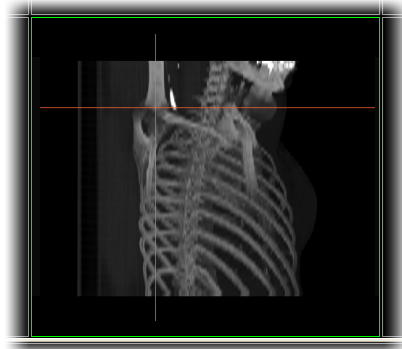


Figure 124 – MIP in the current view

13 DRR Reprojection

To create **DRR (Digitally Reconstructed Radiograph)** reprojection from the patient image data, click on the **DRR...** submenu in the **Tools** menu (see Figure 125).

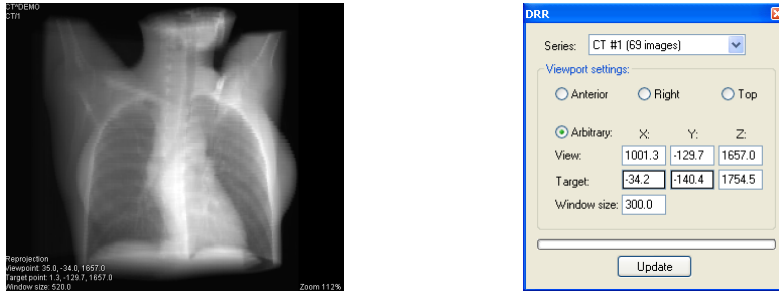


Figure 125 – DRR Reprojection image and dialog

DRR parameters in the **DRR** dialog:

- **Series** - choose the image series to create DRR from,
- **Viewport settings** - setting up the DRR position to the patient's position:
 - **Anterior**,
 - **Right**,
 - **Top**,
 - **Arbitrary** - DRR position using the following parameters:
 - **View** - view position,
 - **Target** - DRR target position,
- **Window size**.

Press the **Update** button to display the created DRR to the current view.

14 Three-Dimensional Visualization


Image data analysis can be simplified if the objects are displayed in 3D rendered views. One of the following methods can be used for display objects in the 3D:

- display ROI in the 3D, which is defined by segmentation (see **10 Contouring the patient – create ROIs**),

NOTE! Precision of object displayed in 3D View, that represents corresponding ROI, is depending on actual setting of resolution for specific ROI (see **10.6 Edit ROI properties**).

- use automatic tool volume rendering (see **14.4 Volume rendering**).

14.1 3D View settings

The **3D view** dialog (see Figure 126) will be opened by clicking on the  **3D** icon in the Standard toolbar or the **3D view...** submenu in the **Tools** menu.

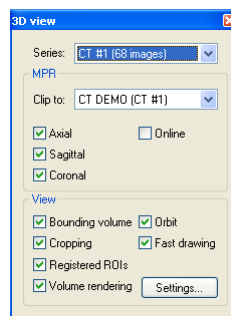


Figure 126 – 3D view dialog

Three-dimensional view of the patient image data from the current series will be opened in the current view (see Figure 127). If no ROIs are defined in the series or the current view is empty, the 3D display will be empty.

There are following options available in the **3D view** dialog:

- **Series** selection,
- **MPR** - MPR plane settings in the 3D view:
 - **Clip to** - select ROI to be used to limit the clipping MPR bitmap. The ROI is marked with ‘*’ in front of its name,
 - Choose a plane, the chosen planes are highlighted with a green rectangle:
 - **Axial**,
 - **Sagittal**,

- **Coronal,**
 - **Online** - MPR to be bound to the current point, **NOTE!** It is possible to click somewhere at the displayed 3D data to define a new current point. If the black background is clicked, the current point will not change. It is not possible to obtain the current position by clicking at the transparent object's surface! Surface position of the nearest solid object behind will be taken instead. Transparent objects are considered as not having a surface;
- **View** - 3D view options:
 - **Bounding volume** - optically marks patient image data with a transparent gray box,
 - **Orbit** - in 3D view, MPR view will be overlaid by set of blue circles that mark image areas with different rotation functionality (see **14.2 Rotation, spatial orientation**),
 - **Cropping** - cropping displayed ROIs by manual moving of one side of displayed box,
 - **Registered ROIs** - display ROIs from different registered series (see **15 Registrations**),
 - **Fast drawing** - while rotating, moving or zooming the 3D image all ROIs are temporarily displayed in Stripes mode. Stripes mode is much easier to operate with; rotating, moving or zooming is realized much faster (recommended on slower computer hardware),
 - **Volume rendering** - automatic tool volume rendering for display 3D view of selected series will be started.

Different ROI display options can be found in **10.6 Edit ROI properties**.

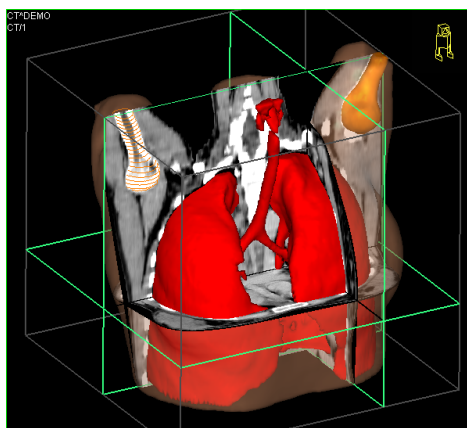







Figure 127 – 3D view

14.2 Rotation, spatial orientation

3D view can be rotated with left mouse button pressed; click on the  **Rotate** item in the 3D view's context menu or in the Context toolbar and use the mouse directly in the 3D view window. Mouse cursor will change to  form.

To help with the image rotation, after selecting the **Orbit** checkbox, 3D view will be overlaid by set of blue translucent spheres (see Figure 128). These 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 rotation mouse button is used to rotate the displayed data.

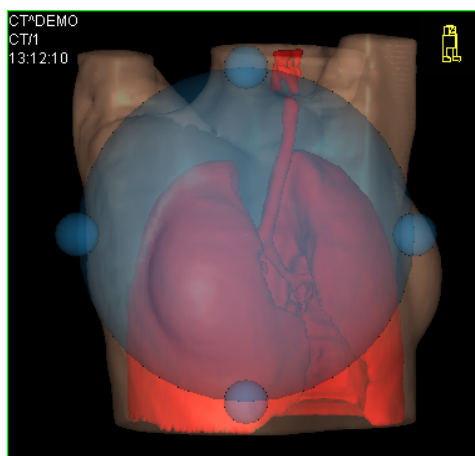



Figure 128 – 3D view with Orbit function

To return to the initial viewing angle and zoom, select the **Reset view** 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 correct cases, its orientation should match the patient's orientation. If its appearance should be disturbing, it can be hidden in the **TomoCon setup** dialog (see 4.3 **Displayed texts in views**).

