

TomoCon 3.0

User's Manual

TatraMed

TomoCon 3.0 Workstation

TomoCon 3.0 Viewer

TomoCon 3.0 Lite

Version 3.0.13

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All patient names used in this manual are fictitious.

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1 General note

1.1 *Intended use*

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

1.2 *Safety precautions*

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

The software is running on Microsoft Windows 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 **2.2 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 **4 Contact**).



2 Installing and uninstalling TomoCon

2.1 System installation requirements

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

2.1.1 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).

2.1.2 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.

2.1.3 Software requirements

TomoCon Workstation:

- **Operating System** Microsoft Windows 2000, XP Professional,
- **Microsoft Internet Explorer** version 5.5 or higher,

TomoCon Viewer, TomoCon Lite:

- **Operating System** Microsoft Windows 98 SE (some functions of application are not available), 2000, XP Professional,
- **Microsoft Internet Explorer** version 5.5 or higher.

2.2 *Installing 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**.

2.3 *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.

3 TomoCon description

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 **3.23 Touch screen mode**).

3.1 *TomoCon basics*

TomoCon is intended to be used for patient image data visualisation and handling. To view a patient, the following actions are generally required:

- Open patient studies (see **3.3 Open a patient study**),
- View images,
- Check and define new grayscale window and level (see **3.6 Window and Level manipulations**),
- Define volumes of interest (see **3.13 Contouring the patient – create ROIs**),
- Describe selected images (see **3.11 Annotations and measurements**),
- Print reviewed patient image data (see **3.21 Print images on a MS Windows printer**),
- Print chosen patient image data on DICOM printer (see **3.22 Print images on a DICOM printer**),
- Save modified patient data to disk (see **3.28 Save a patient study**),
- Back up patient image data (see **3.30 Archive patient studies on CD**).

3.1.1 **Series and Images**

Patient images are often grouped in series of images. These series create one patient study. The complete patient data consists of one or more patient studies.

3.1.2 **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:

- **A**nterior,
- **P**osterior,
- **L**eft,
- **R**ight,
- **H**ead,
- **F**eet.

TomoCon's coordinate system:

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

The coordinates are displayed in millimeters, angles in degrees.

3.1.2.1 ***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.

3.1.2.2 ***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.

3.1.3 **Current point**

After clicking into an image, a corresponding position is calculated and displayed as the current point in the Status bar (see **3.1.4.5 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.

3.1.4 Main application window

The TomoCon main application window (see Figure 1) consists of the following parts:

- Working area (see 3.1.4.1 Working area),
- Thumbnail palette (see 3.1.4.2 Thumbnail palette),
- Main menu (see 3.1.4.3 Main menu),
- Toolbars (see 3.1.4.4 Toolbars),
- Status bar (see 3.1.4.5 Status bar).

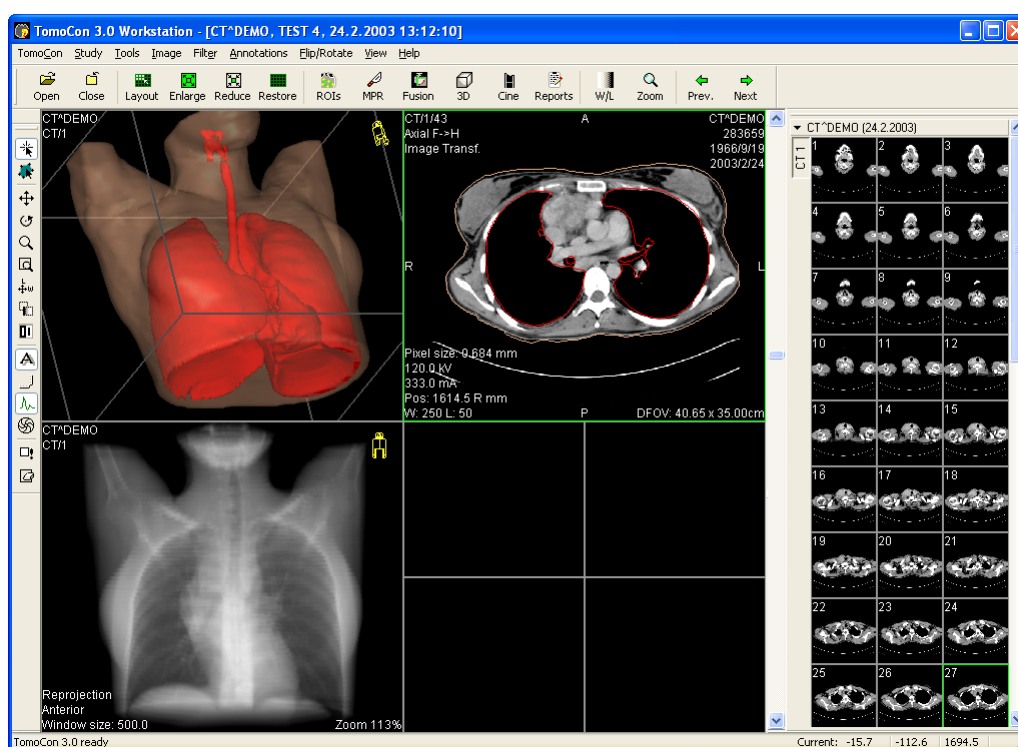


Figure 1 TomoCon application window

3.1.4.1 Working area

This is a large black area and may be divided into smaller windows – called views in this document. When the application is starting, one working area is created (see Figure 1), which is bound to the application window and it is not possible to move it. It is possible to display additional working areas (see Figure 2), which can be freely resized and placed anywhere on different screens.

Working area consists of windows, which are called views. Each view can display different type of view on patient data (view of image selected from thumbnail view, MPR view, 3D view, etc.). After selecting a view with any mouse button, this will

become a current view outlined with a colored frame (you can change the color of the frame, see **3.2.5 Color settings**). The current view is used for all image manipulations. Make another view the current view anytime simply by selecting it with the single click of the mouse.

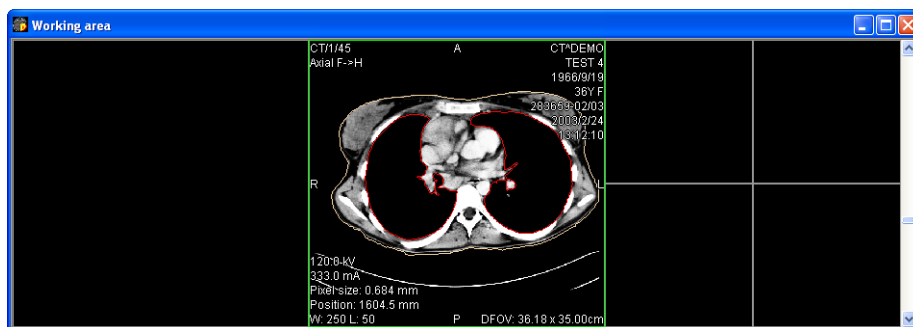


Figure 2 Working area

Use the slider on the right side of the working area to move the images of the chosen series (or the multi-frame images) in the current view. The slider position represents approximate image position in the series.

When a multi-frame image is displayed in the current view, the slider bar is divided in two parts separated with a square box (see Figure 3). Use the slider in the upper part to move between the multi-frame images of the chosen series in the current view. The slider 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 sliders the current frame number of the multi-frame image is displayed.

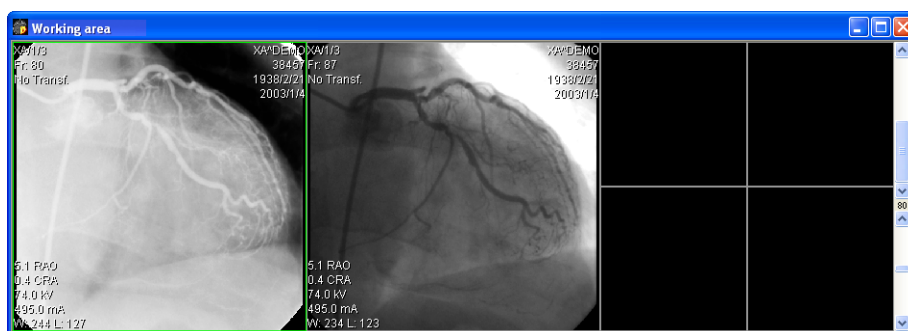


Figure 3 Working area with multi-frame image in the current view

3.1.4.2 Thumbnail palette

The thumbnail palette (see Figure 4) is placed on the right side of the main application window by default and contains images of opened studies displayed as thumbnail previews.

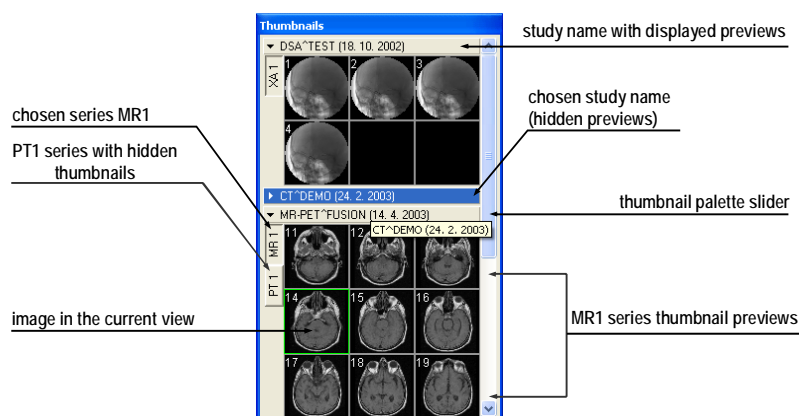


Figure 4 Thumbnail palette (Tabbed mode)

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 at 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 5 a),
- **All – separated**, thumbnails of all series of the study are displayed at once, sorted according to series (see Figure 5 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 6).

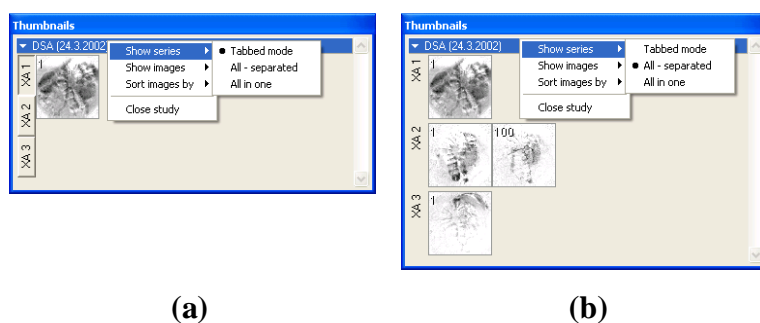


Figure 5 Displaying series in Tabbed mode (a), All – separated (b)

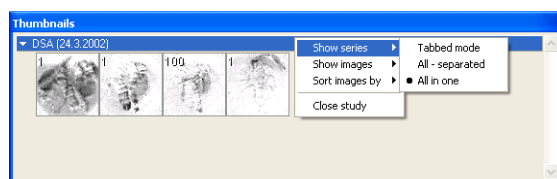


Figure 6 Displaying series in All – in one mode

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 7). 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.

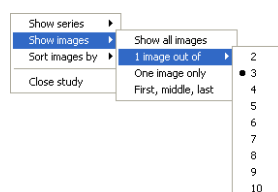


Figure 7 Context menu for selection of the image representation type

Additionally, image thumbnails from the selected study can be sorted in the Thumbnail palette using the **Sort images by** context menu item (see Figure 8):

Index number – as opened in TomoCon,

Instance number – instance number value in DICOM data,

Image position – image sorted by position,
Reverse sort mode.

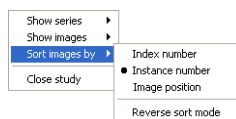


Figure 8 Context menu for sorting images

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.

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

After clicking on a thumbnail preview in the thumbnail palette, the corresponding image will be copied into the current view and the thumbnail preview in the palette will be highlighted in the same color as the current view.

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 **3.1.5.8 View menu**).

3.1.4.3 Main menu

The TomoCon main menu (see Figure 9) consists of the following menus:

- **TomoCon** – application settings, image data print (see **3.1.5.1 TomoCon menu**),
- **Study** – patient study handling (see **3.1.5.2 Study menu**),
- **Tools** – tools for image data handling (see **3.1.5.3 Tools menu**),

- **I**mage – view images and manipulation with images (see **3.1.5.4 Image menu**),
- **F**ilter – filters to soften or sharpen the current view (see **3.1.5.5 Filter menu**),
- **A**nnotations – create annotations in the current view (see **3.1.5.6 Annotations menu**),
- **F**lip/Rotate – flip and rotate image in the current view (see **3.1.5.7 Flip/Rotate menu**),
- **V**iew – display / hide parts of the main menu, image descriptions, change the current view size, delete views, create image sequence, etc. (see **3.1.5.8 View menu**),
- **H**elp (see **3.1.5.9 Help menu**).

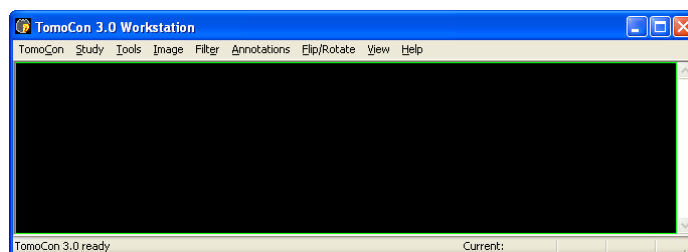


Figure 9 Main menu

3.1.4.4 Toolbars

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

- **Context bar** (see Figure 10),
- **Standard toolbar:**
 - Large toolbar (see Figure 11),
 - Small toolbar (see Figure 12),
- **Annotations** (see Figure 13),
- **Flip/Rotate** (see Figure 14).

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



Figure 10 Context bar



Figure 11 Standard bar (big version)



Figure 12 Standard bar (small version)



Figure 13 Annotations bar

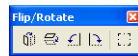


Figure 14 Flip and rotate

3.1.4.5 *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.

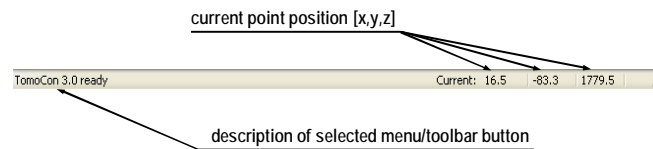


Figure 15 Status bar

3.1.5 Navigating through the menus

3.1.5.1 *TomoCon menu*

The **TomoCon** menu consists of the following items (see Figure 16):

- **S**etup... - set up the application (see **3.2 Setting up the application – User Preferences**),
- **P**rint... - print patient data on a MS Windows printer (see **3.21 Print images on a MS Windows printer**),
- **D**ICOM Print... - print patient data on a DICOM printer (see **3.22 Print images on a DICOM printer**),
- **E**xit - close the application.

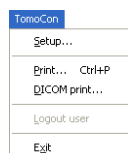


Figure 16 TomoCon menu

3.1.5.2 *Study menu*

Following options are available in the **S**tudy menu (see Figure 17):

- **O**pen study... – open selected DICOM studies retrieved from the external data source or open them from the Local Studies (see **3.3 Open a patient study**),
- **S**ave – save modified DICOM studies to Local studies (see **3.28 Save a patient study**),
- **C**lose – close all open DICOM studies (see **3.29 Close a patient study**),
- **A**nonymize study... – anonymize opened studies (see **3.26 Study anonymization**),
- **C**reate **n**ew series... – creates new series in the new or in the selected study (see **3.4 Create a new patient study/series**),
- **E**xport images... – export selected patient image (or series of images) into bitmap file (see **3.27.1 Export images**),
- **E**xport as **A**VI **v**ideo... – create a video file from a multi-frame image or the series of patient images (see **3.27.2 Export images to AVI format video file**),
- **C**reate **C**D... – archive DICOM study and burn a CD (see **3.30 Archive patient studies on CD**),

- **Reports...** – view and edit structured reports (see **3.25 Structured reports**),
- **Study info...** – display information about the current study.

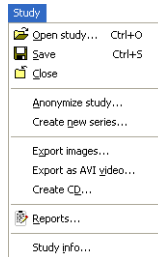


Figure 17 Study menu

3.1.5.3 Tools menu

TomoCon contains **T**ools (see Figure 18) for patient image handling:

- **ROIs...** - create and modify ROI (see **3.13. Contouring the patient – create ROIs**),
- **MPR...** - display **MPRs** through the patient image data (see **3.14 MPR – Multi Planar Reformatting**),
- **Image fusion...** - display image fusion of registered series (see **3.18 Image fusion**),
- **3D view...** - display three-dimensional patient image data representation (see **3.16 Three-Dimensional Visualization**),
- **DRR...** – create **D**igitally **R**econstructed **R**adiograph of the patient image data (see **3.15 DRR Reprojection**),
- **Window/Level...** - Window and level manipulations (see **3.6 Window and Level manipulations**),
- **Zoom...** - zooming the current view in or out (see **3.7 Zooming image views**),
- **Cine...** - play back multi-frame images or series in multi-frame (Cine) mode (like a movie), (see **3.12 Play multi-frame images – Cine dialog**),
- **DSA...** - display XA images with highlighted difference between scans without and with contrast media (see **3.19 DSA – Digital Subtraction Angiography**),
- **Registrations...** – make registration between series of patient image data (see **3.17 Registrations**),
- **Touch screen mode** – run the touch screen mode (see **3.23 Touch screen mode**).

