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2D Processing and Visualization of DICOM Medical Images

Real Time Stream Processing
R T – S P

- 2005 -

Real Time Stream Processing - **RT-SP**

Real Time Stream Processing **(RT-SP)** is a Module of System 2D Processing and Visualization of high resolution medical images. In Stream Processing exclusive methods of frames stream processing are applied for acceleration of qualitative visualization of **DICOM** images. **RT-SP** system's Module is intended for stream processing of a series on whole field of frame.

Series of **DICOM** files, called for viewing and processing, analyzed and assembled in a series, or called from **GDB** database**,** disassemble to temporary bank **- Temporary Bank** to which the station of processing is attached.

Images of a series raises to the station memory for stream processing realization, outcome of which is displayed in the allocated visualization window by a format **1k*1k**, or is displayed in **ZOOM** window without restrictions of the format dependent on an image format and zooming.

Stream processing always works only with one series called for analysis.

The streaming processing interface has 4 groups:

1. Group, describing the patient and parameters of his/her series, called for research.
2. Group of control elements for playing dynamic streaming process.
3. Group of control elements for processing dynamic streaming process.
4. Group of special kind manipulation under streaming processing.

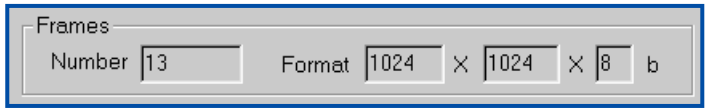
• Group 1. The patient and research parameters

The group includes minimally necessary data:

1.1. **Study** subgroup describing the patient on a lifted series. Following points are included in a subgroup:
Patient name, **Physicians name**, **Patient ID**, **Sex**, **Birth Date**, **Date of Study**, **Time of Study**.
These parameters are not edited, and come from **GDB** on the basis of the data in **DICOM** files.
At work without **GDB** the data is taken directly from **DICOM** file.

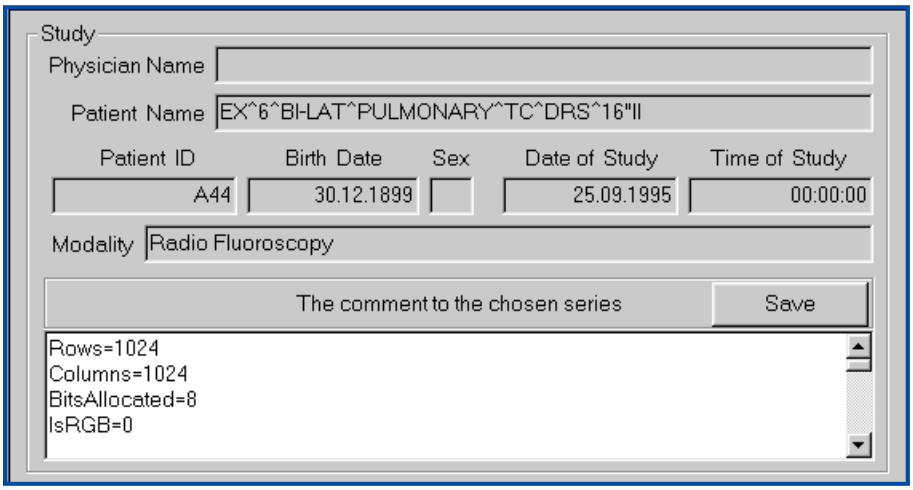
1.2. **Frames** subgroup, describing parameters of this series images: a format and the amount of the images, received from **DICOM** files; is not edited.

Fig. 1.
Frame Parameters.



1.3. **Comments** subgroup of created by the physician to this series. It represents an edited field of comments which is created by the physician and kept in **GDB**. At work without **GDB** comments are not accessible.

Fig. 2. Study Attributes & **Comments**.



• Group 2. Control of streaming playing dynamic process

This group includes everything, which are the elements of step by step on the images or their playing in an automatic mode. Playing group of images includes:

2.1. The boundary position of playing assigned by buttons **First** and **Last**, at all kinds of automatic playing it is determined initial **FirstFrame** and final **LastFrame** buttons the images playing forward or back.

2.2. The slider of personnel positioning being an active element of passage on the images with a scale of image position at a step by step mode.

2.3. Functions controlling of playing forward **PlayF**, playing back **PlayR**, stop **Pause**, step-by-step walking forward **StepF,** step-by-step walking back **StepR** and circular walking **Circular** on the images with indication of the number image, which is synchronously displayed a visualized image (it's in accord with a scale location of personnel positioning).

2.4. Speed control of playing **Speed+** and **Speed-** with a indication scale of relative speed and with a display window of speed value in integer of the number image per second measured for one cycle of playing.