14.3 Moving MPR plane

It is possible to move MPR plane interactive in the view (see Figure 129).

When mouse goes over an 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.

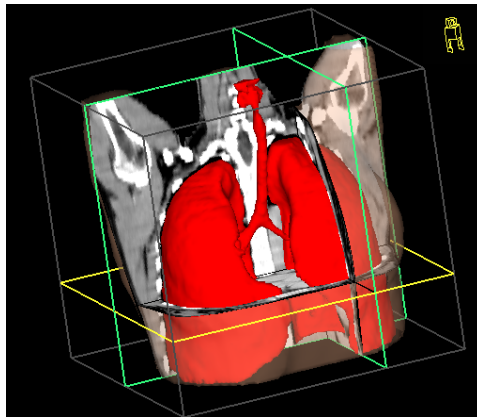


Figure 129 – 3D view with highlighted MPR plane

14.4 Volume rendering



This functionality is available only in TomoCon Advanced WS.

The 3D view of the selected series calculated by automatic tool volume rendering (see Figure 130) will be displayed in the current view by clicking on the **Volume rendering** choice in the **3D view** dialog (see **14.1 3D View settings**). Together with this 3D view, **Volume rendering settings** dialog will be displayed, too. This dialog can be hidden at any moment and repeatedly can be shown by pressing on the **Settings...** button in the 3D view dialog.

The displayed 3D view can be rotated (see **14.2 Rotation, spatial orientation**), cropped or it can display selected MPR.

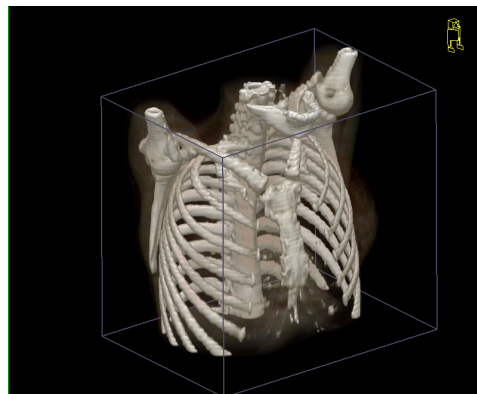


Figure 130 – Volume rendering 3D view

The settings of the volume rendering 3D view can be changed in the **Volume rendering settings** dialog (see Figure 131). This dialog allows to define intervals related to the image values (context menu of the histogram graph in the dialog, **Insert interval** item, **Delete interval** item) and consequently allows to define color map to

the each defined interval and its translucency in the 3D view. In addition this dialog allows save, load or eventually use built-in settings for this dialog.

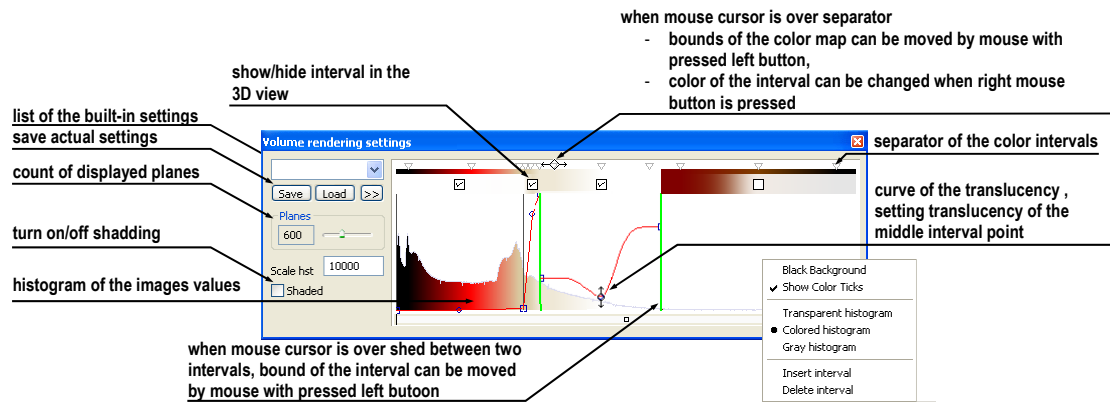


Figure 131 – Volume rendering settings dialog

15 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 **7.5 Image fusion**).

The **Registrations** dialog (see Figure 132) will be opened by clicking on the **Registrations...** submenu in the **Tools** menu.

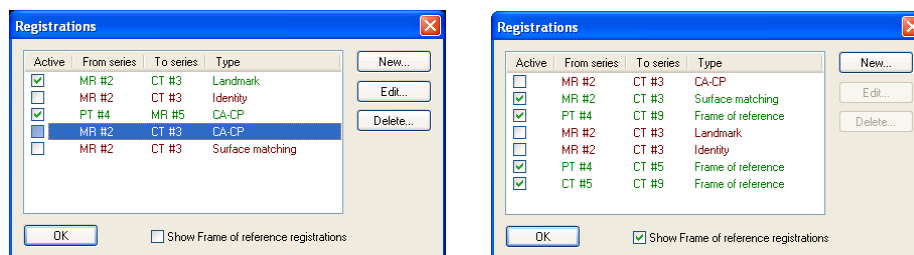


Figure 132 – Registrations dialog

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

- **New...** - define new registration between two series (**15.1 Defining the registration**),
- **Edit...** - edit the chosen 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.

15.1 Defining the registration

Press the **New...** button in the **Registrations** dialog (see Figure 132) to define the relation between two series. The **Define registration** dialog will be opened (see Figure 133).

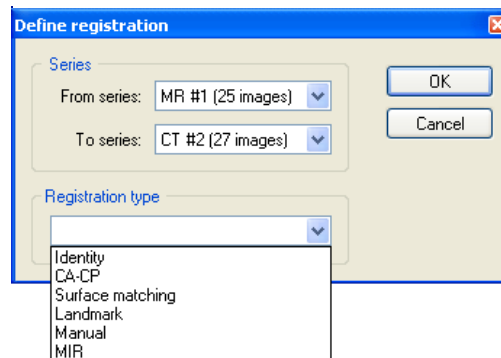


Figure 133 – Define registration dialog, selecting Registration type

The **Define registration** dialog (see Figure 133) specifies:

- **Series** - two series and the registration type between them:
 - **From series**,
 - **To series**,
- **Registration types**:
 - **Identity** (see 15.1.1 Identity),
 - **CA-CP** (see 15.1.2 Patient-related (CA-CP)),
 - **Surface matching** (see 15.1.3 Surface matching),
 - **Landmark** (see 15.1.4 Landmark),
 - **Manual** (see 15.1.5 Manual),
 - **MIR** (see 15.1.6 MIR)

15.1.1 Identity

Identity registration assumes that the coordinate systems of the two image series are equal and exact. 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.

15.1.2 Patient-related (CA-CP)

CA-CP registration (see Figure 134) 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.