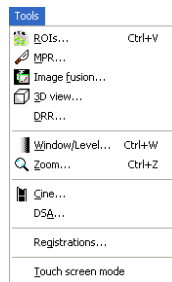


Figure 18 Tools menu

3.1.5.4 Image menu

The **I**mage menu (see Figure 19) allows simple image manipulations and browsing:

- **P**oint **s**election - a click inside the image selects the current point and obtains coordinates and grayscale level (e.g. Hounsfield in CT) values of this current point. This information can be shown in the Status bar (see **3.2.1 Setting up the application**),
- **R**OI **s**election - highlight ROI in the image whenever mouse pointer hovers over it,
- Turn on/off simple image data modifications in the current view:
 - Change **W**indow and **l**evel settings – **W**indow/**L**evel, **W**indow/**L**evel **r**ectangle (see **3.6 Window and Level manipulations**),
 - **I**nvert current image (reverse black and white colors)
 - **Z**oom in or out, **Z**oom **r**ectangle (see **3.7 Zooming image views**),
 - **M**ove the image,
- **M**PR **r**otate, **M**PR **m**ove - rotate and move MPRs,
- **P**revious and **N**ext - scrolling through the series of images or MPRs,
- **D**ICOM **d**ump... - display detailed DICOM information about image in the current view.

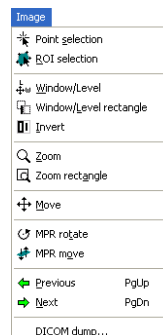


Figure 19 Image menu

3.1.5.5 *Filter menu*

The **F**ilter menu (see Figure 20) automatically applies Image processing filters to the image:

- **S**often image,
- **S**harpen image,
- Equalize levels using histogram (**H**istogram equalization),
- Turn off the filter (**O**riginal image).



Figure 20 Filter menu

3.1.5.6 *Annotations menu*

The **A**nnotations menu (see Figure 21) allows following operations in the image:

- Using annotations and measurements:
 - Freely positioned **T**ext in the image,
 - Description **M**arkers for specific image points,
 - **D**istance between two points,
 - **D**istances and **a**ngle between three points,
 - **P**robe – tracking circle tool for display point level values in the specified round area,
 - **D**ensity **s**pot – current point level value,
 - **D**ensity **p**rofile over the line between two points,
 - Density profile over the elliptical (**E**llipse), rectangular (**R**ectangle) or freely outlined area (**A**rea),
- Change **V**alue units of annotations,
- **U**nlock all annotations,
- **D**etele / **D**etele **a**ll annotations,
- Display the list of annotations (**A**nnotations...).

For detailed description see **3.11 Annotations and measurements**.

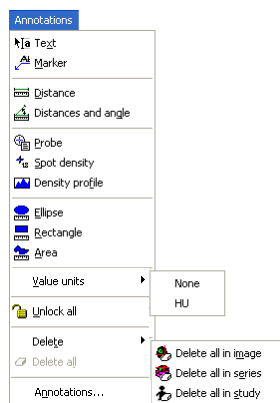


Figure 21 Annotations menu

3.1.5.7 Flip/Rotate menu

The **Flip/Rotate** menu (see Figure 22) allows following actions with the current view:

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

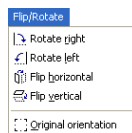


Figure 22 Flip/Rotate menu

3.1.5.8 View menu

Following functions are available through the **View** menu (see Figure 23):

- **Toolbars** – hide or display toolbars:
 - **L**arge toolbar (see Figure 11),
 - **S**mall toolbar (see Figure 12),
 - **C**ontext bar (see Figure 10),
 - **A**nnotations (see Figure 13),
 - **F**lip/Rotate (see Figure 14),
 - **S**tatus bar (see Figure 15),
- **Cr**eate new **w**orking 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,
- **Cutlines** (see 3.20 **Cutlines**),
- **View size** – change the current view size (see 3.8 **Current view size**),
- **Create image sequence** (see 3.9 **Creating a sequence of images**),
- **Series synchronization** – create series synchronization (see 3.10 **Synchronizing displayed series**),
- **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.

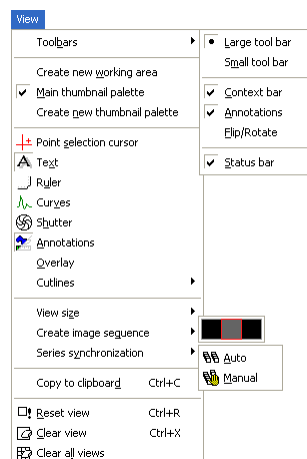


Figure 23 View menu

3.1.5.9 *Help menu*

Use the **H**elp menu to obtain the application version or browse the on-line user's manual (see Figure 24):

- **TomoCon manual** – on-line manual will be opened,
- **A**bout... – the **A**bout... dialog is opened informing about the current application version.

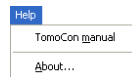


Figure 24 Help menu

3.2 **Setting up the application – User Preferences**

The **TomoCon setup** dialog can be opened by clicking at the **Setup...** submenu in the **TomoCon** menu (see **3.1.5.1 TomoCon menu**). The **TomoCon setup** dialog (see Figure 25) allows to:

- Set up the mouse wheel and buttons behavior and the application settings (see **3.2.1 Setting up the application**),
- Display/hide text types in views (see **3.2.3 Displayed texts in views**),
- Set up the modality settings (see **3.2.4 Modality settings**),
- Set up color shades and shape of TomoCon's objects (see **3.2.5 Color settings**),
- Set up the application language (see **3.2.6 Application language**).

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

3.2.1 **Setting up the application**

Common application settings can be set up in the **View/Controls** tab (see Figure 25), the **TomoCon setup** dialog (see **3.1.5.1 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,
- **Status bar options** – information displayed at the bottom of the Status bar:
 - Turn on/off displaying current point series identifications (**Series**),
 - Turn on/off displaying current point level values (**Level**),
 - Turn on/off displaying current point coordinates (**Current point**),
- **Open on patient load** – display selected dialogs after selecting and opening patient:
 - The Gray dialog (see **3.6 Window and Level manipulations**),
 - The Zoom dialog (see **3.7 Zooming image views**),
 - The Cine dialog (see **3.12 Play multi-frame images – Cine dialog**),
- **Mouse options**:
 - For more Mouse options using the buttons and the scrolling wheel in the current view (see **3.2.2 Mouse actions**).

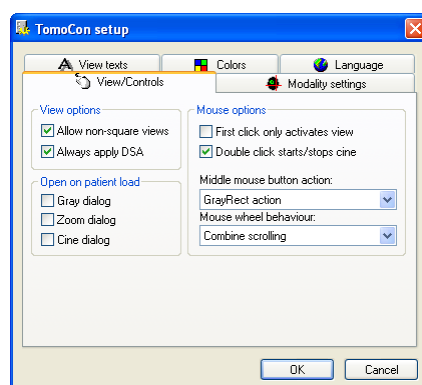


Figure 25 TomoCon setup dialog, View/Controls tab

3.2.2 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 25):

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 **3.12 Play multi-frame images – Cine dialog**).

3.2.3 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 adjustable by user (see Figure 26). Use the **View texts** tab in the **TomoCon setup** dialog to set up your own preferences.

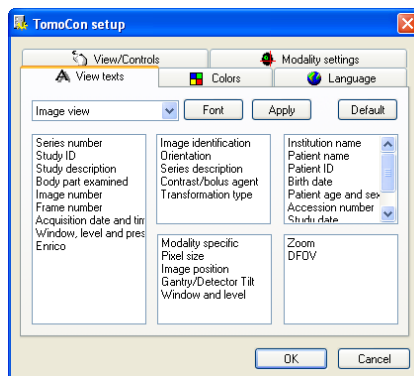


Figure 26 TomoCon setup dialog, View texts tab

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.

3.2.4 Modality settings

Use the **Modality settings** tab in the **TomoCon setup** dialog (see Figure 27) to set up properties separated for each modality:

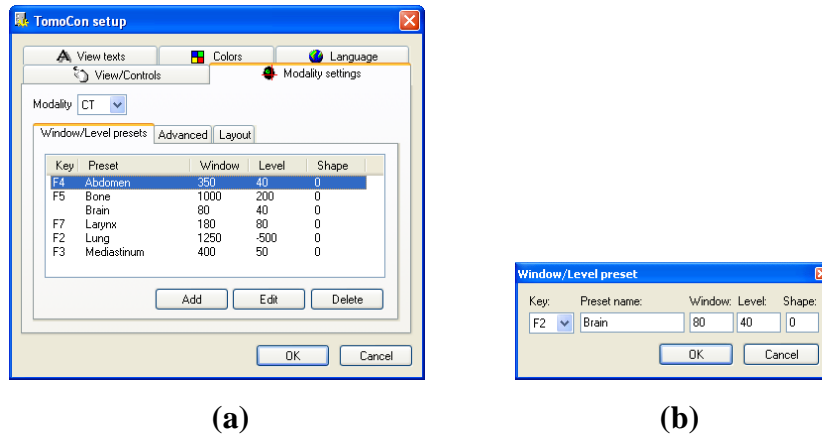


Figure 27 TomoCon setup dialog, Modality settings tab, Window/Level presets sub tab (a), Window/level preset dialog (b)

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

- **Window/Level presets** sub tab (see Figure 27 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 27), which allows you to make the changes, will be opened.

- **Advanced** sub tab (see Figure 28) 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 visualisation:

- **None**,

- **Bilinear,**
- **Bicubic,**

Turn on/off the **Enable supersampling** function.

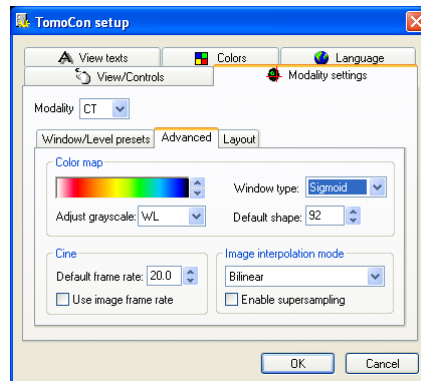


Figure 28 TomoCon setup dialog, Modality settings tab, Advanced sub tab

- **Layout** (see Figure 29) – depending on the modality allows following actions after opening the first study:

Load layout – fill the views with the first images of the first series opened in TomoCon.

NOTE! If the **Create image sequence** option is activated, the views will be filled only if the first series of the first study opened in TomoCon does not contain multi-frame images;

Create image sequence from all views in the working area.

Set the view layout (number of rows and columns)

- **Rows,**
- **Columns.**

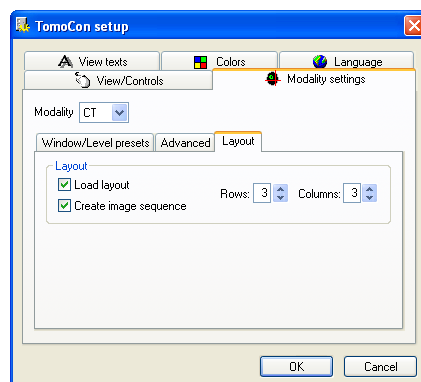


Figure 29 TomoCon setup dialog, Modality settings tab, Layout sub tab

3.2.5 Color settings

Default colors of certain displayed objects in TomoCon can be changed in the **Colors** tab, the **TomoCon setup** dialog (see Figure 30). 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,
 - Image sequence** – frame image sequence 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,

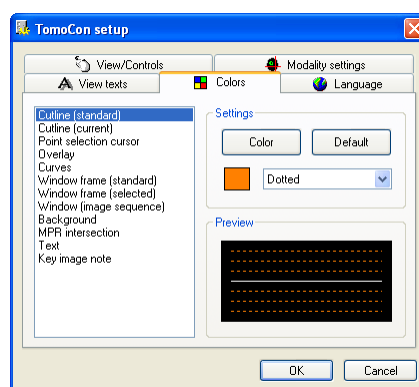


Figure 30 TomoCon setup dialog, Colors tab

Click at 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.

3.2.6 Application language

TomoCon allows to select the application language using the **Language** tab in the **TomoCon** dialog (see Figure 31):

- **Slovak,**
- **Czech,**
- **English.**

The language will be changed after restarting the application.

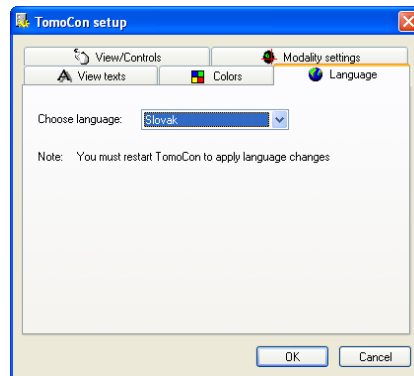



Figure 31 TomoCon setup dialog, Language tab

3.3 Open a patient study

The Search studies dialog (see Figure 32) allows to search and open selected study of patient in TomoCon.

A dialog will be opened by either clicking at the  **Open study** icon the Standard toolbar or the **Open study...** submenu in the **Study** menu (see 3.1.5.2 Study menu).

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

- **Local studies** (see 3.3.2 Local studies),
- DICOM format source (CD, HD, etc.) (see 3.3.4 DICOMDIR),
- PACS system (see 3.3.3 TomoCon PACS server),
- Device with DICOM protocol (see 3.3.6 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

3.3.1 Studies filter



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 32):

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. 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 at the  symbol or fold the list by clicking at 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).

3.3.2 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 32) and after select they can be opened.

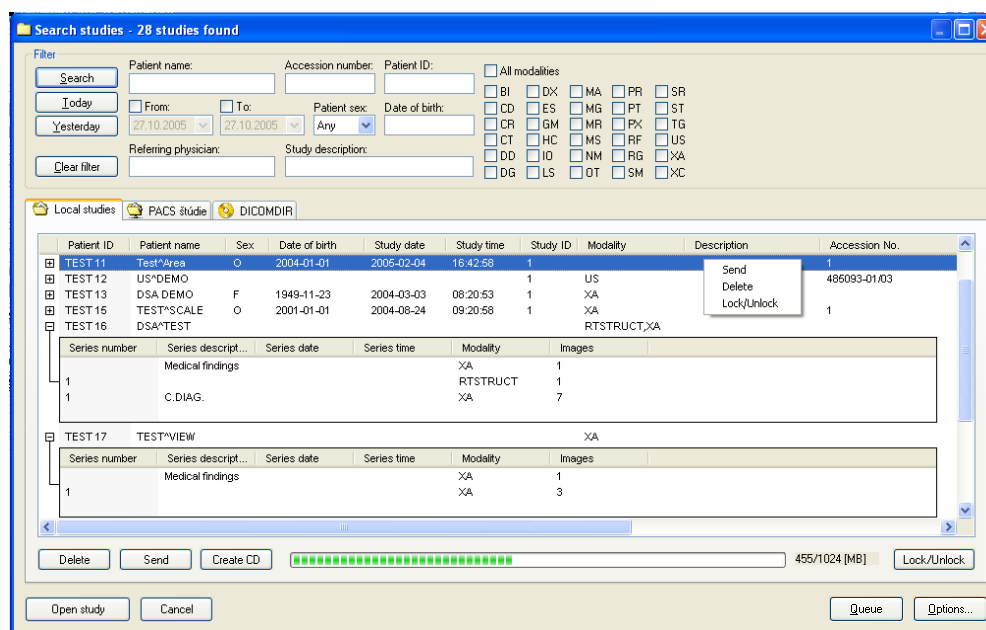


Figure 32 Search studies dialog

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 **3.30 Archive patient studies on CD**), after pressing the **Add** button the selected study will be added to the list of studies, ready to be burned).

3.3.3 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 33).

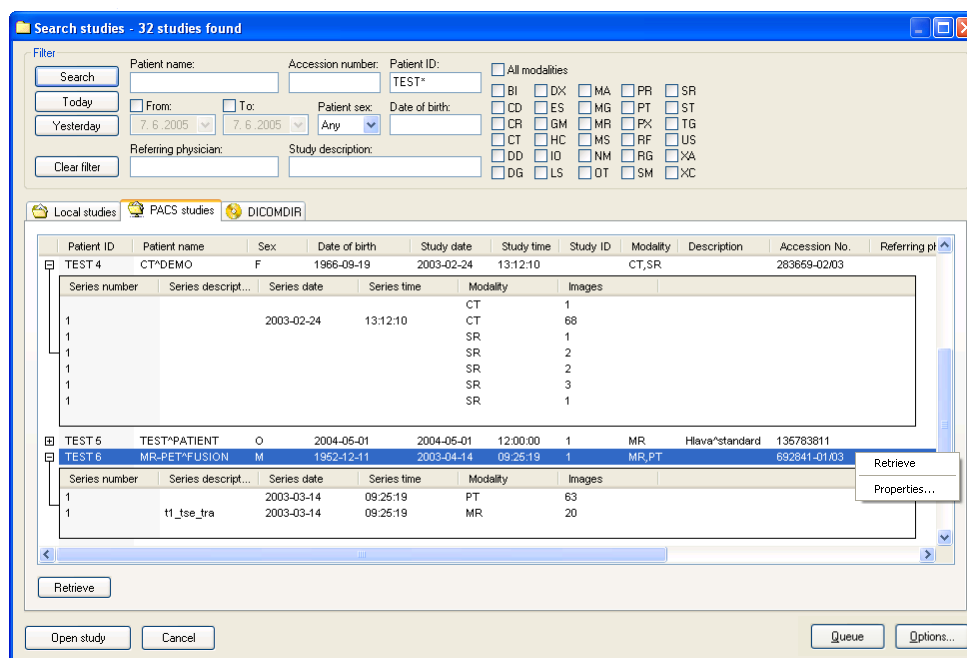


Figure 33 Search studies on PACS server dialog

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.