2.5. Zooming control: by pressing button **Z** (function **Zoom+)** with scaling factor, multiple to integers **ZoomFactor = 1:1**, **2:1**, **3:1**, **4:1** …, and by pressing button **Z** (function **Zoom-),** with scaling factor, inversely proportional to integers **ZoomFactor = 1:1**, **1:2**, **1:3**, **1:4. Zoom** window call can be activated by **ZoomN** button**.** Display of scaling factor value is in **ZoomFactor** window.

2.6. Connection with the Patient Navigator **(PATNAV)** for transferring to it and a call of image loading in special modes - loading with scaling mode by option **LoadZ** and loading with qualitative visualization by option **LoadQ**.

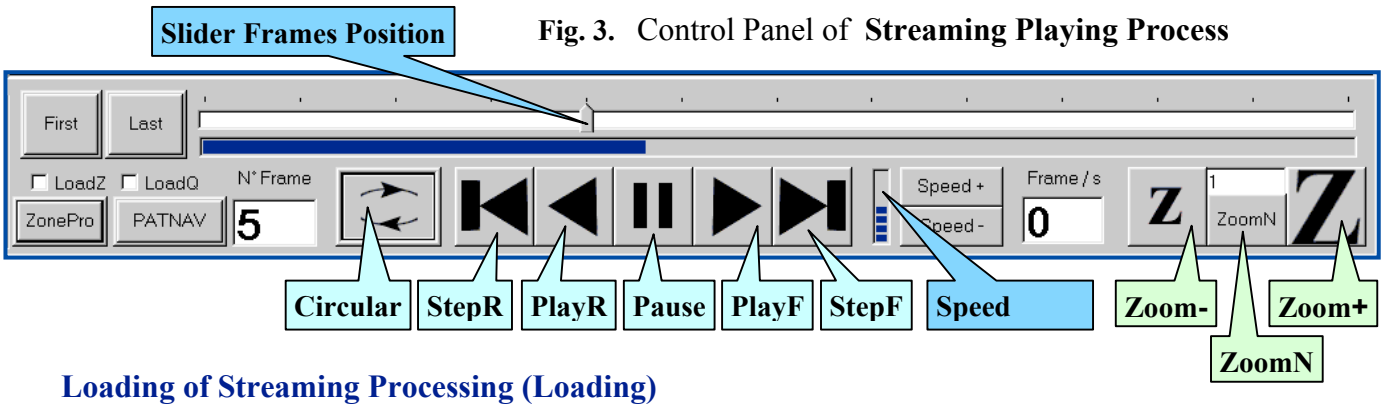


Fig. 3. Control Panel of **Streaming Playing Process**

Loading of Streaming Processing (Loading)

Standard frames loading of one series images of streaming processing, which format does not exceed **1024*1024 (1k*1k)**, are carried out in scaling factor **1:1**.

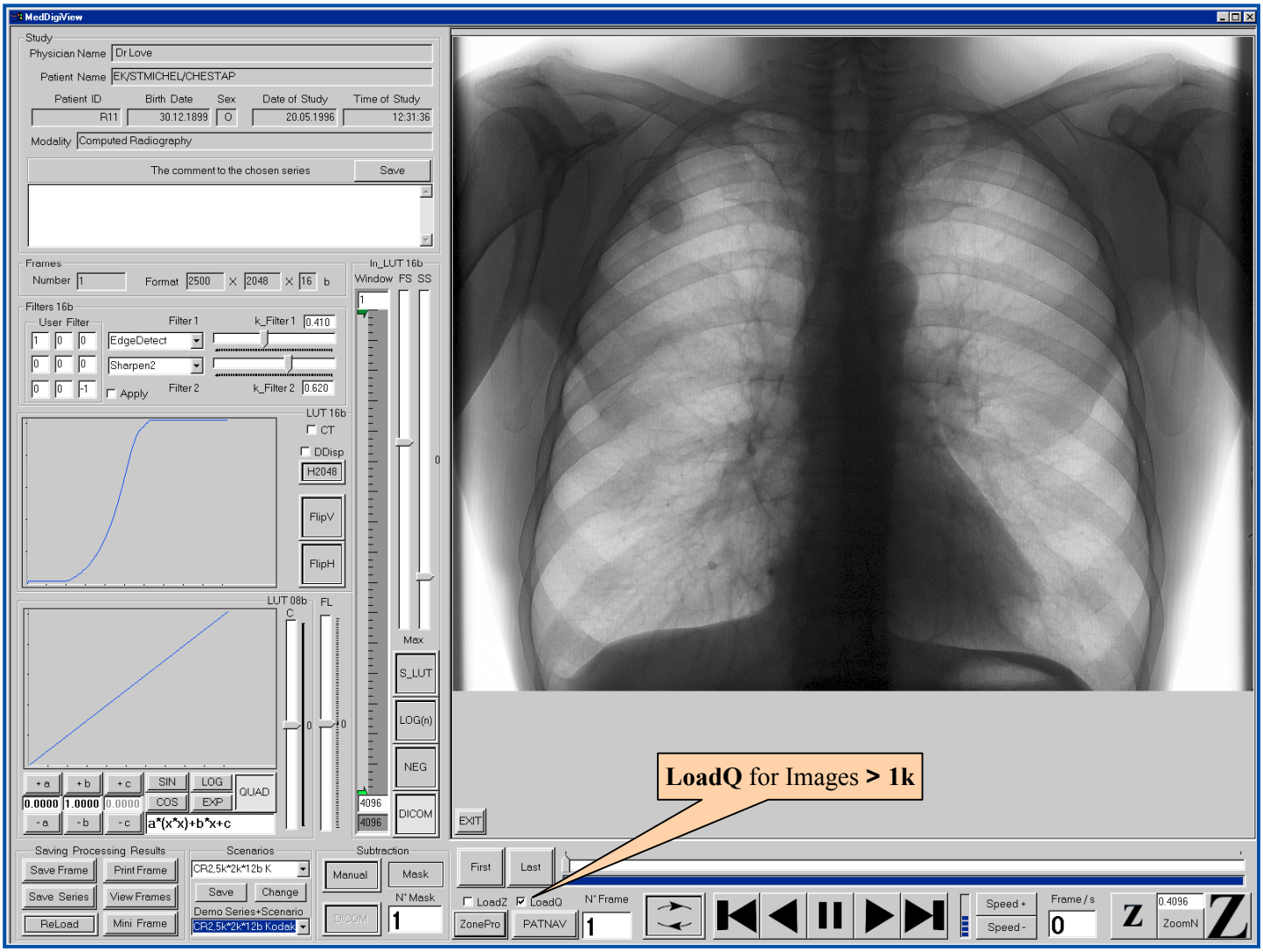
1. Enlarging middle size images with the format no more than **512*512** performed by activating **LoadZ** option, which loads initial images in scaling factor **2:1** (function **LoadZoom**), if necessary.