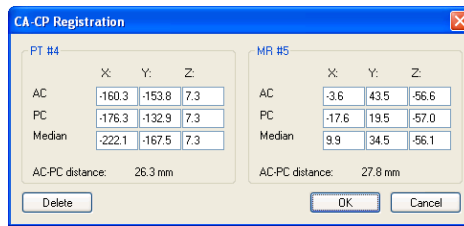


Figure 134 – CA-CP Registration dialog

15.1.3 Surface matching

Surface matching registration (see Figure 135) 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.

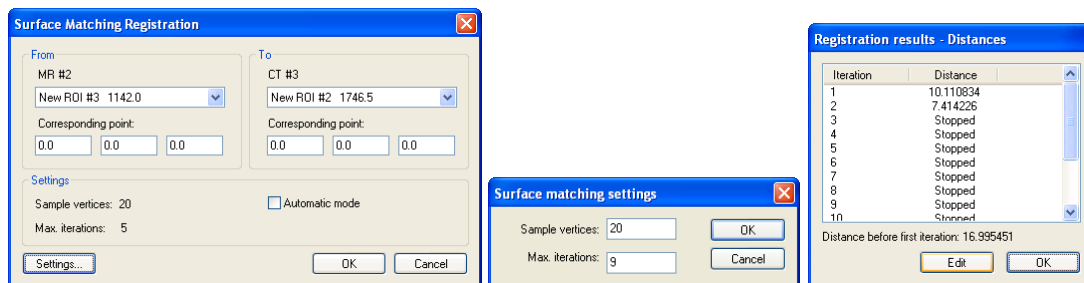


Figure 135 – Surface Matching Registration dialog, Surface matching settings dialog, Registration results - Distances dialog

15.1.4 Landmark

Landmark registration (see Figure 136) uses the coordinates of several landmarks to establish a series registration.

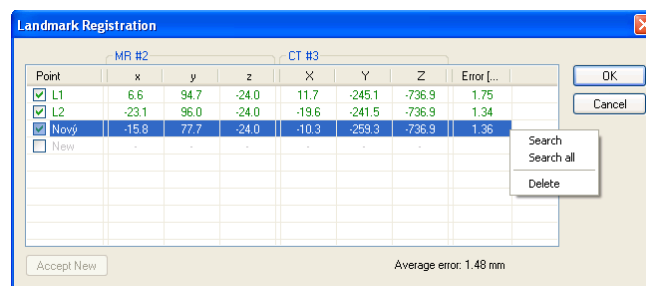



Figure 136 – Landmark Registration dialog

Wrong landmark twins 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. Simply 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  with their respective name.

15.1.5 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 137) for initial settings of manual registration. In this dialog we 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).

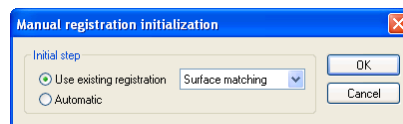


Figure 137 – Manual registration initialization dialog

After confirming the initial step with **OK** button three views for manual registration will be displayed in workspace (see Figure 138) together with the **Manual registration** dialog (see Figure 139).

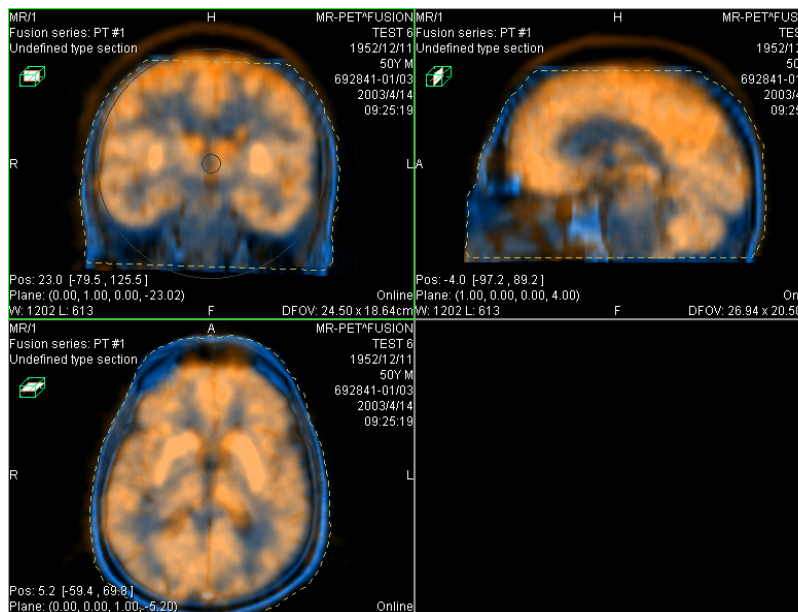


Figure 138 – Manual registration working area layout

The registration layout contains three independent views, every view displaying a pair of MPRs (every 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 each series' MPRs is displayed in **Manual registration** dialog and it is anytime possible to change it.

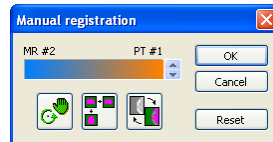



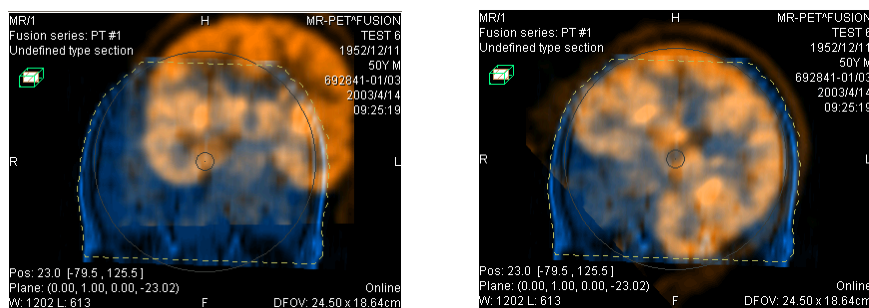


Figure 139 – Manual registration dialog

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 has  figure). Press the left mouse button, move the MPR to required place in view and release the mouse button (see Figure 140 a). Out of this circle we can rotate MPR around the centre of view (cursor has  figure). Press the left mouse button, rotate the MPR to required orientation in view and release the mouse button (see Figure 140 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 remaining views are automatically redrawn.



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 140 – 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. Activate a 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 141 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 141 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 successfully defining the manual registration by pressing the **OK** button the registration will be added to the list of existing registrations. Otherwise, after pressing the **Cancel** button, the registration will be discarded and will not be used.