3.3.4 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 34).

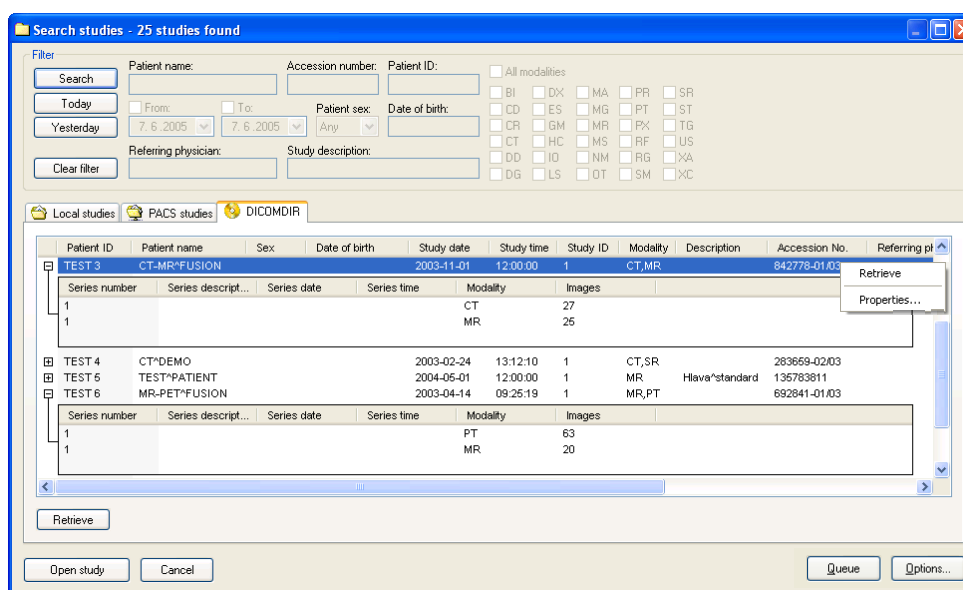


Figure 34 Search studies in DICOMDIR dialog

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.

3.3.5 Opening multiple studies

Multiple patient studies can be opened simultaneously in TomoCon. When opening another study, a dialog will be opened (see Figure 35). Choose the **No** button if you want to keep the currently opened studies. Press **Yes** to close the studies.

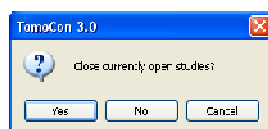


Figure 35 “Close currently opened studies?” message box

3.3.6 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 **3.3.9 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.

3.3.7 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 36) 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 **3.3.9 Settings**).

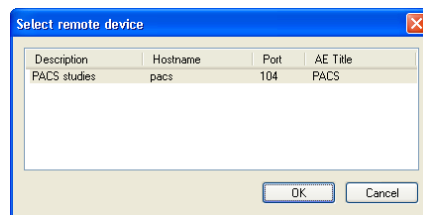


Figure 36 Select remote device dialog

3.3.8 Monitoring and controlling the send/receive process

TomoCon allows with dialog **Queue management** (see Figure 37) 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.

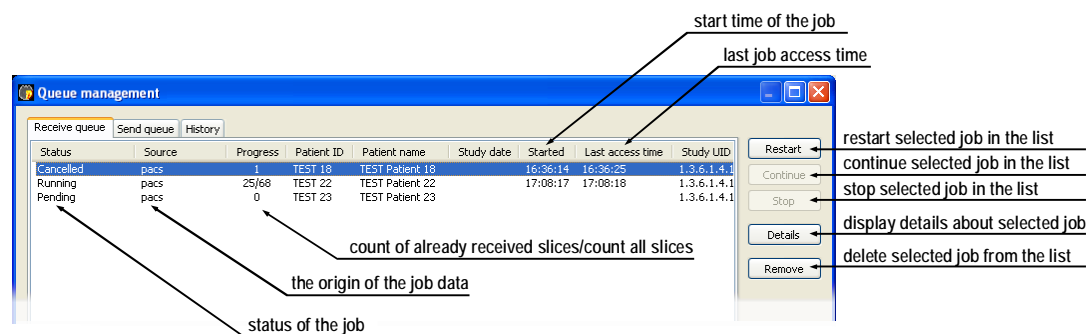


Figure 37 Queue management, Receive queue tab

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

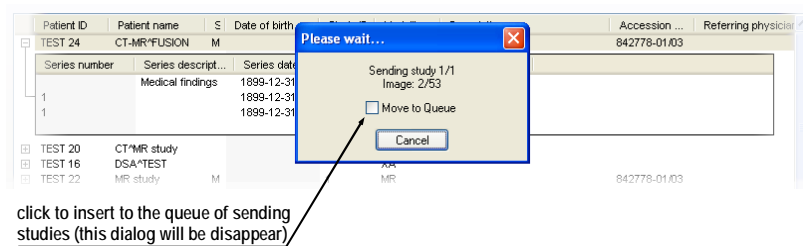
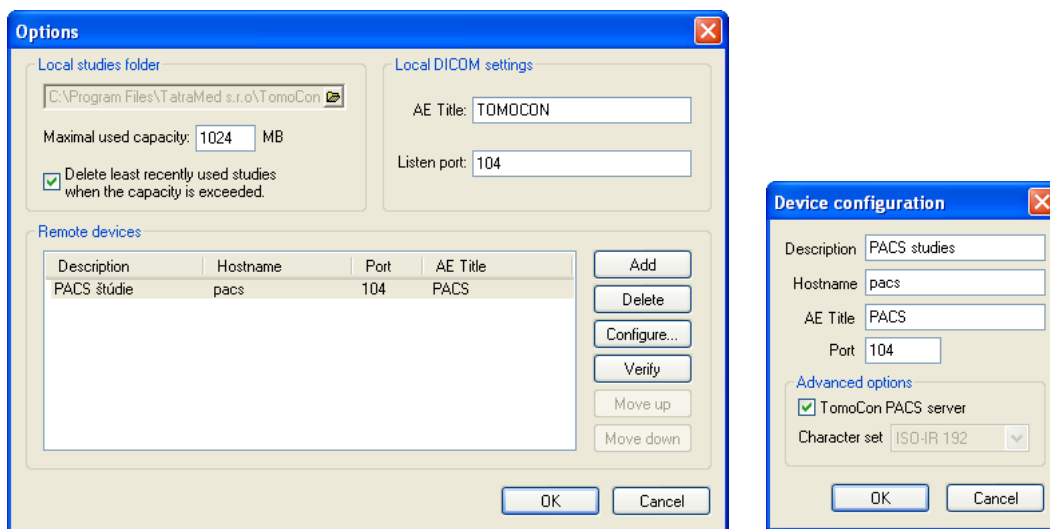


Figure 38 Search studies dialog, sending of selected study from Local studies

3.3.9 Settings

Following settings are available through the **Options** dialog (see Figure 39 a) that will be displayed after pressing **Options** in the **Search studies** dialog:

- **Local studies folder** – local studies folder properties (see **3.3.9.1 Local studies properties**),
- **Local DICOM settings** – settings for importing DICOM data to **TomoCon** (see **3.3.9.2 DICOM receiver settings**),
- **Remote devices** – external devices settings for DICOM data exchange (see **3.3.9.3 External DICOM device configuration**).



(a)

(b)

Figure 39 Options dialog (a), Device configuration dialog (b)

3.3.9.1 Local studies properties

It is possible to define a folder for Local Studies in the **Options** dialog (see Figure 39 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.

3.3.9.2 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.

3.3.9.3 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 39 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.

3.4 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 3.1.5.1 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 40),
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 42) 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 41) 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.

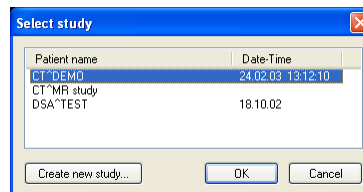


Figure 40 Select study dialog

Patient information

Patient ID:

Name:

Birth date: Patient's sex:

Size: cm Weight: kg

Admitting diagnoses:

Study information

Study ID:

Accession number:

Study description:

Study date: Study time:

Referring physician:

Figure 41 New study dialog

Series information

Series number:

Modality:

Description:

Series date: Series time:

Performing physician:

Operator:

Figure 42 New series dialog

3.5 *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 43).

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 43) and select **Insert image** / **Insert image copy** item. Image from the current view will be automatically inserted to the end of this series.

To insert screen shot of the current view:

1. Prepare image for screen shot in the current view,
2. Move mouse cursor over the thumbnail previews of images from series, which is dedicated to insert new image,
3. Press right mouse button to display context menu (see Figure 43) and select **Insert image** / **Insert view screenshot** item. Screenshot of 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 43) and select **Delete image** item. Image will be automatically deleted from series.

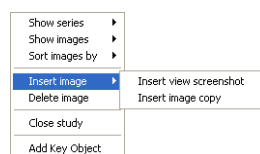



Figure 43 Context menu of thumbnail palette

3.6 Window and Level manipulations

To be able to see patient image data with correct contrast and image details in some particular grayscale range, the user can change the gray level and window with the **Window/Level** dialog (see Figure 44). It will be opened by either clicking at the  **Window and Level...** icon in the Standard toolbar or **Window/Level...** submenu in the **Tools** menu (see 3.1.5.3 **Tools menu**).

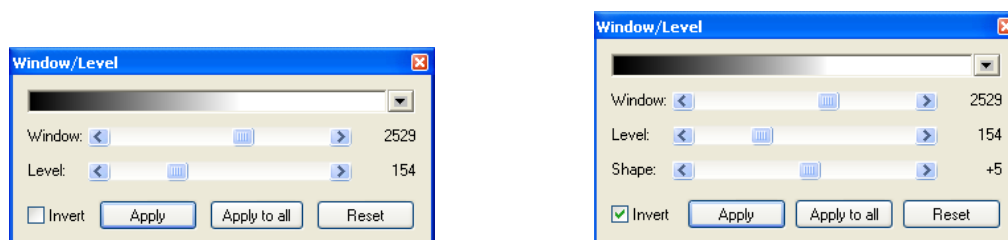



Figure 44 Window/Level dialog variants

Changes made with the **Window** and **Level** sliders will be only seen in the current view and stay valid until a new image from the thumbnail palette is chosen. The 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 3.2.4 **Modality settings**).

Users can create and use their own “predefined window, level and shape settings” by 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 45). 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 3.2.4 **Modality settings**).

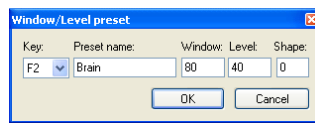








Figure 45 Window/Level dialog – defining new Window/Level/Shape preset

To modify window and level simultaneously without opening the **Window/Level** dialog, click at the  **Window/Level** icon in the **Image** menu or at the Context toolbar (mouse cursor will get  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 at the  **Window/Level Rectangle** icon. The mouse cursor will get  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/Level** and **Window/Level rectangle** functions apply only to the current view. 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.

3.7 Zooming image views

The **Zoom** dialog (see Figure 46) can be used for zooming details in the image, e.g. while contouring small structures or clicking reference points. It can be opened by either clicking at the  **Zoom** icon in the Standard toolbar or the **Zoom...** submenu in the **Tools** menu.

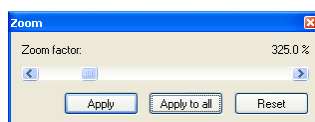








Figure 46 Zoom dialog

The **Zoom factor** 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. 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.

Click on the **Apply** button in the **Zoom** dialog to apply the zoom to the image opened in more views and to the thumbnail preview. Click on the **Apply to all** button in the **Zoom** dialog to apply the zoom to all images, views and thumbnail previews of the same series.

To modify the zoom factor using the mouse (without opening the **Zoom** dialog), click at the  **Zoom** icon in the **Image** menu or on the Context toolbar (mouse cursor will get  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 at the icon (mouse cursor will get  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** and **Zoom rectangle** functions apply only to the current 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.

3.8 *Current view size*

The current view size can be changed using the options in the **V**iew menu, **V**iew **s**ize (see Figure 47) or using the Standard toolbar. The following actions are available:

-  **E**nlarge view - enlarge the current view up to the size of the main window,
-  **R**educe view - reduce the current view down to the original size,
-  **R**estore **a**ll views - restore all views to their original sizes.

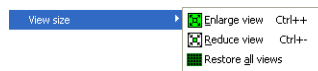


Figure 47 View size options

3.9 Creating a sequence of images

Whole image series can be previewed in the thumbnail palette. However, thumbnail previews are rather small and lack additional text information. The solution is to create a image sequence by clicking at the **Create image sequence** submenu in the **View** menu.

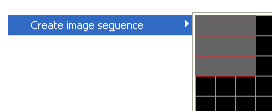


Figure 48 Create image sequence

A small grid matching the currently selected views layout will be displayed. Mark any two views in the grid and the rectangular area of views between them will form a new sequence (see Figure 48) marked with a colored frame (see 3.2.5 Color settings). If you activate any of the sequence views and click at the thumbnail preview, the whole sequence of views will be filled with images around the selected one (see Figure 49). The selected image will be displayed in the current view. This set of images can be scrolled with **Prev** and **Next** icons located at the Standard toolbar or with the slider at the right side of the Working area.

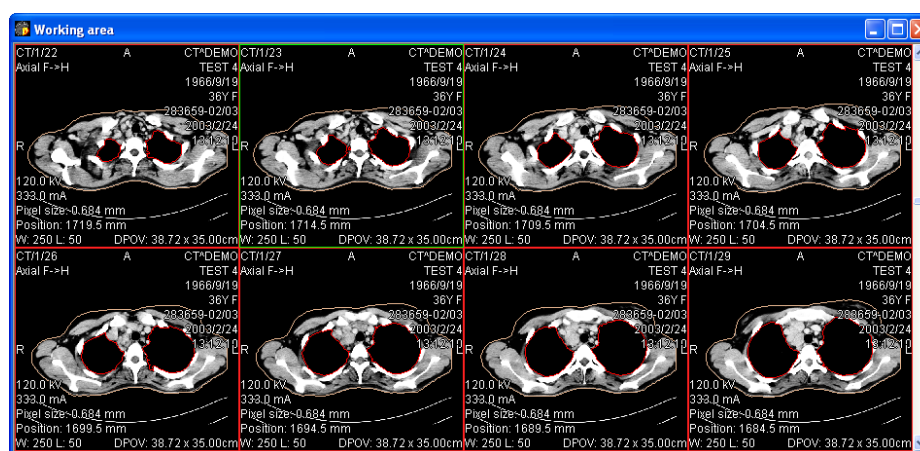




Figure 49 Image sequence

Multiple image sequences can be created containing same or different series. It is not possible to define overlapping areas of sequence views.

Image sequence can be deleted by clicking at the  **Clear view** icon in the **View** menu or at the Context toolbar when any sequence view is active. Clicking at the  **Clear all views** in the **View** menu deletes all defined sequences.

3.10 Synchronizing displayed series

Multiple series can be “locked” together to scroll synchronously in views. This mode can be selected by clicking at the **Series synchronization** submenu (see Figure 50) in the **View** menu.

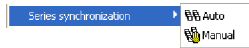


Figure 50 Series synchronization

Two synchronization modes are available:

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

In automatic mode images from different series are displayed at matching or similar positions. While scrolling one view, images in other views 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 views are considered as “currently being displayed at correct positions”. While scrolling one view, images in other views are scrolled by approximately same offsets.

3.11 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 **3.11.1 Text annotations**),
- **Marker** – text description with a marker pointing to the point described (see **3.11.2 Marker annotations**),
- **Distance** – distance between two point (see **3.11.3 Distance**),
- **Distances and angle** (see **3.11.4 Distances and angle**),
- **Probe** – tracking circle tool to display point level values in the specified round area (see **3.11.5 Probe**),
- **Density spot** – desired point level values (see **3.11.6 Density spot**),
- **Density profile** - characteristics of all image points between two points (see **3.11.7 Density profile**),
- **Ellipse** - characteristics of all image points covered by the elliptical area (see **3.11.8 Ellipse**),
- **Rectangle** - characteristics of all image points covered by the rectangular area (see **3.11.9 Rectangle**),
- **Area** - characteristics of all image points covered by a free area (see **3.11.10 Free area**).

All annotations and measurements can be found in the **Annotations** menu (see **3.1.5.6 Annotations menu**). It is also possible to activate them in the Annotations toolbar (see **3.1.4.4 Toolbars**). After activating, the tools can be used only once except Probe tool. It means that every time you need to use a chosen tool, it is necessary to activate it again.

After using an annotation and measurement tool, it is possible to set up its properties through the annotations and measurements context menu (see Figure 51). 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:

- **F**or **a**ll tools,
- **F**or **s**ame **t**ype tools,
- **E**dit label,
- **D**el~~e~~te a tool,
- **L**ocked a tool in the image against moving, deleting or above mentioned actions.



Figure 51 Annotations and measurements context menu

When using a tool covering an area (Ellipse, Rectangle, Free area), the **S**how **t**ext option is added (see Figure 52), which allows to show or to hide **S**ize of the outlined area, **M**in **v**alue, **M**ax **v**alue, **M**ean **v**alue and **D**eviation.