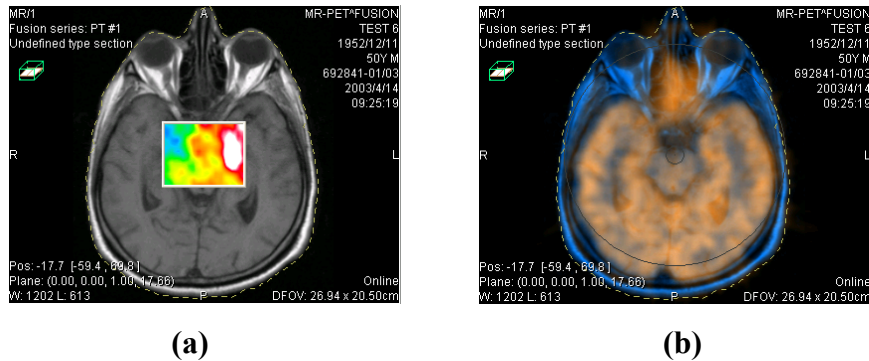


Figure 141 – Moving the Base MPR's plane (a), manual registration with shifted plane of the Base MPR (b)

15.1.6 MIR



This functionality is available only in TomoCon Advanced 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 142) for initial settings of MIR registration. In this dialog we 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).

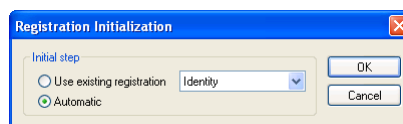


Figure 142 – MIR registration initialization dialog

After confirming the initial step with **OK** button, a **Mutual Information Registration** dialog will be displayed (see Figure 143). Calculation of the registration is started by pressing the **OK** button (registration progress will be displayed in log window).

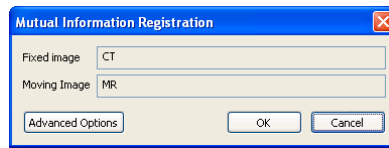


Figure 143 – MIR Registration dialog

Advance settings for the MIR registration can be changed in the **Mutual Information Registration - Advanced Options** dialog. After clicking the **Advance Options** button, a dialog will be opened (see Figure 144), where we can define all advanced settings of the registration process.

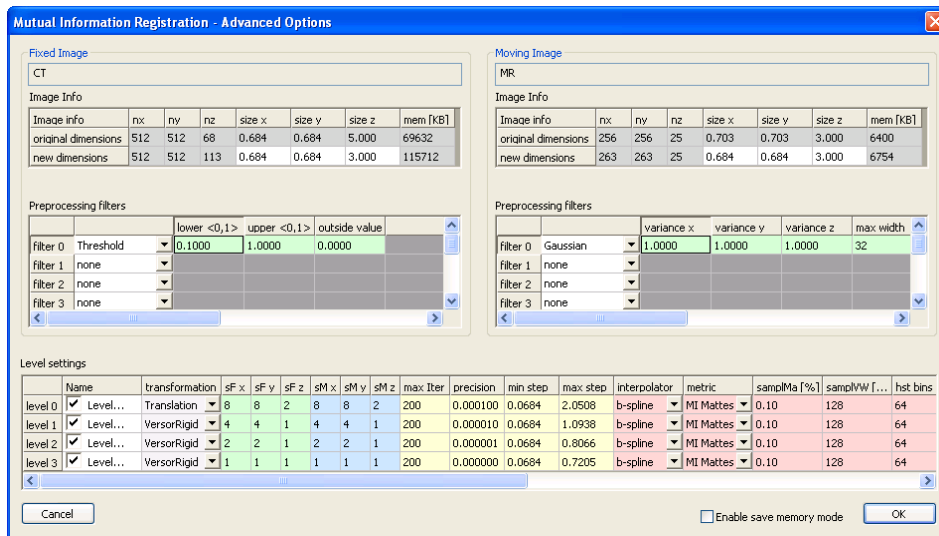


Figure 144 – Mutual Information Registration - Advanced Options dialog

16 Print images

16.1 MS Windows printer

Patient image data can be printed on a MS Windows printer using the **Print** dialog (see Figure 145) that will be opened by clicking at **Print...** in **TomoCon** menu.

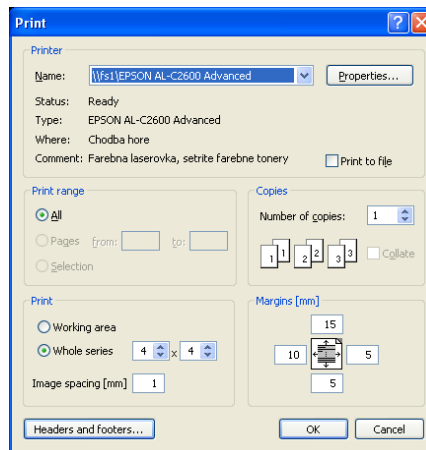


Figure 145 – Print dialog

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 you want to appear on printed papers. On the Figure 146 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.

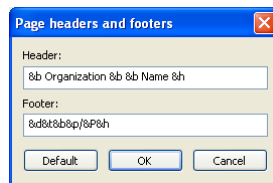


Figure 146 – Page headers and footers dialog

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.

16.2 DICOM printer

Patient image data can be printed on a DICOM printer using the DICOM print interface (see Figure 147) that will be displayed after pressing the **DICOM print...** submenu in **TomoCon** menu.



Figure 147 – DICOM print interface

DICOM print interface consists of:

- Working area (see 16.2.1 DICOM print working area),
- Thumbnail palette (see 16.2.2 DICOM print thumbnail palette),
- Print queue (see 16.2.11 Monitoring and controlling the print process),
- Menu (see 16.2.3 DICOM print menu),
- Standard toolbar (see 16.2.4 DICOM print standard toolbar),
- Status bar (see 16.2.5 DICOM print status bar).

16.2.1 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 16.2.7 Setting up DICOM print interface properties).

Use the mouse to move between the views, the current view is highlighted in a colored frame (see 4.5 Color settings). Use the actions in the DICOM Print view's

context menu, Standard toolbar (see **16.2.4 DICOM print standard toolbar**) or program menu (see **16.2.3 DICOM print menu**) to operate with the image in the current view.

16.2.2 DICOM print thumbnail palette

The thumbnail palette is located at the right side of the DICOM print interface (see Figure 147) and it is a copy of a thumbnail 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 thumbnail palette in TomoCon (see **3.2 Thumbnail palette**).

16.2.3 DICOM print menu

DICOM Print menu is located as a DICOM Print window system menu (see Figure 147). It has following sub menus:

- **File** - DICOM printer installation (the **Printers...** submenu, see **16.2.6 DICOM printer**); end work in DICOM Print interface (**Exit**),
- **Images** - image modification in the current view (see **16.2.8 Edit images**),
- **Selection** - choose images from the thumbnail palette to the working area (see **16.2.9 Images for print**),
- **Film** - edit and move between the films (see **16.2.10 Edit and move films**),
- **View** - hide/display:
 - **Toolbar**,
 - **Status bar**,
 - **Thumbnail palette**,
 - **Print properties** dialog,
 - **Print queue** list,

and following informations in all images of the films:

- **Text**,
- **Ruler**,
- **Curves**,
- **Shutter**,
- **Overlay**,
- **Annotations**.

- **Help** (see **3.6.10 Help menu**).

16.2.4 DICOM print standard toolbar

The Standard toolbar (see Figure 148) is located under the DICOM Print interface system (to display/hide the dialog see **16.2.3 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 **3.4 Toolbars**):

- Move to the previous film (**Previous**),
- Move to the next film (**Next**),
- Select all images in the thumbnail palette (**Select all**),
- Deselect all chosen images in the thumbnail palette (**Deselect all**),
- Invert the chosen images from the thumbnail palette (**Invert**),
- Add all chosen images from the thumbnail palette to the working area (**Add**),
- Display/hide the **Print properties (Properties)** dialog,
- Display DICOM printers installation dialog (**Printers**).



Figure 148 – DICOM print standard toolbar

16.2.5 DICOM print status bar

The Status bar is located at the bottom of the DICOM Print interface (to hide/display the dialog see **16.2.3 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.

16.2.6 DICOM printer installation

Use the **Printers** dialog (see Figure 150) to install a DICOM printer. Click on the **File/Printers...** in the DICOM print interface program menu to open the dialog (see Figure 149).



Figure 149 – File menu

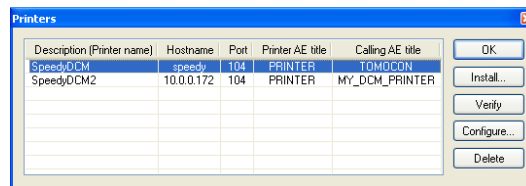


Figure 150 – Printers dialog

The **Printers** dialog contains a list of installed DICOM printers. It is possible to configure them using the Configuration dialog of a chosen printer (see Figure 151) 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.

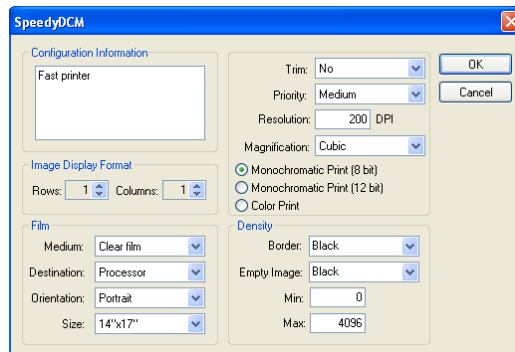


Figure 151 – Printer configuration dialog

To install a new DICOM printer click on the **Install...** button to open the **Printer installation** dialog (see Figure 152). Specify the new printer's properties:

- **Printer name,**
- **Hostname,**
- **Port,**
- **Printer AE title,**
- **Calling AE title.**

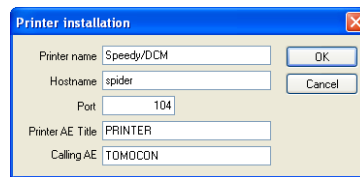


Figure 152 – Printer installation dialog

16.2.7 Setting up DICOM print interface properties

Use the **Print Properties** dialog to set up DICOM Print interface preferences (to display/hide the dialog see **16.2.3 DICOM print menu, View/Print properties**). This dialog is placed on the left side of the working area. It can be docked anywhere inside the area same way as the thumbnail palette.

Using the **Print properties** dialog (see Figure 153) it is possible to set up the following DICOM Print interface properties:

- Choose a printer from the list of installed printers (**Printer**),
- Number of rows and columns in the working area that match image layout in the film (**Image Display Format**),
- film properties:
 - type (**Medium**),
 - **Destination**,
 - **Orientation**,
 - **Size**,
- Number of film copies (**Copies**).

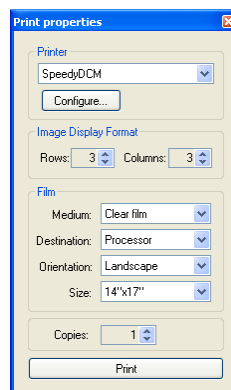


Figure 153 – Print properties dialog

Press the **Print** button when the film is ready for printing. The actual state of process will be displayed in dialog Preparing data (see Figure 154) and when this process will

be finished, new created print task will be added to the print queue (see **16.2.11 Monitoring and controlling the print process**).

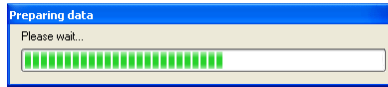


Figure 154 – DICOM printing...

16.2.8 Edit images

Images in the working area can be edited the same way as the images in TomoCon. Using the **Images** menu (see Figure 155) it is possible to make following modifications of the image data in the current view:

- **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 **3.6.4 Image menu**).

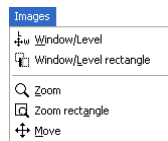


Figure 155 – Images menu

16.2.9 Images for print

Choose images for print in the DICOM Print interface from the thumbnail palette where all series are located. Use the **Selection** menu to choose the images and add them to the film (see Figure 156).

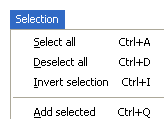


Figure 156 – Selection menu

The **Selection** menu allows to:

- Choose all images displayed in the thumbnail palette (**Select all**),
- Cancel the choice of all images from the thumbnail palette (**Deselect all**),
- Invert the selected images (**Invert selection**),

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

16.2.10 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 157):

- 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**.

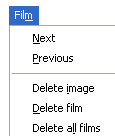
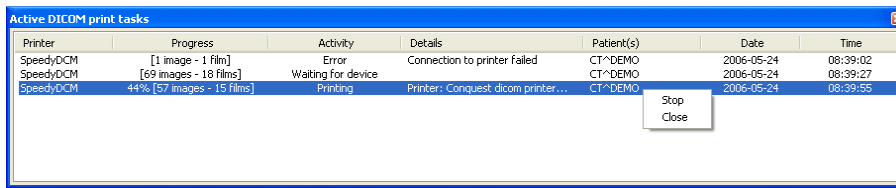


Figure 157 – Film menu

16.2.11 Monitoring and controlling the print process

Using the **Active DICOM print tasks** list, 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 actual state of each task displayed in **Activity** column, there are displayed main information of each task like name of the printer (**Printer** column), progress of actual task's state (**Progress** column), **Details** about task, 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.



Printer	Progress	Activity	Details	Patient(s)	Date	Time
SpeedyDCM	[1 image - 1 film]	Error	Connection to printer failed	CT^DEMO	2006-05-24	08:39:02
SpeedyDCM	[69 images - 18 films]	Waiting for device		CT^DEMO	2006-05-24	08:39:27
SpeedyDCM	44% [57 images - 15 films]	Printing	Printer: Conquest dicom printer...	CT^DEMO	2006-05-24	08:39:55

Stop
Close


Figure 158 – Active DICOM print tasks list

17 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 159):

- 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 **17.5 Working area layout**). If there are more views in the working area, choose 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.