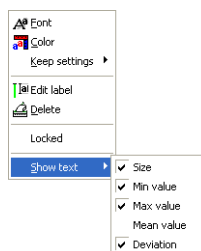


Figure 52 Context menu for ellipse, rectangle and free area

In case of using Density profile, the **S**how/**H**ide **g**raph option is added (see **3.11.7 Density profile**).

If the image selected in the current view contains DICOM information of the measurements value units, **V**alue **u**nits 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 54). 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 **3.1.2.1 Image Transformation**). Images with no transformation (see **3.1.2.2 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 **3.11.11 Calibration**).

3.11.1 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 at 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 53). Type in the description text and press Enter.



Figure 53 Image with Text annotations

3.11.2 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 at 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 54).

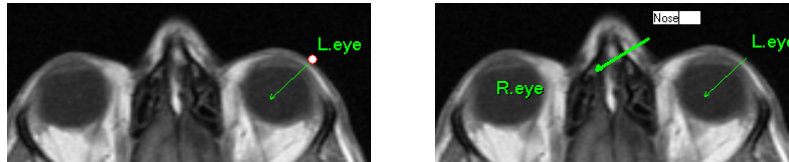



Figure 54 Image with Marker annotations

3.11.3 Distance

Distance measurement can be used after clicking at 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 55).

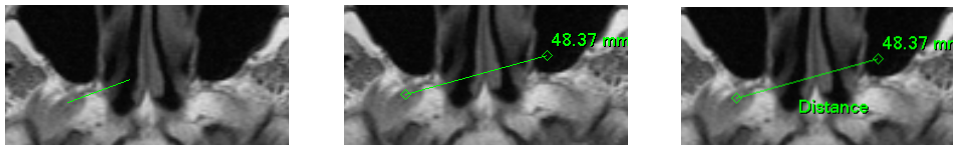



Figure 55 Distance between 2 points

3.11.4 Distances and angle

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

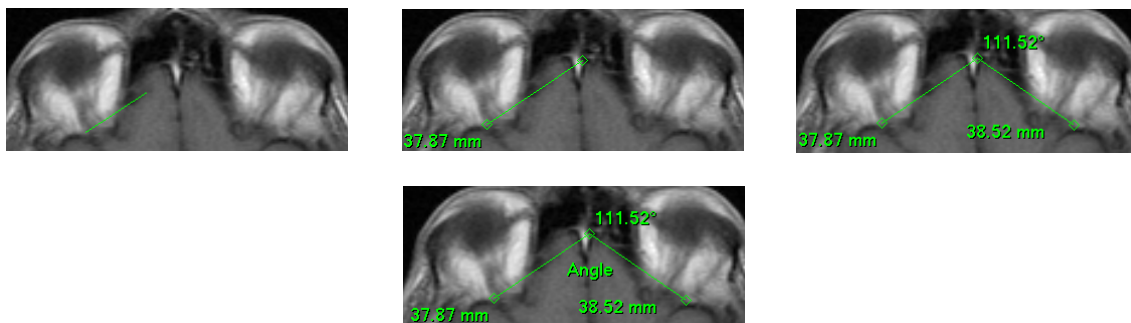



Figure 56 Distances and angle between 3 points

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 56).

3.11.5 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 at 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 display actual minimal pixel value, maximal pixel value and mean value from pixels, which are lying within probe's circle at actual place (see Figure 57). 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 57 Probe measurement

3.11.6 Density spot

Density spot measurement can be used after clicking at 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 58).

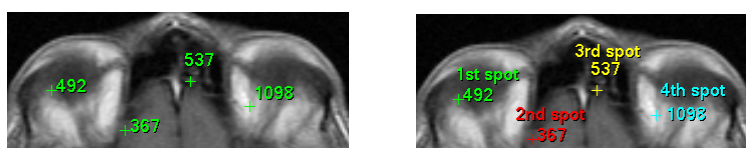



Figure 58 Density spot at various points

3.11.7 Density profile

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

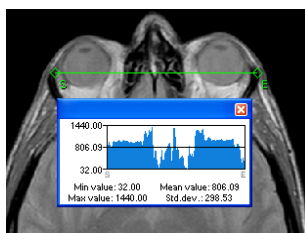



Figure 59 Density profile over a line between 2 points

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 59).

In open studies there can be more measurement lines created in the images. Their Density profiles can be temporarily hidden by clicking at 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 60).

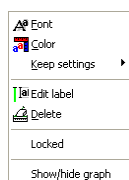



Figure 60 Density profile's context menu

3.11.8 Ellipse

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

Click at any point with the left mouse button, hold it and drag an ellipse between this point and mouse cursor. Characteristics of all image points covered by the elliptical area are summarized and displayed above the ellipse (see Figure 61).

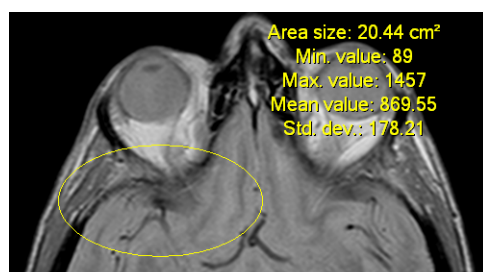



Figure 61 Elliptical area profile

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.

3.11.9 Rectangle

Rectangle drawing will be activated by clicking at the  **Rectangle** item in the **Annotations** menu.

Click at any point with the left mouse button, hold it and drag a rectangle between this point and mouse cursor. Characteristics of all image points, covered by the rectangular area, are summarized and displayed above the rectangle (see Figure 62).

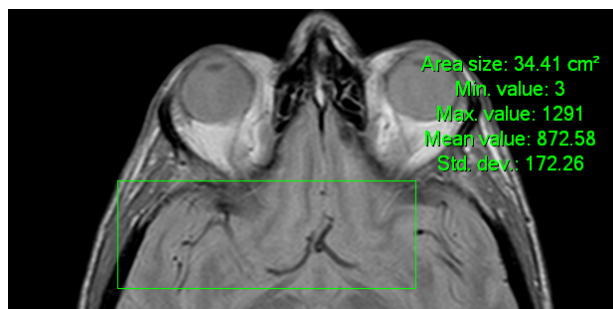



Figure 62 Rectangular area profile

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.

3.11.10 Free area

Free Area drawing will be activated by clicking at 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 63).



Figure 63 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.

3.11.11 Calibration

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

Choose **C**alibration (see Figure 64) 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:

- **C**alibrate measurement – open the **C**alibration dialog to define the calibration (see Figure 64),
- **A**pply to whole series – apply the defined calibration to the series.



Figure 64 Calibration context menu and Calibration dialog

The **C**alibration dialog allows to define the calibration by entering the chosen line length in millimeters in the **E**nter distance box. After pressing the **O**K 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 **C**alibration dialog. A dialog will be open informing that the image is already calibrated (see Figure 65).

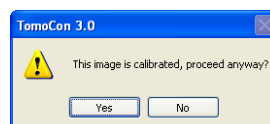


Figure 65 Calibration dialog; This image is calibrated, proceed anyway?

When changing the calibration in the series with calibrated images using the **A**pply to whole series option, a dialog will be open informing that the series is calibrated (see Figure 66).

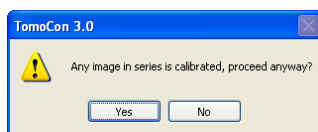



Figure 66 Calibration dialog; Any image in series is calibrated, proceed anyway?


NOTE! Calibration can not be used for images with transformation.

3.11.12 Hide / show annotations




To hide or show existing annotations in all views and TomoCon working areas, select the  **A**nnotations icon in the **V**iew/**A**nnotations menu or **V**iew/**T**oolbars/**A**nnotations.

3.11.13 Discard annotations

A single annotation can be deleted by clicking at it with the context mouse button and selecting the **D**el~~e~~te entry in the opened **A**nnotations context menu. You can also choose the **A**nnotations... dialog in the **A**nnotations menu (see **3.11.14 List of annotations**).

To discard all defined annotations, defined in all opened patient studies, click at the  **C**lear all annotations icon in the **A**nnotations menu.

It is also possible to discard annotations in the current image, series or study using the respective entries in the **A**nnotations / **D**el~~e~~te menu:

-  **C**lear all in **i**mage icon,
-  **C**lear all in **s**eries icon,
-  **C**lear all in **s**tudy icon.

3.11.14 List of annotations

Click at the **A**nnotations... item in the **A**nnotations menu to open a dialog with the list of all annotations defined in the open studies (see Figure 67).

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

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

By pressing **D**el~~e~~te button the selected annotation will be deleted both from the list and the image.

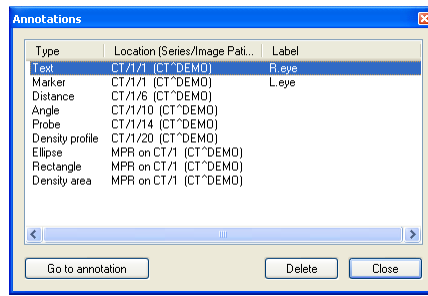



Figure 67 Annotations dialog

3.12 Play multi-frame images – Cine dialog

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 at the  **Cine** icon in the Standard toolbar or the **Cine** submenu in the **Tools** menu (see Figure 68).

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.

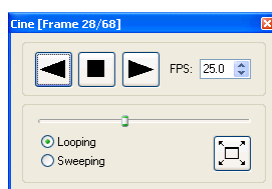






Figure 68 Cine dialog

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),
- To turn on/off the presentation mode  (see **3.12.1 Full Screen/Presentation mode**).

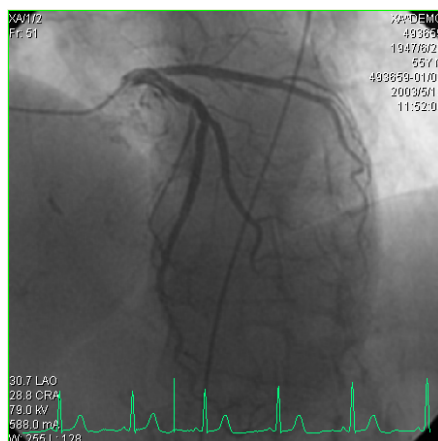



Figure 69 Cine view playing multi-frame image with ECG curve

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 69). 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 **3.2.2 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.

3.12.1 Full Screen/Presentation mode

After pressing the  **Full screen** icon in the **Cine** dialog, TomoCon will be switched into **Presentation mode/Full screen mode**, which is adapted for the projection in darkened room.

Full screen **Presentation mode** contains one view and allows:

- To play back multi-frame images in multi-frame mode (see **3.12 Play multi-frame images – Cine dialog**),
- To select series and an image within the chosen series (**Series & Image selection**),
- **Window/Level** settings (see **3.6 Window and Level manipulations**).

Press the  icon in the **Cine** section or the Esc button on the keyboard to quit the Presentation mode.

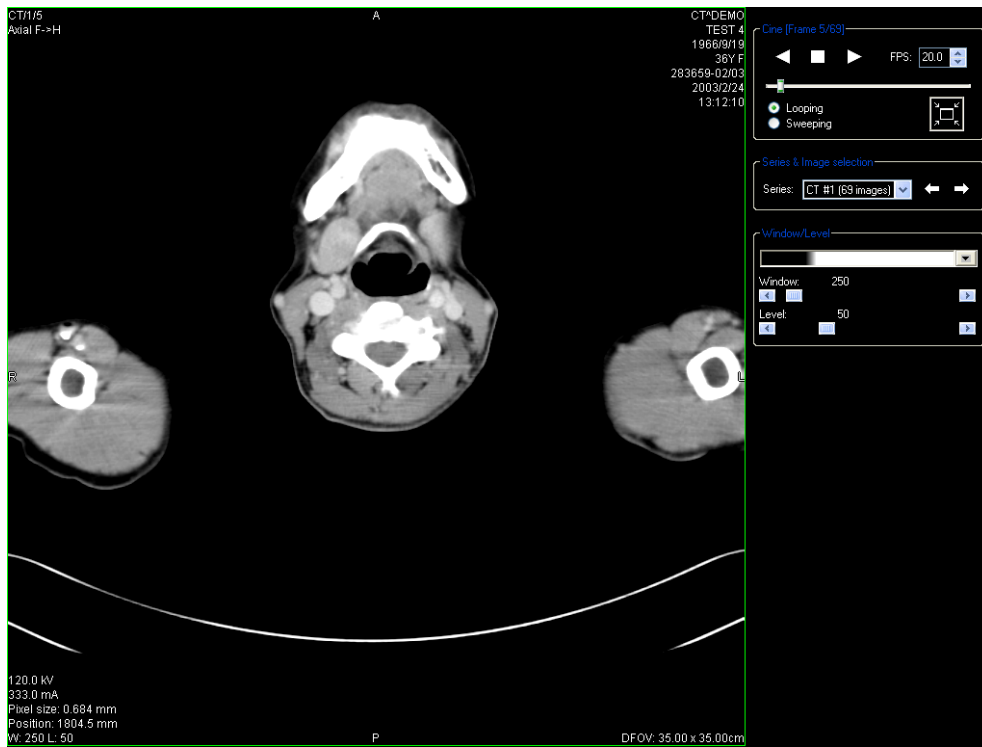


Figure 70 Full screen Cine mode

3.13 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 71). 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 cm³) is calculated automatically.

NOTE! Calculated volume of ROI is depending on actual setting of resolution for specific ROI (see. **3.13.6 Edit ROI properties**).

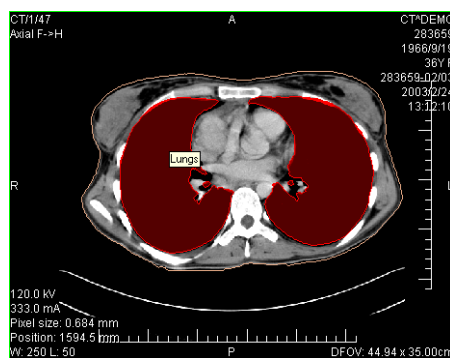



Figure 71 Defined contour

Contours and ROIs can be defined using the **ROI properties** dialog (see Figure 72). It can be opened by clicking at the  **ROI** icon in the Standard toolbar or the **ROIs...** submenu in the **Tools** menu.

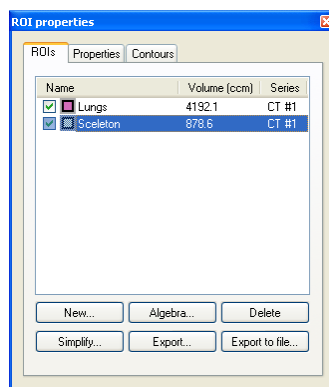


Figure 72 ROI properties dialog, ROIs tab

The **ROI properties** dialog allows:

- To define new ROI – the **ROIs** tab, the **New...** button (see **3.13.1 Adding new ROI**),

- To realize based algebraic operations between two selected ROIs – the **ROIs** tab, the **Algebra...** button (see **3.13.2 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 **3.13.3 Simplify ROI**),
- To copy ROI between any two registered series – the **ROIs** tab, the **Export** button (see **3.13.4 Copying ROIs**),
- To export selected ROI into a file – **ROIs** tab, the **Export to file...** button (see **3.13.5 Export ROI to DXF or VTK file**),
- To define chosen ROI properties – the **Properties** tab (see **3.13.6 Edit ROI properties**),
- To define contour – the **Contours** tab (see **3.13.7 Edit contours**).

3.13.1 Adding new ROI

Add a new ROI to the list of ROIs by clicking at the **New...** button in the **ROIs** tab, the **ROI properties** (see Figure 72). If the current view is empty, the **New ROI** dialog will be opened with the list of series (see Figure 73).

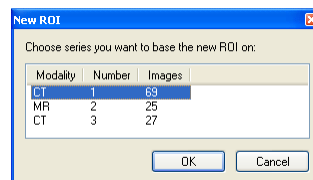


Figure 73 New Region of Interest dialog

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.

3.13.2 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 74) you have to click on the **Algebra...** button in the **ROIs** tab of the **ROI properties** dialog (see Figure 72).

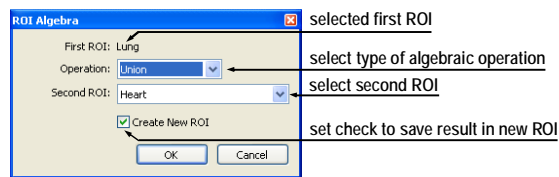


Figure 74 ROI algebra dialog

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

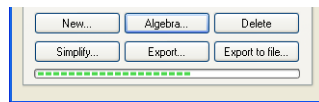


Figure 75 Progress of the algebra computation

3.13.3 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 76), 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 enter 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 72).

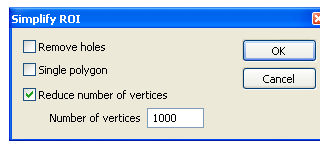


Figure 76 Simplify ROI dialog

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

3.13.4 Copying ROIs

ROIs can be copied between any two registered series (see **3.17 Registrations**). This can visually highlight objects, which are better viewable in another series.

You can do this by Export ROI dialog, which will be displayed, when you have to selected source ROI in the **ROIs tab** and you click on the **Export...** . 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.

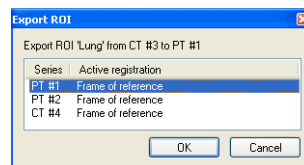


Figure 77 Export ROI dialog

3.13.5 Export ROI to DXF or VTK file

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

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 78), which will be opened.