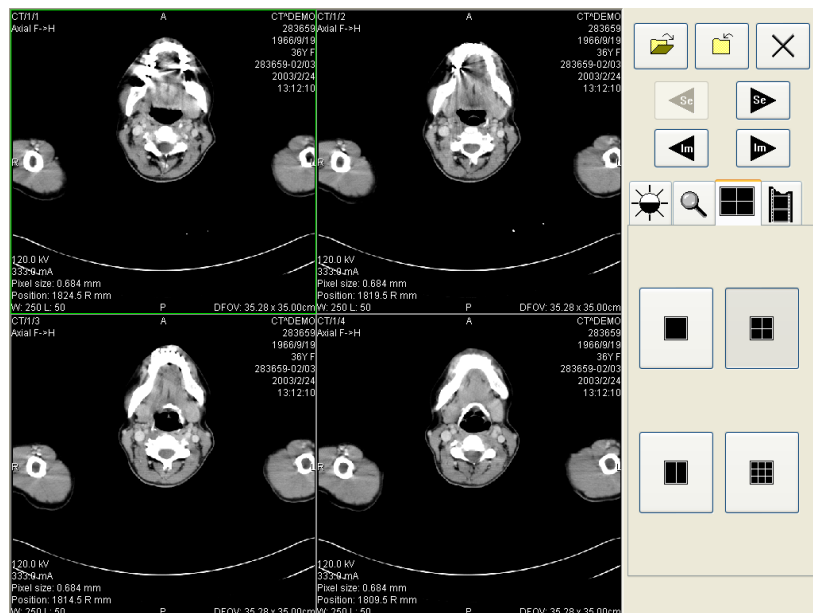













Figure 159 – Touch screen mode – layout

Control buttons panel is divided to 3 parts:

1. The top part of the panel contains the following buttons:


- Open a patient study  (see **17.1 Open a patient study**),
 - Close a patient study  (see **17.2 Close a patient study**),
 - Exit the touch screen mode ,
 - Choose image series:
 -  - Move to the previous series,
 -  - Move to the next series
- (The series are in the same order as they were opened in TomoCon),
- Move the images within the series:
 -  - Move to the previous image,
 -  - Move to the next image,

2. The middle part of the panel contains the following tabs:


-  - Window, level, shape settings (see **17.3 Window, level, shape settings**),
-  - Move and zoom images (see **17.4 Move and zoom images**),
-  - Working area layout settings (see **17.5 Working area layout**),
-  - Switch to the Cine mode (see **17.6 Play multi-frame images**),

3. The bottom part of the panel contains buttons connected to the action chosen.

17.1 Open a patient study


In the Touch screen mode a patient study will be open after pressing the  button. The **Search studies** dialog will be opened (see **5 Retrieving and Opening study**).



17.2 Close a patient study

All studies opened in TomoCon can be closed by pressing on the  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 to save the changes before closing the studies (see Figure 52).

17.3 Window, level, shape settings

Choosing the  tab the following buttons will be displayed at the bottom part of the panel (see Figure 160):




-  - 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 default values of window, level a shape in the series,
-  - apply new values of window, level and shape to the series.

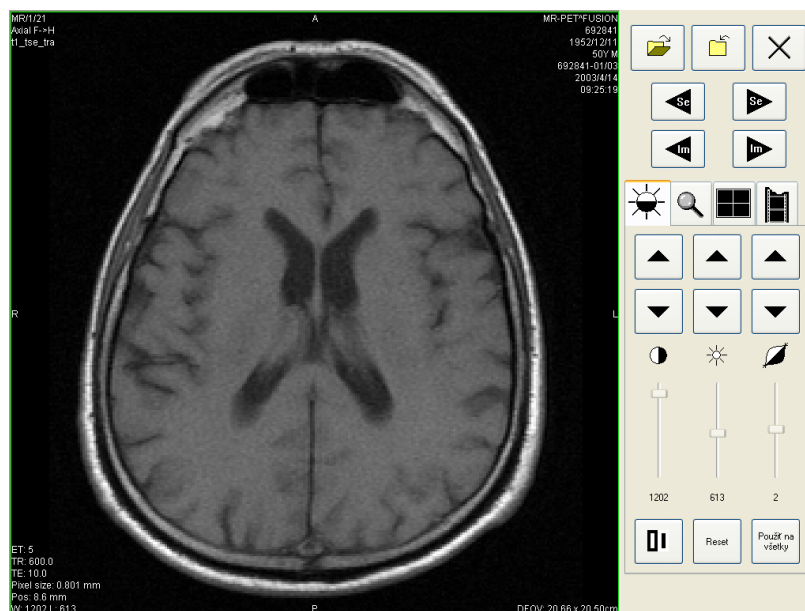





Figure 160 – Touch screen mode - gray, W&L settings

17.4 Move and zoom images





Choosing the  tab the following buttons will be displayed at the bottom part of the panel (see Figure 161):


- 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 - .

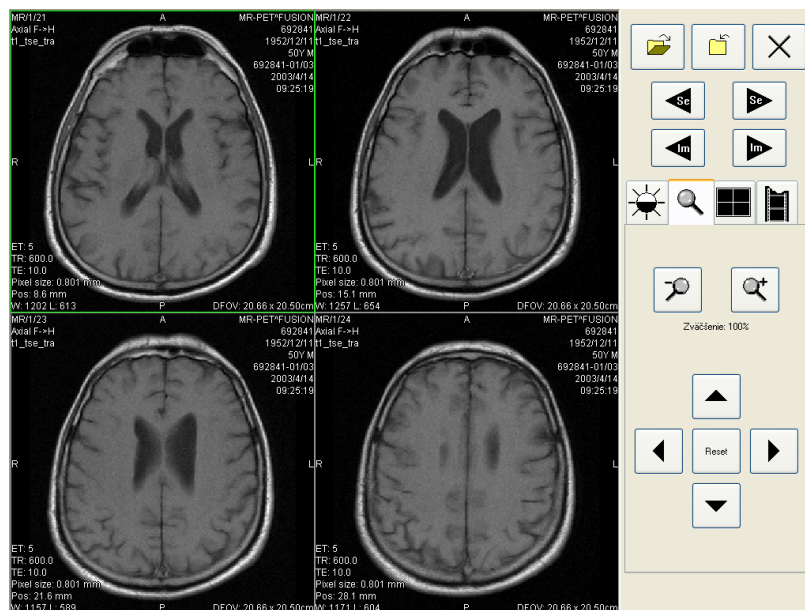




Figure 161 – Touch screen mode - move and zoom images

17.5 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 159).

17.6 Play multi-frame images

Choosing the  tab the following buttons will be displayed at the bottom part of the panel (see Figure 162):

- 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).

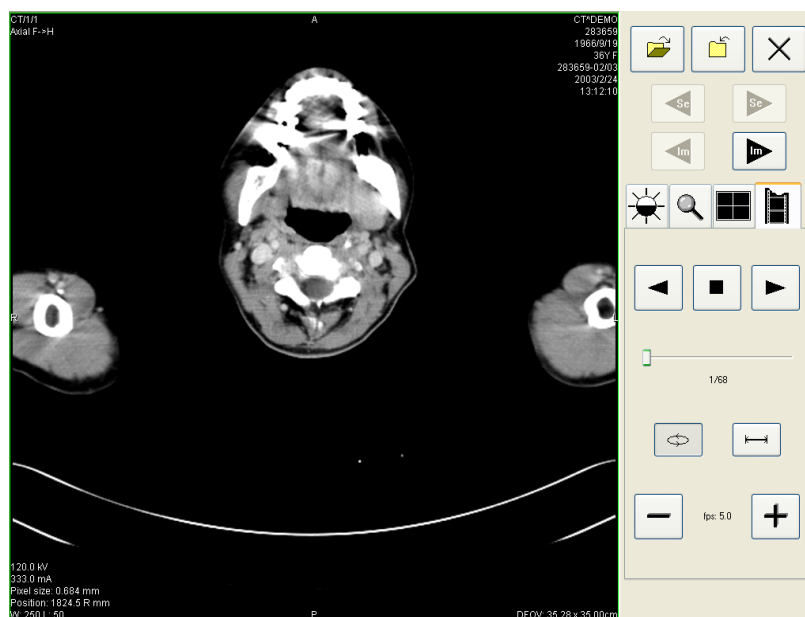


Figure 162 – Touch screen mode - playback multi-frame images

18 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 163).

The **Reports...** dialogs can be resized and relocated anywhere inside the application.

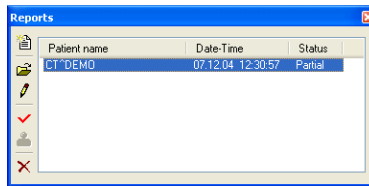



Figure 163 – Reports dialog

18.1 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 164).

To create new template click on the **New** button and enter its name. Dialog **Report** (see Figure 165) will be displayed 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.

18.2 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.

When 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 164) 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 disc,
- text report - when you select  text type report icon, you can write text report in the **Report** dialog, which will be displayed (see Figure 165).

You can also select and open the template double-click on its template's icon.

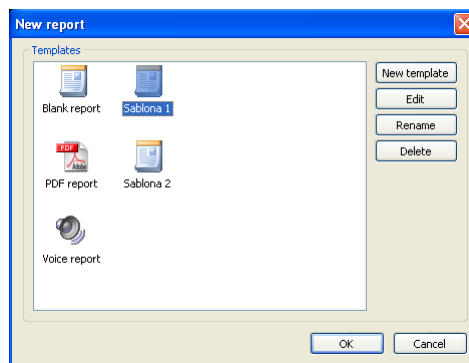


Figure 164 – Template choice dialog

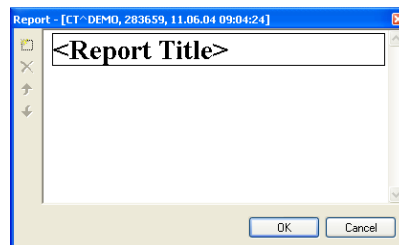



Figure 165 – Report dialog

Click on the  **Add new section** icon on the left side of the dialog or choose **Add new section** 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 166):

- **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** - medical finding physical properties.

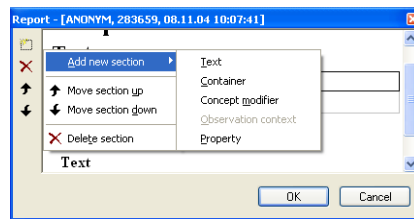





Figure 166 – Report dialog – context menu

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 167).

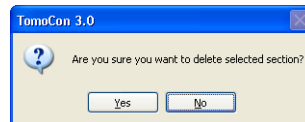





Figure 167 Are you sure you want to delete selected section? dialog

The reports have three statuses:

- **Partial** - open to editing,
- **Complete**,
- **Verified** (who verified + 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 168). 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 is not possible to edit it.

Click on the  **Verify report** icon, the **Verify report** will be opened (see Figure 168). 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.

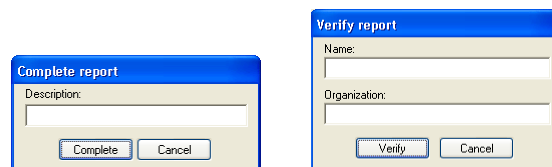




Figure 168 – Complete report and Verify report dialog

18.3 View report

Click on the  **View report** icon in the **Reports** dialog or click with the right mouse button on the report and choose the  icon. The report will be opened. The report heading (see Figure 169) 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 does not change, the date and time of the primary document is displayed.

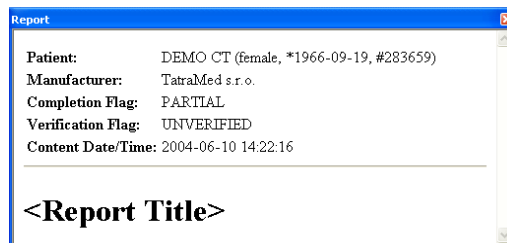


Figure 169 – Report heading

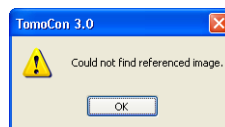



Figure 170 – “Could not find referenced image” dialog


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 170).

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  button at the right top corner of the dialog or press Esc keyboard to close the report.

18.4 Edit a report

Choose 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 171).

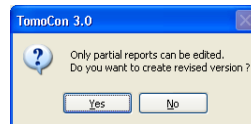



Figure 171 – “Only partial reports can be edited. Do you want to create revised version?” dialog

The original document will not change and in the heading of the revised version a link to the original document will be added (Predecessor Docs). When the original report was not loaded into the application, it is not possible to open it.

18.5 Save a report

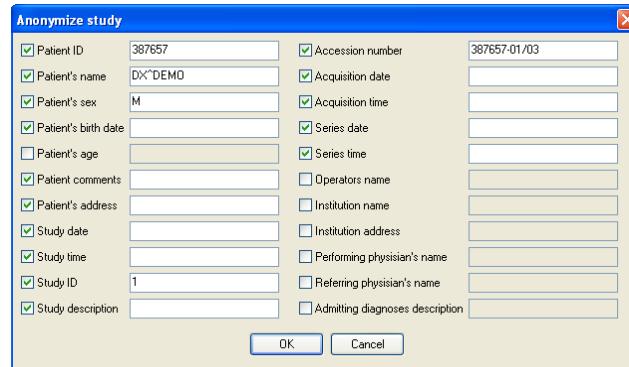
Open the **Study** menu and choose **Save** to save the report. When closing TomoCon a dialog will be opened allowing you to save unsaved changes.