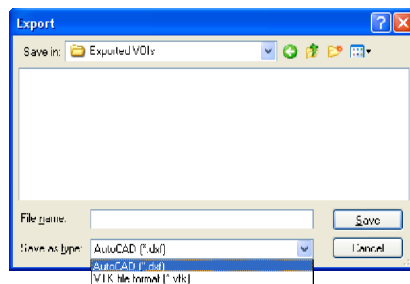


Figure 78 Export dialog

3.13.6 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 79).

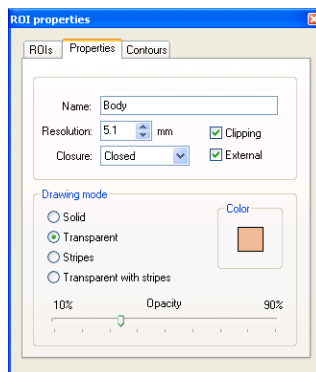


Figure 79 ROI properties dialog, Properties tab

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 **3.16.1 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.

3.13.7 Edit contours

ROI consist of separate contours, which can be manually edited or automatically created after switching to the **Contours** tab (see Figure 80), **ROI properties** dialog.

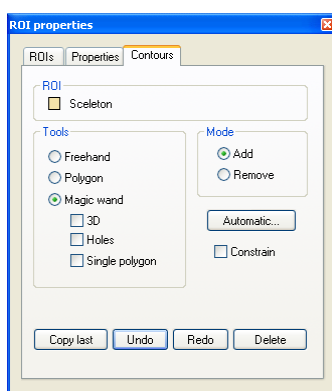


Figure 80 ROI properties dialog, Contours tab









If you want automatically create ROI, you have to click on the **Automatic...** button and the dialog for automatic contouring will be displayed (see **3.13.8 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 press 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.

3.13.8 Automatic contouring

After pressing the **Automatic...** button in the **ROIs** tab in the **ROI properties** dialog (see Figure 72) the **Threshold** dialog for automatic contouring will be opened (see Figure 81).

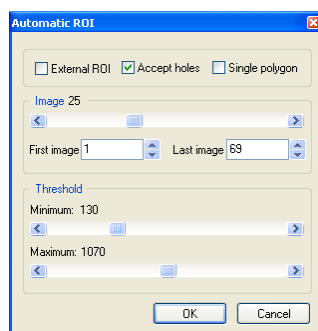


Figure 81 Automatic contouring, Automatic ROI dialog

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 white, the rest is black (see Figure 82).
- 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 treshold value,
 - **Single polygon** – only one polygon in every image without holes according to setting of minimal and maximal treshold value is used.

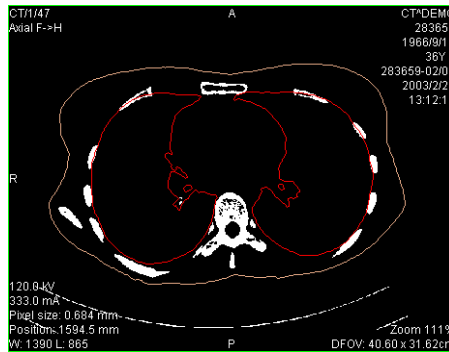


Figure 82 Segmented image with threshold selection, contouring bones

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 83).

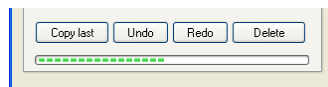



Figure 83 ROI properties dialog, Automatic contouring

3.14 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 84) 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 84) can be opened by clicking at the  **MPR** icon in the Standard toolbar or the **MPR...** submenu in the **T**ools menu.

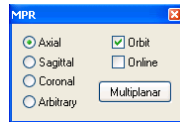


Figure 84 MPR dialog

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 **3.14.1 Arbitrary**),
- Display a rotation tool to help with the MPR rotation – **Orbit** (see **3.14.1 Arbitrary**),
- **Online** – MPR to be bound to the current point (see **3.14.2 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.

While the **MPR** dialog is opened, the position of the plane in the current view is indicated by a colored line (see **3.2.5 Color settings**) in all images and thumbnails, which are intersected by the MPR image plane (see Figure 85).

3.14.1 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 at 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.

3.14.2 Online MPR

The **Online** checkbox in the **MPR** dialog defines the online MPR to be bound to the current point (see Figure 85). 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.

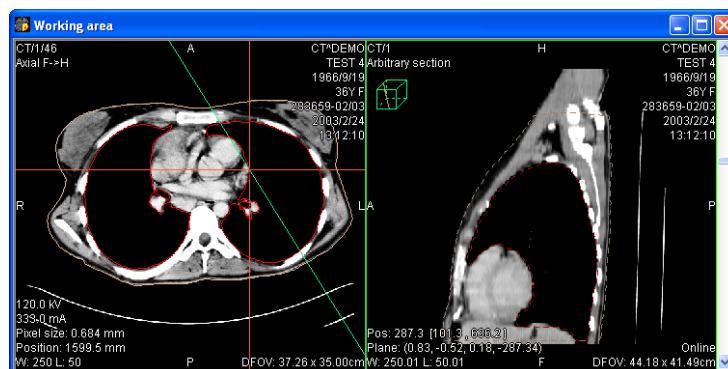


Figure 85 Arbitrary MPR view and intersected axial MPR plane

3.15 DRR Reprojection

To create **DRR (Digitally Reconstructed Radiograph)** reprojection from the patient image data, click at the **DRR...** submenu in the **T**ools menu (see Figure 86).

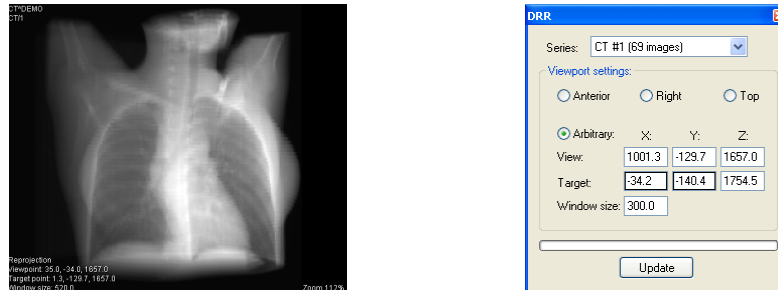


Figure 86 DRR Reprojection image and dialog

DRR parameters in the **DRR** dialog:

- **Series** – choose the image series to create DDR from,
- **Viewpoint settings** – setting up the DDR position to the patient's position:
 - **Anterior**,
 - **Right**,
 - **Top**,
 - **Arbitrary** – DDR 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.

3.16 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. **3.13.6 Edit ROI properties**),

NOTE! Precision of object displayed in 3D View, that represents corresponding ROI, is depending on actual setting of resolution for specific ROI (see. **3.13.6 Edit ROI properties**).

- use automatic tool volume rendering (see **3.16.4 Volume rendering**).

3.16.1 3D View settings

The **3D view** dialog (see Figure 87) will be opened by clicking at the  **3D** icon in the Standard toolbar or the **3D view...** submenu in the **T**ools menu.

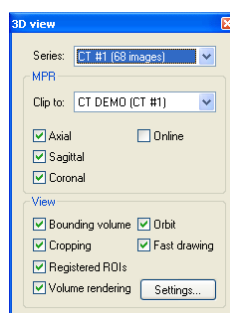


Figure 87 3D view dialog

Three-dimensional view of the patient image data from the current series will be opened in the current view (see Figure 88). 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 **3.16.2 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 **3.17 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 **3.13.6 Edit ROI properties**.

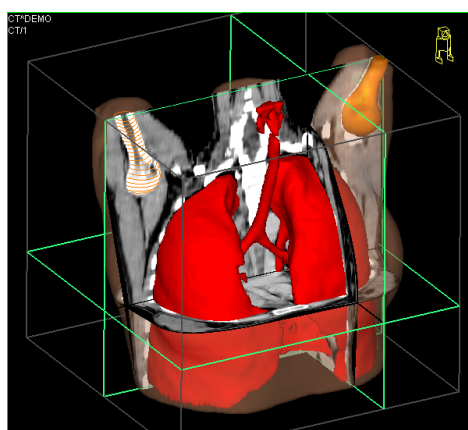







Figure 88 3D view

3.16.2 Rotation, spatial orientation

3D view can be rotated with left mouse button pressed; click at 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 get  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 89). 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.

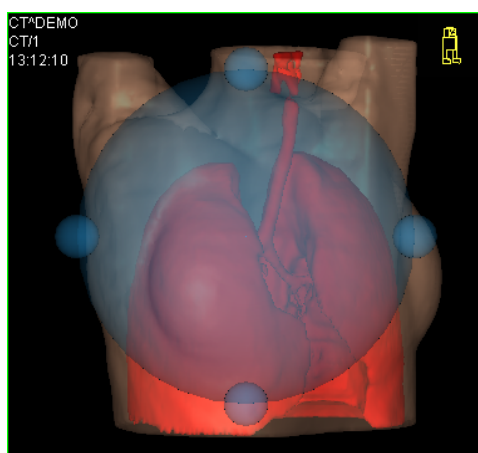



Figure 89 3D view with Orbit function

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 **3.2.3 Displayed texts in views**).

3.16.3 Moving MPR plane

It is possible to move MPR plane interactive in the view (see Figure 90).

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.

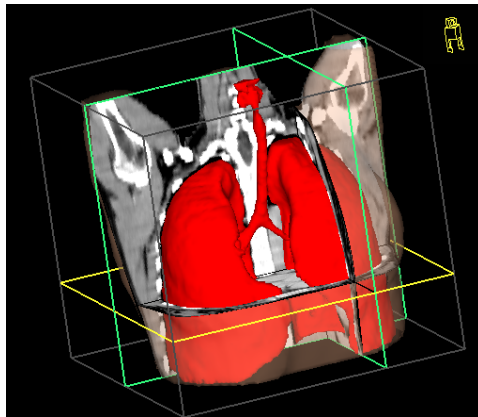


Figure 90 3D view with highlighted MPR plane

3.16.4 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 91) will be displayed in the current view by clicking at the **Volume rendering** choice in the **3D view** dialog (see **3.16.1 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 at the **Settings...** button in the 3D view dialog.

The displayed 3D view can be rotated (see **3.16.2 Rotation, spatial orientation**), cropped or it can display selected MPR.

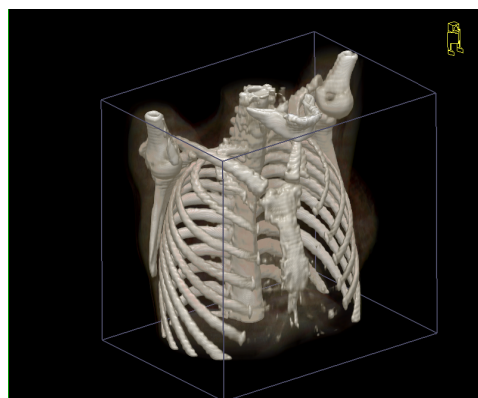


Figure 91 volume rendering 3D view

The settings of the volume rendering 3D view can be changed in the **Volume rendering settings** dialog (see Figure 92). 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.

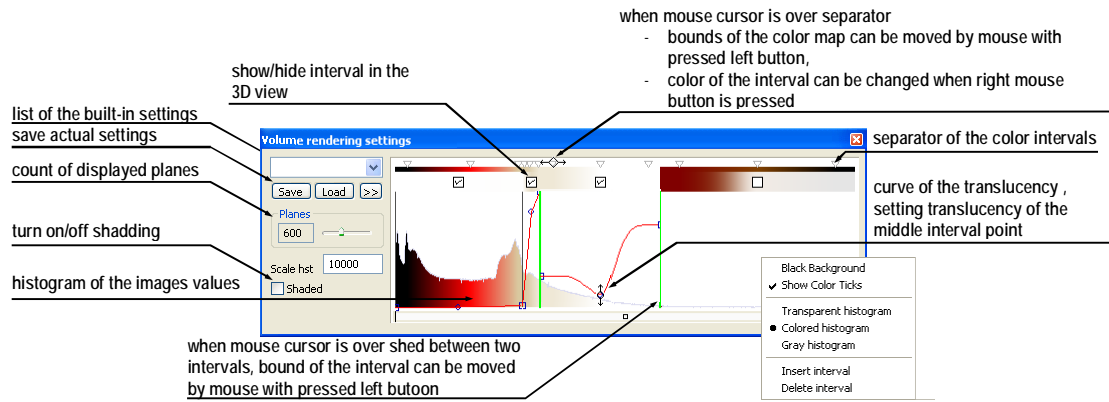


Figure 92 Volume rendering settings dialog

3.17 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 **3.18 Image fusion**).

The **Registrations** dialog (see Figure 93) will be opened by clicking at the **Registrations...** submenu in the **Tools** menu.

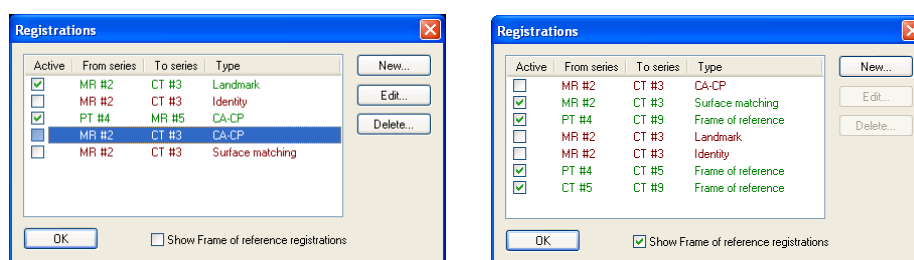


Figure 93 Registrations dialog

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

- **New...** – define new registration between two series (**3.17.1 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.

3.17.1 Defining the registration

Press the **New...** button in the **Registrations** dialog (see Figure 93) to define the relation between two series. The **Define registration** dialog will be opened (see Figure 94).

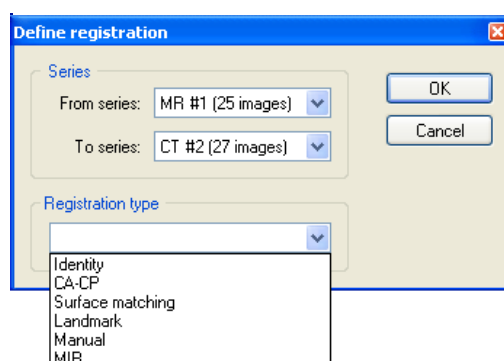


Figure 94 Define registration dialog, selecting Registration type

The **Define registration** dialog (see Figure 94) specifies:

- **Series** - two series and the registration type between them:
 - **From series**,
 - **To series**,
- **Registration types**:
 - **Identity** (see **3.17.1.1 Identity**),
 - **CA-CP** (see **3.17.1.2 Patient-related (CA-CP)**),
 - **Surface matching** (see **3.17.1.3 Surface matching**),
 - **Landmark** (see **3.17.1.4 Landmark**),
 - **Manual** (see **3.17.1.5 Manual**),
 - **MIR** (see **3.17.1.6 MIR**)

3.17.1.1 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.

3.17.1.2 Patient-related (CA-CP)

CA-CP registration (see Figure 95) 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.

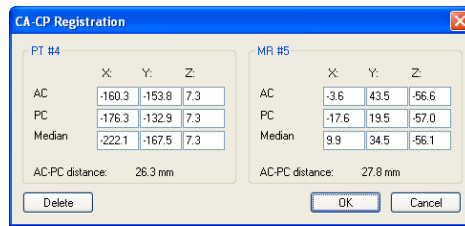


Figure 95 CA-CP Registration dialog

3.17.1.3 Surface matching

Surface matching registration (see Figure 96) 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.

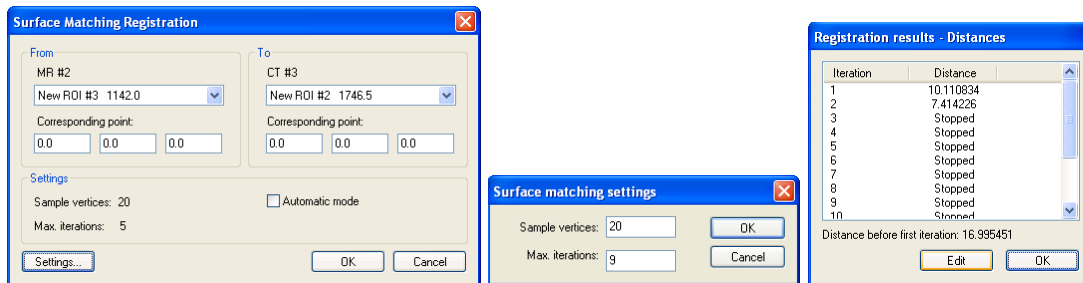


Figure 96 Surface Matching Registration dialog, Surface matching settings dialog, Registration results – Distances dialog

3.17.1.4 Landmark

Landmark registration (see Figure 97) uses the coordinates of several landmarks to establish a series registration.

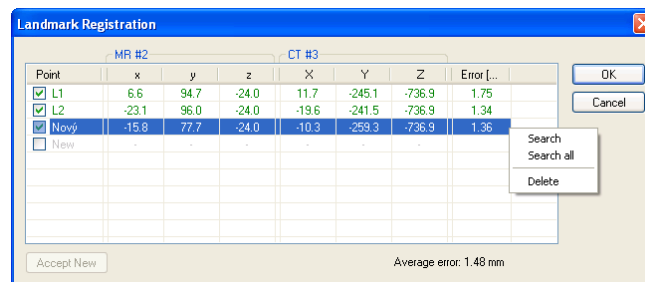


Figure 97 Landmark Registration dialog

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 **Marker2** with their respective name.