18.6 Delete a report

Choose a report in the **Reports** and click on the  **Delete report** icon or choose **Delete** in the context menu. A dialog will be opened allowing you to delete the report. Click on the **Yes** button to delete the report from the **Reports...** list.

19 Study anonymization

TomoCon allows to save the series of all opened studies as a new anonymized study to the Local studies. Use the **Anonymize study** dialog (see Figure 172) that will be opened after clicking at **Anonymize study...** in the **Study** menu.



The 'Anonymize study' dialog box is a standard Windows-style window with a blue title bar and a close button in the top right corner. It contains two columns of fields, each with a checked checkbox to its left. The fields are: Patient ID (387657), Patient's name (DIX'DEMO), Patient's sex (M), Patient's birth date, Patient's age, Patient comments, Patient's address, Study date, Study time, Study ID (1), Study description, Accession number (387657-01/03), Acquisition date, Acquisition time, Series date, Series time, Operators name, Institution name, Institution address, Performing physician's name, Referring physician's name, and Admitting diagnoses description. At the bottom, there are 'OK' and 'Cancel' buttons.

Figure 172 – 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 173).

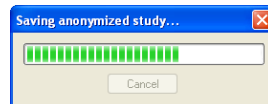


Figure 173 – Saving anonymized study ... dialog

20 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 **3.6.1 TomoCon 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 174),
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 176) and click on the **OK** button,
4. New series will be automatically added to selected study.

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 175) 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.

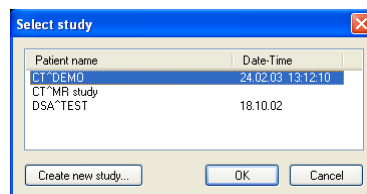


Figure 174 – Select study dialog

New study

Patient information

Patient ID:

Name:

Birth date: 19. 7. 2006 Patient's sex: Unknown

Size: cm Weight: kg

Admitting diagnoses:

Study information

Study ID:

Accession number:

Study description:

Study date: 19. 7. 2006 Study time: 8:55:27

Referring physician:

OK Cancel

Figure 175 – New study dialog

New series

Series information

Series number: 1

Modality: CT

Description:

Series date: 19. 7. 2006 Series time: 19. 7. 2006

Performing physician:

Operator:

OK Cancel

Figure 176 – New series dialog

21 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 Microsoft Windows XP with started “IMAPI CD-Burning COM” service,
- installed Nero Burning ROM 6.3 or higher,
- installed Pinnacle Instant CD 8.0 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 177) 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.

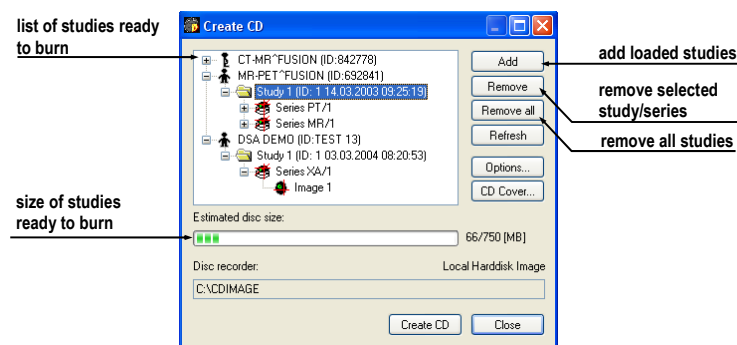


Figure 177 – Create CD dialog

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 178).

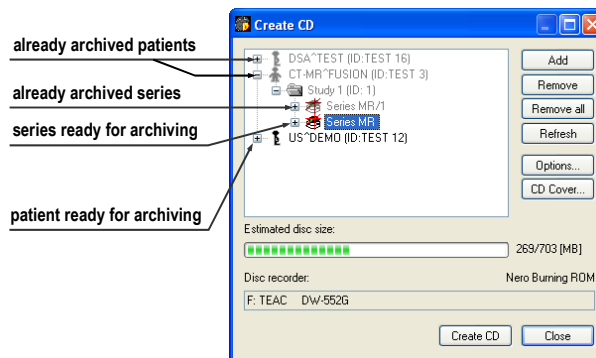
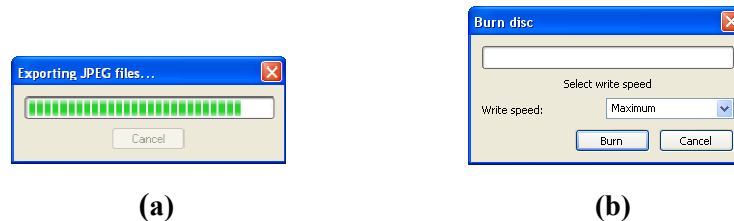


Figure 178 – Create CD dialog (add a study/series to the CD)

Press the **Create CD** button to start the archiving process. Process of burning will be displayed in dialog (see Figure 179).



(a)

(b)

Figure 179 – Archive patient image data in progress, (a) IMAPI CD-Burning COM, (b) Nero Burning ROM

Press the **Options...** button to specify the archiving settings. The **Create CD options** dialog will be opened (see Figure 180).

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 Harddisk 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,

- 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.

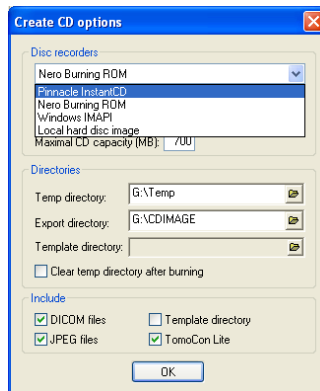


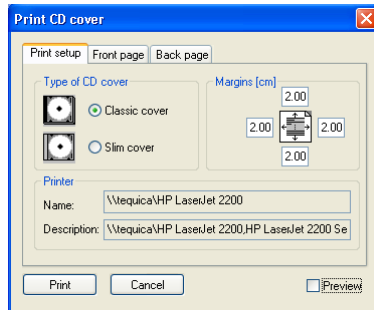
Figure 180 – Create CD options dialog

To create and print the cover for the created CD use the **CD cover** dialog (see Figure 181). 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.

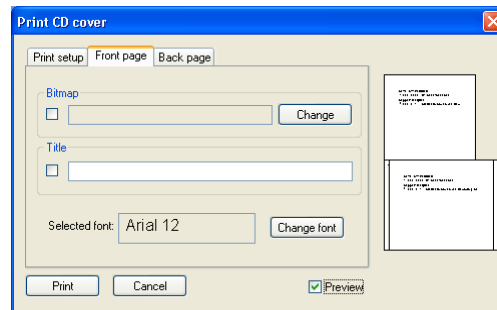
Following settings are available in the **CD cover** dialog:

- **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 choose 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 181 – CD Cover dialog, Print setup tab (a), Front page and Back page tabs (b)

22 Contact

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