3.17.1.5 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 98) 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).

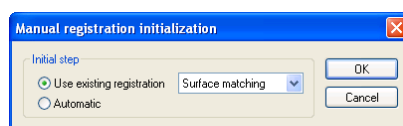


Figure 98 Manual registration initialization dialog

After confirming the initial step with **OK** button three views for manual registration will be displayed in workspace (see Figure 99) together with the **Manual registration** dialog (see Figure 100).

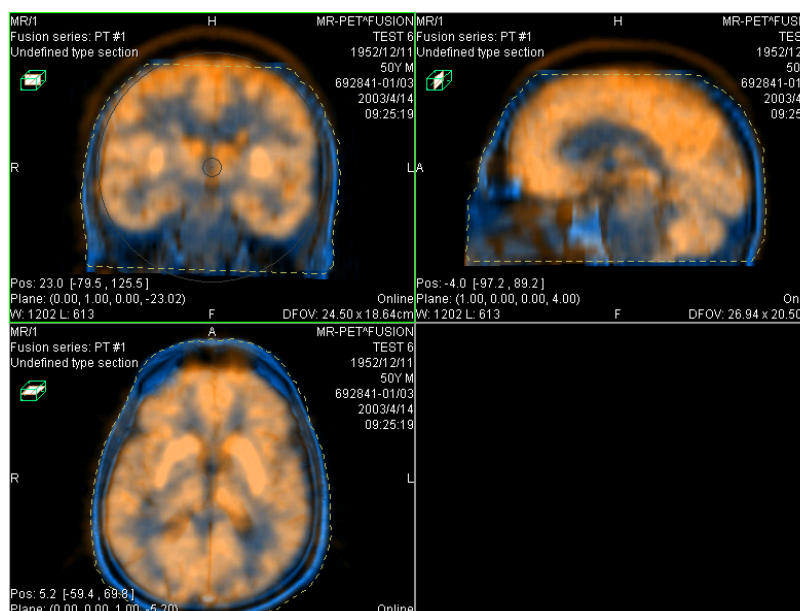


Figure 99 Manual registration working area layout

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.

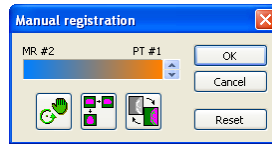



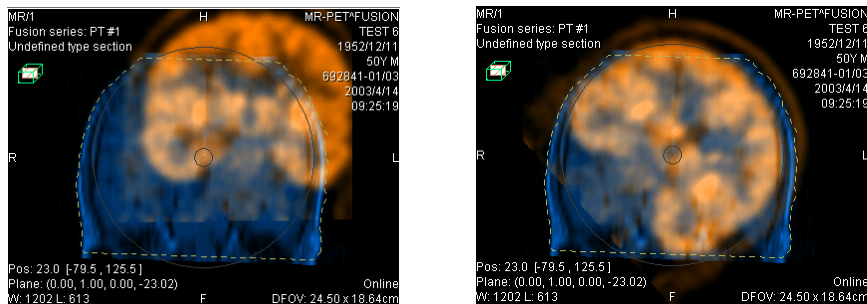


Figure 100 Manual registration dialog

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 101 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 101 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 101 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 102 a), which can be moved and rotated (standard MPR display, see **3.14 MPR – Multi Planar Reformatting**). After pressing the  button once more it is possible to continue editing the manual registration view (see Figure 102 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.

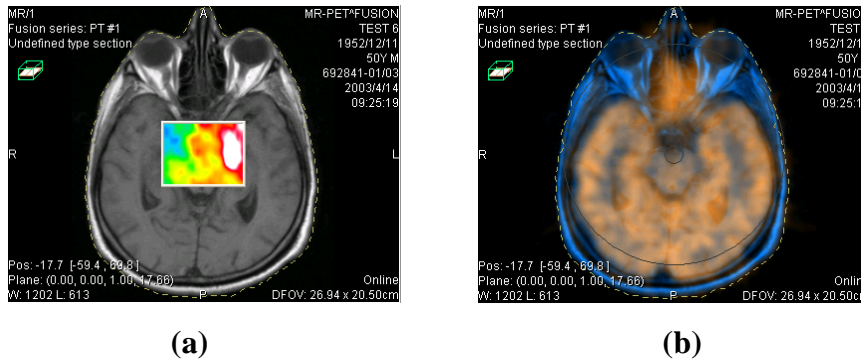


Figure 102 Moving the Base MPR's plane (a), manual registration with shifted plane of the Base MPR (b)

3.17.1.6 *MIR*



This functionality is available only in TomoCon Advanced WS.

MIR (Mutual Information Registration) 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 103) 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).

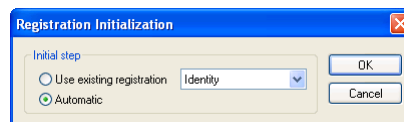


Figure 103 MIR registration initialization dialog

After confirming the initial step with **OK** button, a **Mutual Information Registration** dialog will be displayed (see Figure 104). Calculation of the registration is started by pressing the **OK** button (registration progress will be displayed in log window).

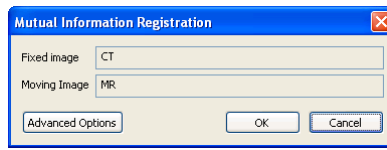


Figure 104 MIR Registration dialog

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 105), where we can define all advanced settings of the registration process.

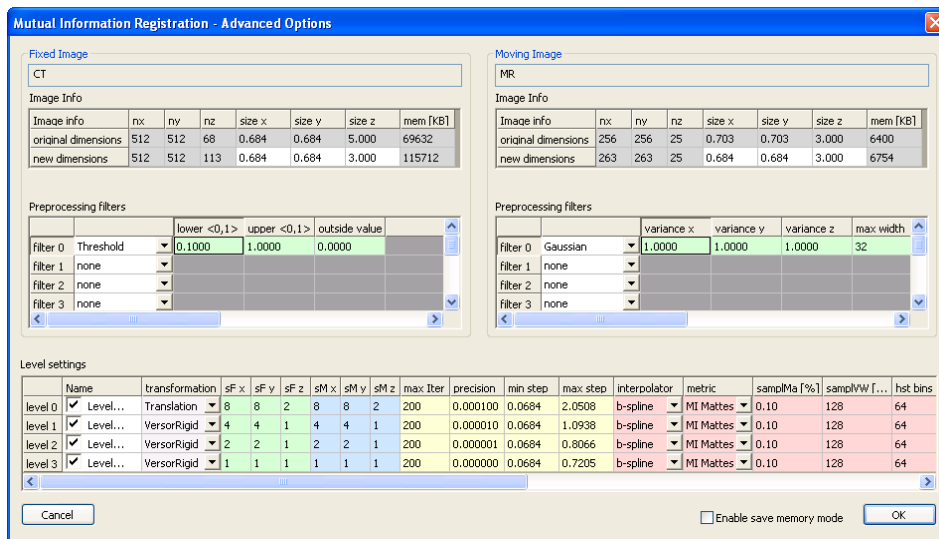



Figure 105 Mutual Information Registration – Advanced Options dialog

3.18 Image fusion

Image fusion allows displaying the data from two registered series combined or overlapped in one image view (see **3.17 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 106) will be opened by either clicking at the  **Fusion** icon in the Standard toolbar or **Image fusion...** submenu in the **T**ools menu.

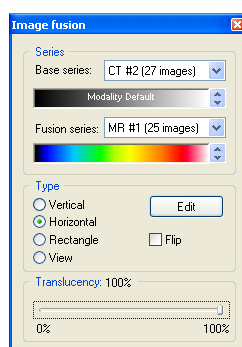


Figure 106 Image fusion dialog

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 107, 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 107, left),
 - **View** – the image from overlaying series is covering whole view,
 - **Edit** – after choosing this option (or double-clicking at 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).

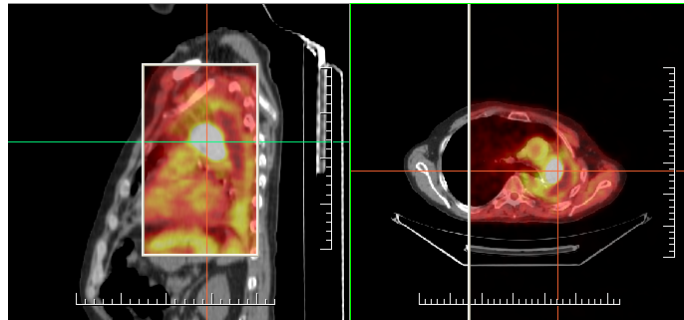


Figure 107 Fusion images between MR and PET series

3.19 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 **3.19.1 Automatic DSA mode**),
- Manual – the image separation has to be made manually (see **3.19.2 Manual DSA mode**).

3.19.1 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 **3.2.1 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 108).

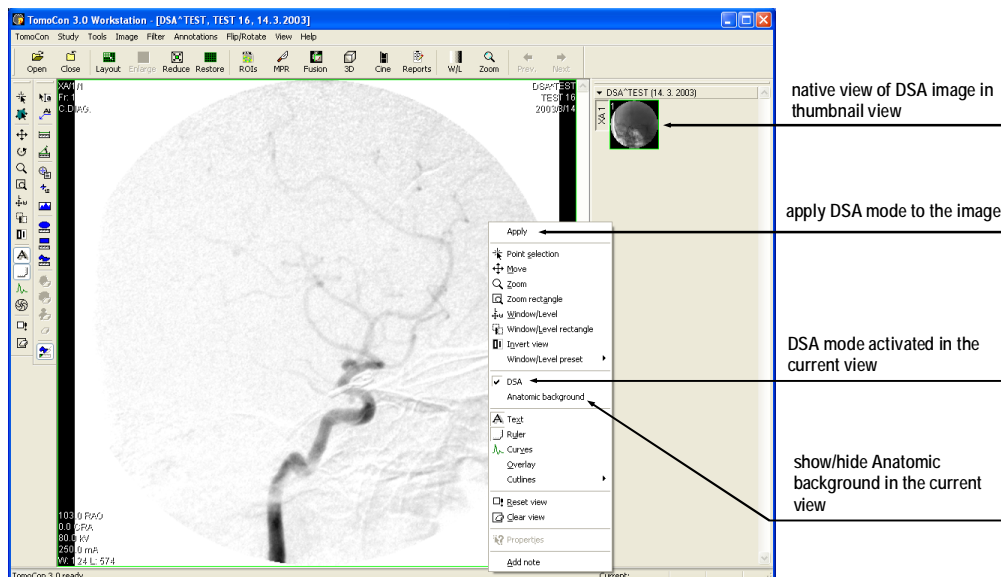


Figure 108 Automatic DSA mode

DSA mode in the current view can be turned off using the view's context menu. Click at 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 at the **Apply to all** items in the current view's context menu.

3.19.2 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 at 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 109):

- **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 at the **Auto mode** item and the settings will return to the image original DICOM setting.

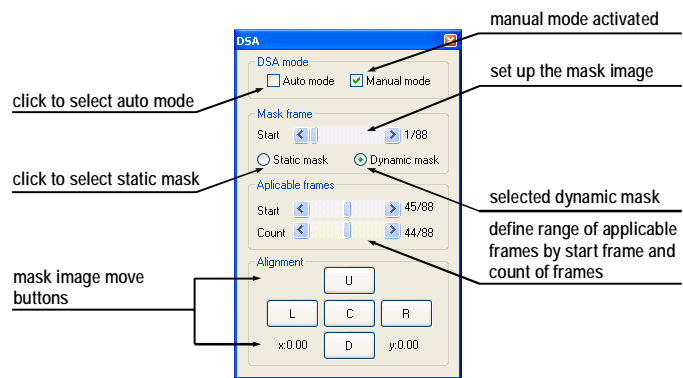


Figure 109 Manual DSA mode

3.20 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 **3.17 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 at the **Cutlines** option in the view's context menu or the **View** menu/**Cutlines** to activate the **Cutlines** function (see Figure 110).

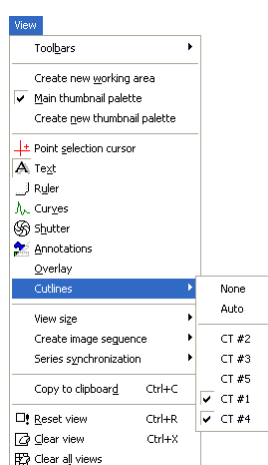


Figure 110 View/Cutlines menu

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 111). Set up the Cutlines color and the line shape in the application settings (see **3.2.5 Color settings**).

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 **3.2.5 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 111). In each view, click at 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).

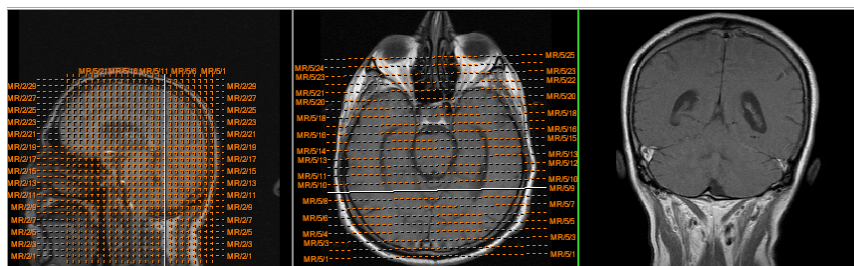


Figure 111 Displayed cutlines at the working area

3.20.1 Delete cutlines

The **None** option in the **Cutlines** menu (see Figure 110) 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 at the context mouse button, choose **Cutlines/None**).

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

3.20.2 Auto mode

Click at the right mouse button in the current view and choose **Cutlines/Auto** from the context menu (see Figure 110). Open an image from any patient series in a new window. The cutlines of the new series will be displayed automatically in the view with the **Auto** mode. The chosen image will be displayed as a current cutline. Current cutlines will be changed automatically when changing an image in the current view.

3.20.3 Print and save cutlines

Defined cutlines can be printed out with the image on a standard MS Windows printer (see 3.21 **Print images on a MS Windows printer**) and a DICOM printer (see 3.22 **Print images on a DICOM printer**). When closing a patient study, cutlines will not be saved.

3.21 Print images on a MS Windows printer

Patient image data can be printed on a MS Windows printer using the **Print** dialog (see Figure 112) that will be opened by clicking at **Print...** in **TomoCon** menu.

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**.

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.

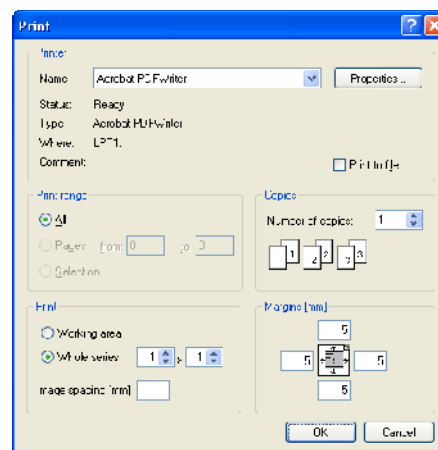


Figure 112 Print dialog

3.22 Print images on a DICOM printer



This functionality is not available on MS Windows 98 SE.

Patient image data can be printed on a DICOM printer using the DICOM print interface (see Figure 113) that will be displayed after pressing the **DICOM print...** submenu in **TomoCon** menu.



Figure 113 DICOM print interface

DICOM print interface consists of:

- Working area (see 3.22.1 DICOM print working area),
- Thumbnail palette (see 3.22.2 DICOM print thumbnail palette),
- Print queue (see 3.22.11 Monitoring and controlling the print process),
- Menu (see 3.22.3 DICOM print menu),
- Standard toolbar (see 3.22.4 DICOM print standard toolbar),
- Status bar (see 3.22.5 DICOM print status bar).

3.22.1 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 3.22.7 Setting up DICOM print interface properties).

Use the mouse to move between the views, the current view is highlighted in a colored frame (see **3.2.5 Color settings**). Use the actions in the DICOM Print view's context menu, Standard toolbar (see **3.22.4 DICOM print standard toolbar**) or program menu (see **3.22.3 DICOM print menu**) to operate with the image in the current view.

3.22.2 DICOM print thumbnail palette

The thumbnail palette is located at the right side of the DICOM print interface (see Figure 113) 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 **3.1.4.2 Thumbnail palette**).

3.22.3 DICOM print menu

DICOM Print menu is located as a DICOM Print window system menu (see Figure 113). It has following sub menus:

- **File** – DICOM printer installation (the **Printers...** submenu, see **3.22.6 DICOM printer**); end work in DICOM Print interface (**Exit**),
- **Images** – image modification in the current view (see **3.22.8 Edit images**),
- **Selection** – choose images from the thumbnail palette to the working area (see **3.22.9 Images for print**),
- **Film** – edit and move between the films (see **3.22.10 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 **3.1.5.9 Help menu**).

3.22.4 DICOM print standard toolbar

The Standard toolbar (see Figure 114) is located under the DICOM Print interface system (to display/hide the dialog see **3.22.3 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 **3.1.4.4 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 114 DICOM print standard toolbar

3.22.5 DICOM print status bar

The Status bar is located at the bottom of the DICOM Print interface (to hide/display the dialog see **3.22.3 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.

3.22.6 DICOM printer installation

Use the **Printers** dialog (see Figure 116) to install a DICOM printer. Click at the **File/Printers...** in the DICOM print interface program menu to open the dialog (see Figure 115).



Figure 115 File menu

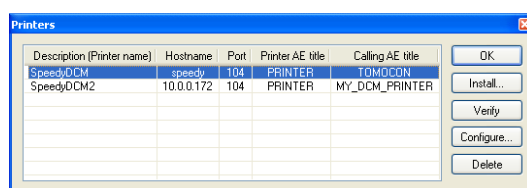


Figure 116 Printers dialog

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 117) that will be displayed after clicking at 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.

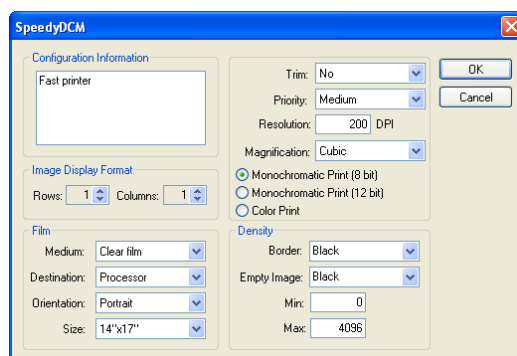


Figure 117 Printer configuration dialog

To install a new DICOM printer click at the **Install...** button to open the **Printer installation** dialog (see Figure 118). Specify the new printer's properties:

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

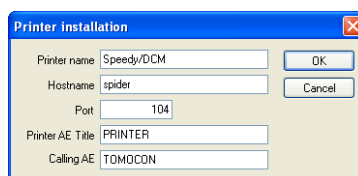


Figure 118 Printer installation dialog

3.22.7 Setting up DICOM print interface properties

Use the **Print Properties** dialog to set up DICOM Print interface preferences (to display/hide the dialog see **3.22.3 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 119) 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**).

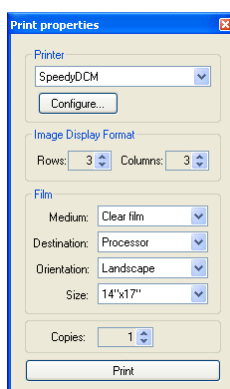


Figure 119 Print properties dialog

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 120) and when this process will

be finished, new created print task will be added to the print queue (see **3.22.11 Monitoring and controlling the print process**).

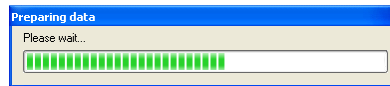


Figure 120 DICOM printing...

3.22.8 Edit images

Images in the working area can be edited the same way as the images in TomoCon. Using the **I**images menu (see Figure 121) it is possible to make following modifications of the image data in the current view:

- **W**indow/**L**evel, **W**indow/**L**evel rectangle,
- **Z**oom, **Z**oom **R**ectangle,
- **M**ove.

Activation and using the modifications is identical to the options of TomoCon's **I**mage menu (see **3.1.5.4 Image menu**).

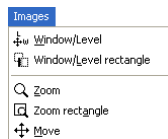


Figure 121 Images menu

3.22.9 Images for print

Choose images for print in the DICOM Print interface from the thumbnail palette where all series are located. Use the **S**election menu to choose the images and add them to the film (see Figure 122).

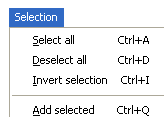


Figure 122 Selection menu

The **S**election menu allows to:

- Choose all images displayed in the thumbnail palette (**S**elect all),
- Cancel the choice of all images from the thumbnail palette (**D**eselect all),
- Invert the selected images (**I**nvert selection),

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

3.22.10 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 123):

- Move to the next film (**N**ext),
- Move to the previous film (**P**revious),
- Delete an image in the current view (**D**elete **i**mage). Images following the deleted image will be replaced in one position;
- **D**elete film and **D**elete all films.

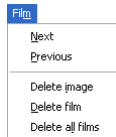
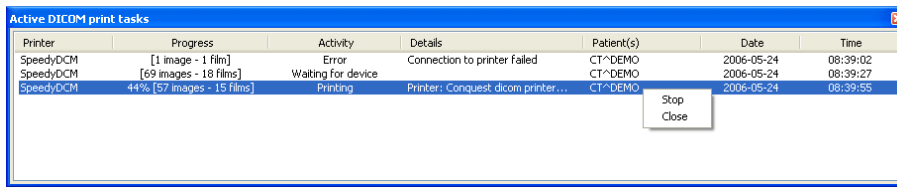


Figure 123 Film menu

3.22.11 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 124 Active DICOM print tasks list

3.23 Touch screen mode




This functionality is not available on MS Windows 98 SE.

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 TomoCon description**) 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 125):

- 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 **3.23.5 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.

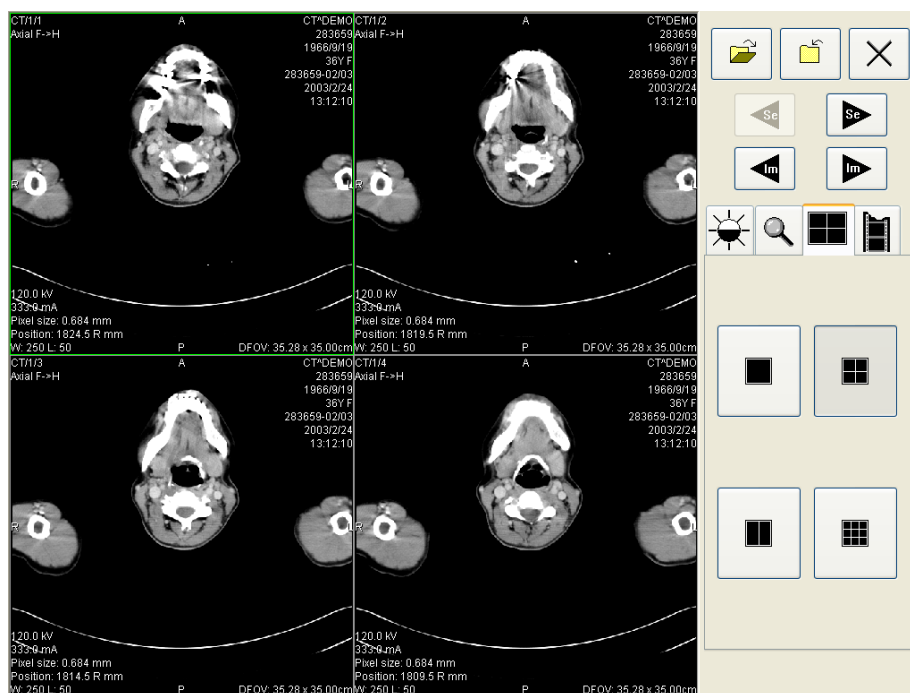





Figure 125 Touch screen mode – layout

Control buttons panel is divided to 3 parts:


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


Open a patient study  (see **3.23.1 Open a patient study**),

Close a patient study  (see **3.23.2 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 **3.23.3 Window, level, shape settings**),


 - Move and zoom images (see **3.23.4 Move and zoom images**),

 - Working area layout settings (see **3.23.5 Working area layout**),


 - Switch to the Cine mode (see **3.23.6 Play multi-frame images**),

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


3.23.1 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 **3.3 Open a patient study**).

3.23.2 Close a patient study




All studies opened in TomoCon can be closed by pressing at 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 148).

3.23.3 Window, level, shape settings

Choosing the  tab the following buttons will be displayed at the bottom part of the panel (see Figure 126):




-  – 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.

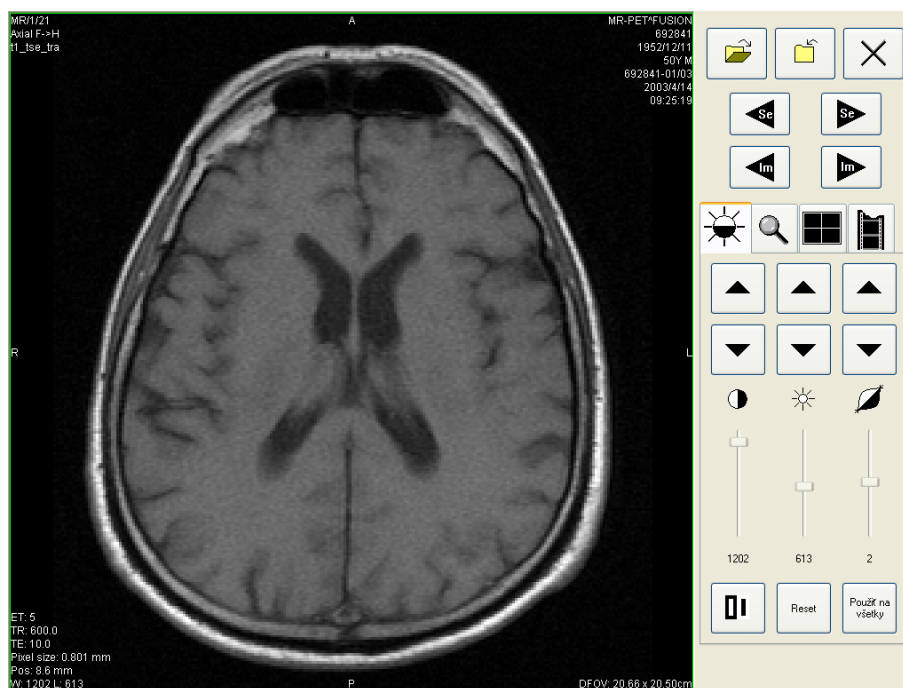





Figure 126 Touch screen mode - gray, W&L settings

3.23.4 Move and zoom images

Choosing the  tab the following buttons will be displayed at the bottom part of the panel (see Figure 127):


- 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 - .

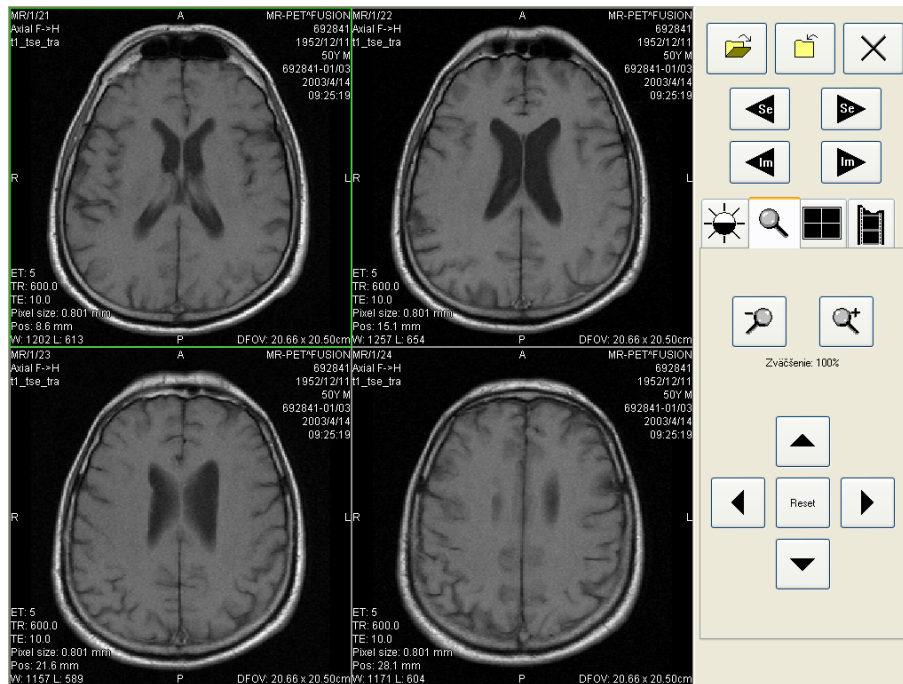




Figure 127 Touch screen mode – move and zoom images


3.23.5 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 125).


3.23.6 Play multi-frame images

Choosing the  tab the following buttons will be displayed at the bottom part of the panel (see Figure 128):

- 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).

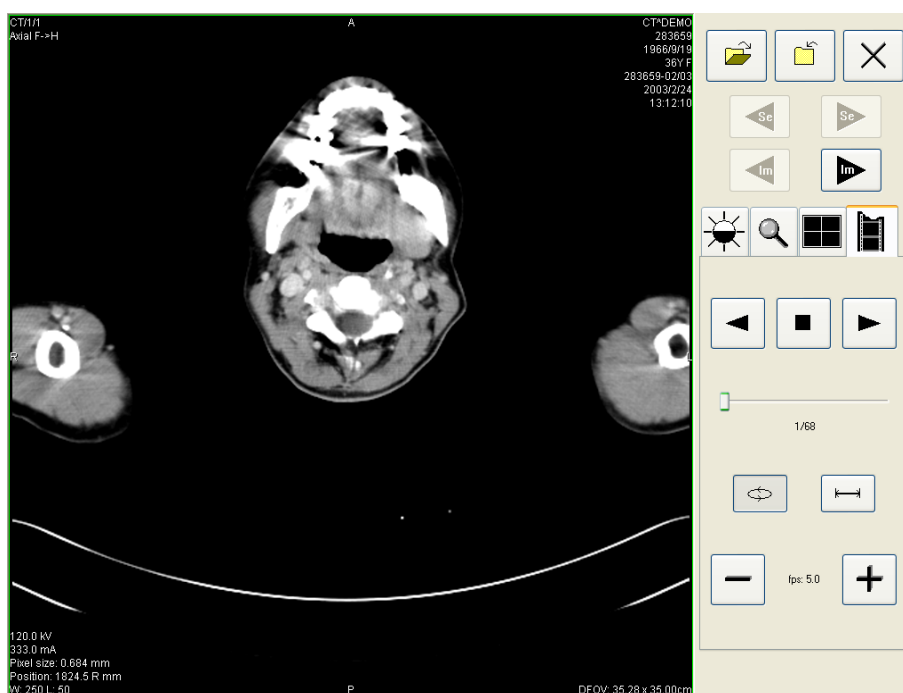


Figure 128 Touch screen mode – playback multi-frame images

3.24 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.

3.24.1 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 129 a) and click at the **Next** button. Next fill information about creator (see Figure 129 b) and click at the **Next** button. In the end write description about new note in this dialog (see Figure 129 c) and click at the **Finish** button. New note will be automatically added to the image.

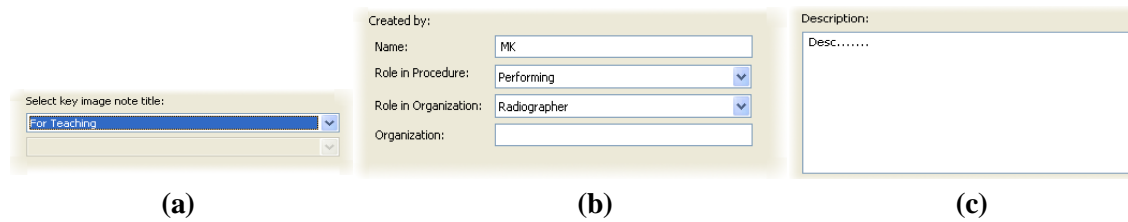


Figure 129 Dialog Key image note, Note title (a), Information about creator (b), Description (c)

3.24.2 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 132). If the image has more than one note, **Key image notes** dialog (see Figure 131) will be displayed to select concrete note by double click.

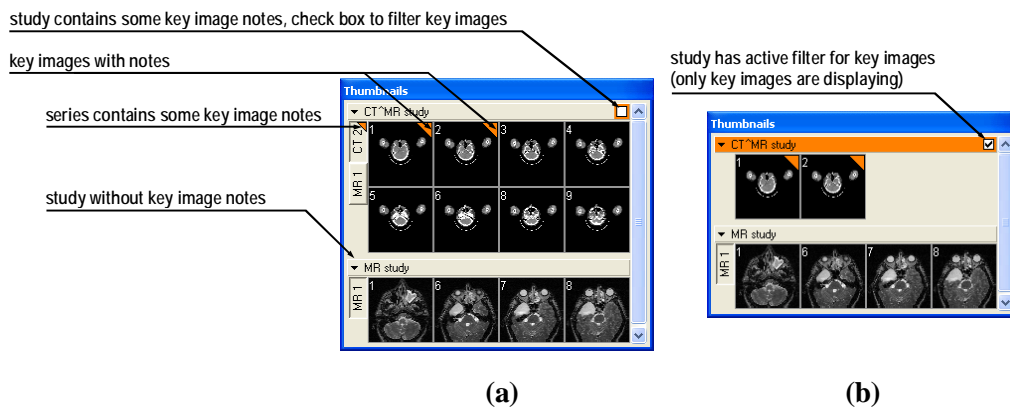


Figure 130 Key image notes in thumbnail palette, (a) filter for key images id disabled, (b) filter for key images is enabled

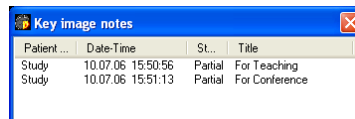


Figure 131 Dialog Key image notes to chosen concrete note

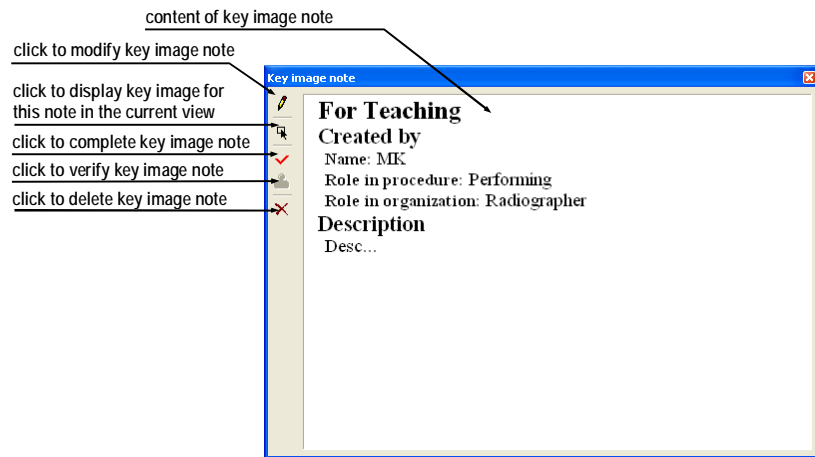


Figure 132 Dialog Key image note

3.24.3 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 at the **S**ave button in the **S**tudy 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 **S**earch studies dialog as objects with KO modality (see Figure 133). When study with some key image notes will be opened, associate key image notes to this study also will be automatically opened.

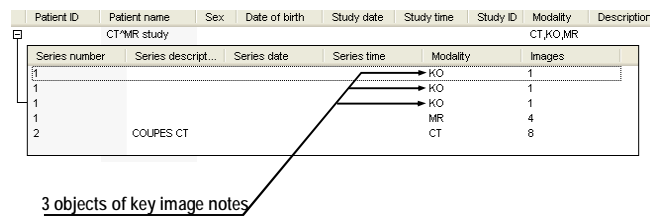


Figure 133 Search studies dialog, study with key image notes

3.25 Structured reports

Structured reports are used to write medical reports, findings and other reports referring to a patient study or an image.

Click at the **S**udy menu, **R**eports... to open the **R**eports... dialog (see Figure 134).

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

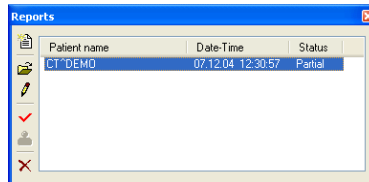



Figure 134 Reports dialog

3.25.1 Create a new template

TomoCon provides possibility to use template to create new structured report. Click at the  **Create new report** icon in **R**eports dialog to open the list of existing templates (see Figure 135).

To create new template click at the **N**ew button and enter its name. Dialog **R**eport (see Figure 136) will be displayed for writing new template.

To edit already existing template click at **E**dit button (to editing contents of selected template) or click at the **R**ename button (to change name of the selected template).


To delete already existing selected template click at the **D**elete button.

3.25.2 Create a new report

To create a new report click at the **S**udy menu, **R**eports....

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 (**O**pen study, **S**earch studies) and already created structured report, the **R**eports... dialog will be opened automatically. When there is study of another patient opened in TomoCon, the **R**eports... dialog will be opened after clicking at the **S**udy menu, **R**eports....

If there is only one patient opened in TomoCon, after clicking at the  **Create new report** icon in the **R**eports... dialog an editing dialog will be opened with the patient's name in the heading. When there are more studies opened in TomoCon, the **S**elect study... dialog will be opened. After choosing a patient and pressing the **O**K button, the **N**ew **R**eport dialog will be opened (see Figure 135) for selecting template, which will be used to create new report. After selecting template, double-click at selected

template's icon and dialog **Report** (see Figure 136) will be displayed for writing new report.

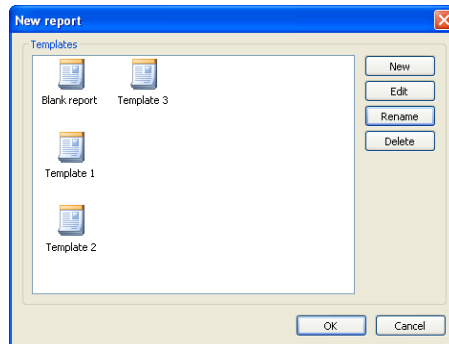


Figure 135 Template choice dialog

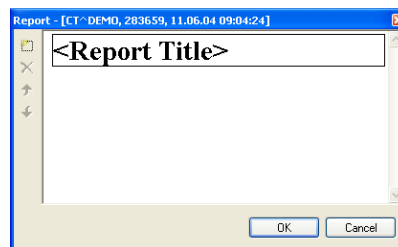



Figure 136 Report dialog

Click at 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 137):

- **T**ext – subtitle, report text,
- **C**ontainer – contains text or another container (max 64 elements),
- **C**oncept **m**odifier – specifies the report heading,
- **O**bservation **c**ontext – report information (author, examining surgeon etc.)
- **P**roperty – medical finding physical properties.

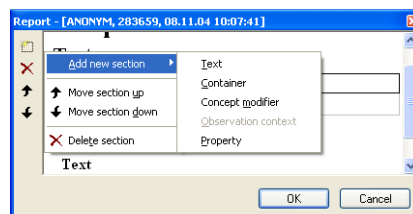





Figure 137 Report dialog – context menu

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 at 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 138).

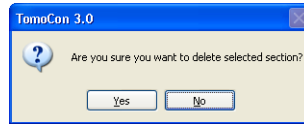





Figure 138 Are you sure you want to delete selected section? dialog

The reports have three statuses:

- **Partial** – open to editing,
- **Complete**,
- **Verified** (who verified + organization).

Click at 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 139). The dialog will be opened after clicking at the  icon. When clicking at 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 at the  **Verify report** icon, the **Verify report** will be opened (see Figure 139). 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.

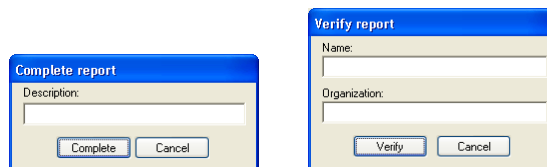




Figure 139 Complete report and Verify report dialog

3.25.3 View report

Click at the  **View report** icon in the **Reports** dialog or click with the right mouse button at the report and choose the  icon. The report will be opened. The report heading (see Figure 140) 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.

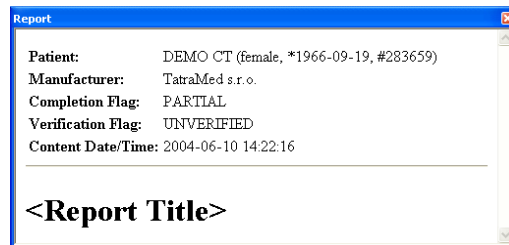


Figure 140 Report heading

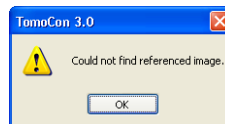



Figure 141 “Could not find referenced image” dialog


If there is a link to a patient image in the report, click at 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 141).

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

3.25.4 Edit a report

Choose a report from the **Reports...** and click at 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 142).

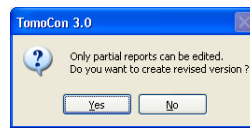



Figure 142 “Only partial reports can be edited. Do you want to create revised version?” dialog

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.

3.25.5 Save a report

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

3.25.6 Delete a report

Choose a report in the **R**eports... and click at the  **D**delete report icon or choose **D**delete in the context menu. A dialog will be opened allowing you to delete the report. Click at the **Y**es button to delete the report from the **R**eports... list.

3.26 Study anonymization



This functionality is not available on MS Windows 98 SE.

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 143) that will be opened after clicking at **Anonymize study...** in the **Study** menu.

Field	Value
<input checked="" type="checkbox"/> Patient ID	387657
<input checked="" type="checkbox"/> Patient's name	DX*DEMO
<input checked="" type="checkbox"/> Patient's sex	M
<input checked="" type="checkbox"/> Patient's birth date	
<input type="checkbox"/> Patient's age	
<input checked="" type="checkbox"/> Patient comments	
<input checked="" type="checkbox"/> Patient's address	
<input checked="" type="checkbox"/> Study date	
<input checked="" type="checkbox"/> Study time	
<input checked="" type="checkbox"/> Study ID	1
<input checked="" type="checkbox"/> Study description	
<input checked="" type="checkbox"/> Accession number	387657-01/03
<input checked="" type="checkbox"/> Acquisition date	
<input checked="" type="checkbox"/> Acquisition time	
<input checked="" type="checkbox"/> Series date	
<input checked="" type="checkbox"/> Series time	
<input type="checkbox"/> Operator's name	
<input type="checkbox"/> Institution name	
<input type="checkbox"/> Institution address	
<input type="checkbox"/> Performing physician's name	
<input type="checkbox"/> Referring physician's name	
<input type="checkbox"/> Admitting diagnoses description	

Figure 143 Anonymize study dialog

The items in the dialog are filled with DICOM data received from the first opened study. Click at 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 **Anonymize study...** dialog (see Figure 144).

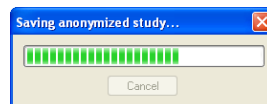


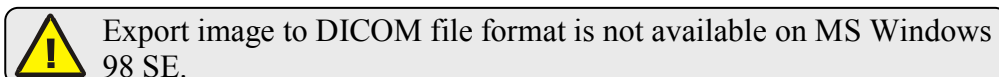
Figure 144 Saving anonymized study ... dialog

3.27 Export image data

TomoCon offers to export the image patient data to the following formats:

- JPEG, DICOM, TIFF, BMP (see **3.27.1 Export images**),
- AVI (see **3.27.2 Export images to AVI format video file**).

3.27.1 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 at the **Export images...** submenu in the **Study** menu (see Figure 145).

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.

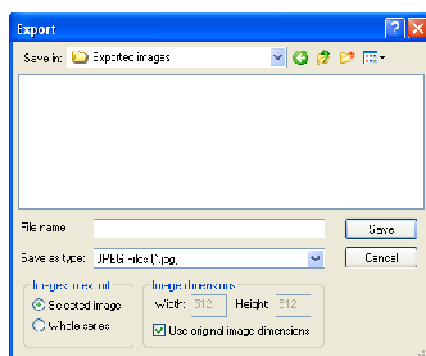


Figure 145 Export images dialog

3.27.2 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 146) will be opened by clicking at the **Export as AVI video...** submenu in the **Study** menu.

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.

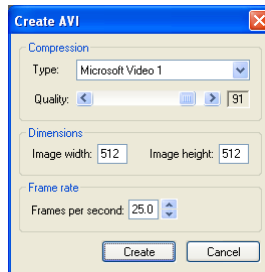


Figure 146 Create AVI dialog

3.28 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 at the **S**ave button in the **S**tudy 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 147) will inform you about the ongoing progress.

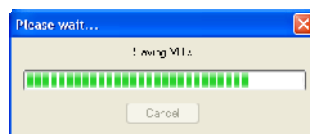



Figure 147 Saving modified study data in progress...

3.29 Close a patient study

Open DICOM studies can be closed by clicking at the  **C**lose studies icon in the Standard toolbar or at the **C**lose submenu in the **S**tudy menu. When closing the study a dialog will be opened (see Figure 148) allowing you to save unsaved changes (ROIs, registrations, annotations).

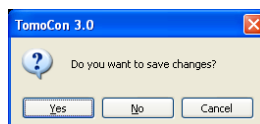


Figure 148 "Do you want to save changes?" dialog

3.30 Archive patient studies on CD



This functionality is not available on MS Windows 98 SE.

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 149) will be opened by clicking at 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.

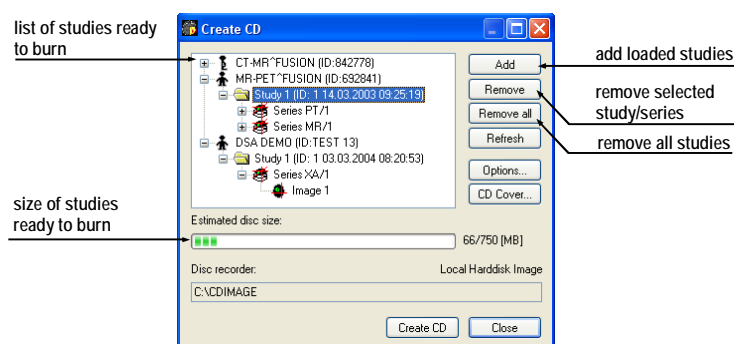


Figure 149 Create CD dialog

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 150).

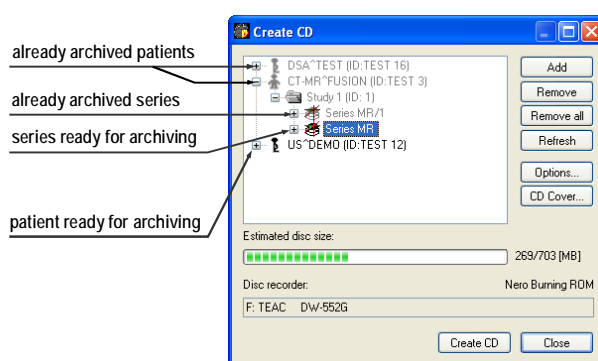


Figure 150 Create CD dialog (add a study/series to the CD)

Press the **Create CD** button to start the archiving process. Process of burning will be displayed in dialog (see Figure 151).

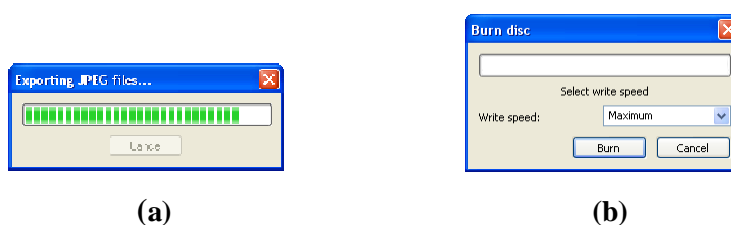


Figure 151 Archive patient image data in progress, (a) IMAPI CD-Burning COM, (b) Nero Burning ROM

Press the **Options...** button to specify the archiving settings. The **Create CD options** dialog will be opened (see Figure 152).

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.

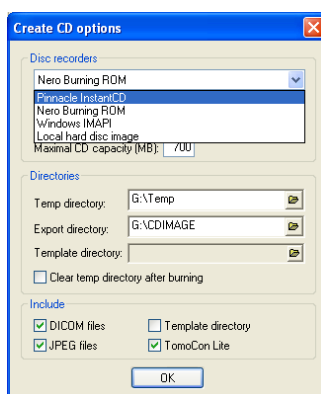


Figure 152 Create CD options dialog

To create and print the cover for the created CD use the **CD cover** dialog (see Figure 153). 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,

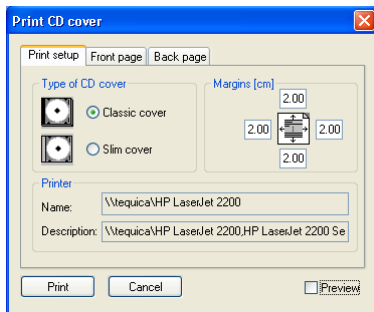
- **Front page** tab:

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 at the check box to print the picture on the front page;

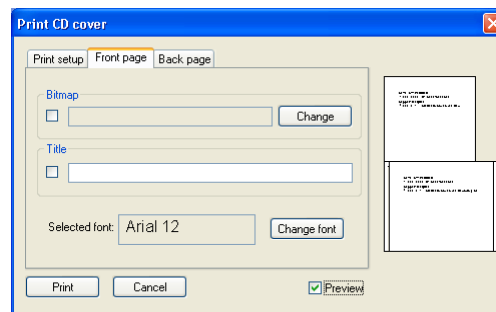
Setting up the **Title**. Use the **Change font** button to change the font size and type for the title. Click at the check box to print the title on the front page;

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

4 Contact

If you have any questions or comments, please contact our headquarters:

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5 Glossary

- **Context mouse button** – mouse button with specified action - context menu,
- **DRR** – Digitally Reconstructed Radiograph,
- **DSA (*Digital Subtraction Angiography*)** – display multi-frame XA images with highlighted difference between scans taken without and with the contrast media,
- **Frame of reference** – relationship between two series (registration) loaded from the patient image data,
- **Fps (*frame per second*)** – number of frames per second,
- **Landmark** – orientation point for defining Landmark registration,
- **Level** – parameters for gray level settings (view position),
- **Local studies** – local storage for TomoCon application studies,
- **MIR – Mutual Information Registration**, probability method for registration,
- **MPR (*Multi Planar Reformatting*)** – display patient image data in various MPR planes,
- **Multi-frame image** – patient image consisting of more images / slices (e.g. angio XA),
- **Online MPR** – MPR plane current point,
- **PACS** – Picture Archiving and Communication Systems,
- **Pixel** – (picture element) the smallest discrete component of a digital image,
- **Registration** – relationship between two series,
- **ROI (*Region of Interest*)** – 2D defined area in the image,
- **Segmentation** – the features of interest separation (identifying) from the background,
- **Series** – set of patient images taken in unchanged device settings and patient position,
- **Shape** – parameters for gray level settings,
- **Status bar** – a row located at the bottom of the main application window,
- **Study** – set of one patient series,
- **Thumbnail preview** – minimized patient image in the thumbnail palette,

- **Thumbnail palette** – a part of the application window where all opened studies are displayed,
- **Window** – parameters for gray level settings (view width),
- **Working area** – a part of main window for patient image data handling,
- **3D** – three-dimensional,
- **2D** – two-dimensional.