2. At a format of the images of frames exceeding **1k*1k**, images are loaded with scaling factor, inversely proportional integers (function of fast scaling) for placing the zoomed image in a visualization window.

For qualitative visualization the frames images are loaded with option **LoadQ** (function of qualitative zooming **LoadQual**), with reduction of the image displayed in a window **1k*1k** in the greatest possible size with scaling factor, displayed in **ZoomFactor** window. This function subjects the image to complex mathematical computing for artifacts exclude of visualization at scaling.

At choosing **LoadZ** or **LoadQ** option it is necessary to pass reloading process on the Patient Navigator by pressing button **PATNAV** and reload the chosen series. If both functions are not chosen, loading is made by standard way without scaling at a format up to 1k*1k, and with reduction in an integer of times (2, 3, 4…) at the greater frame format.

Fig. 4. Application of **LoadZoom** Function



Circular and step-by-step Playing (Playing)

In standard loading the first and the last frame of series is established as limits of playing, by default. **First** and **Last** buttons are used for a range change of playing and for installation accordingly the initial and final frame of playing.

At the same time without fail:

- With slider frame position the first frame determines the beginning of playing by pressing **First** button.
- With slider frame position the last frame determines the end of playing by pressing **Last** button.

Playing range is limited by the first and the last frames numbers, witch displayed in frame number window.

Playing is performed step-by-step in forward and return directions by pressing accordingly on **PlayF** and **PlayR** buttons inside the chosen range of the frames.

For fulfilling of continuous playing on a circle it is necessary to activate **Circular** button. The stop is carried out at any moment by **Pause** button, removal from a pause mode is performed by pressing on **PlayF** and **PlayR**.

By default the average speed of playing is chosen for loading, which displays on the speed indicator and its change in the higher or smaller speed is performed by **Speed+** and **Speed-** buttons**.**

The speed value is calculated at the end of every playing cycle and displayed as average speed in integers of the frames/sec, dependent on two factors:

- from complexity of the involved sequence processing elements;
- from the processor computing capacity of station,

therefore the speed indicator shows relative meaning of chosen speed. Its minimal value does not exceed 1 frame/sec, and the maximal speed will be displayed in the window as a result of station's computing opportunities.

Special case of playing is step-by-step playing a series by short-term pressing **StepF** and **StepR** buttons**,** accordingly in forward and backward directions. Pressing any of these buttons at the moment of playing stops it and transfers in a mode of step-by-step playing. Step-by-step playing is not limited by bounds of the initial and final frames established for playing in an automatic mode, and it is possible to display on all frames of a series. While loading a series always step-by-step playing mode is establish by default.

Simultaneously with step-by-step or automatic playing, position of scale frames location with display of current number of a visualized frame changes.

Zooming.

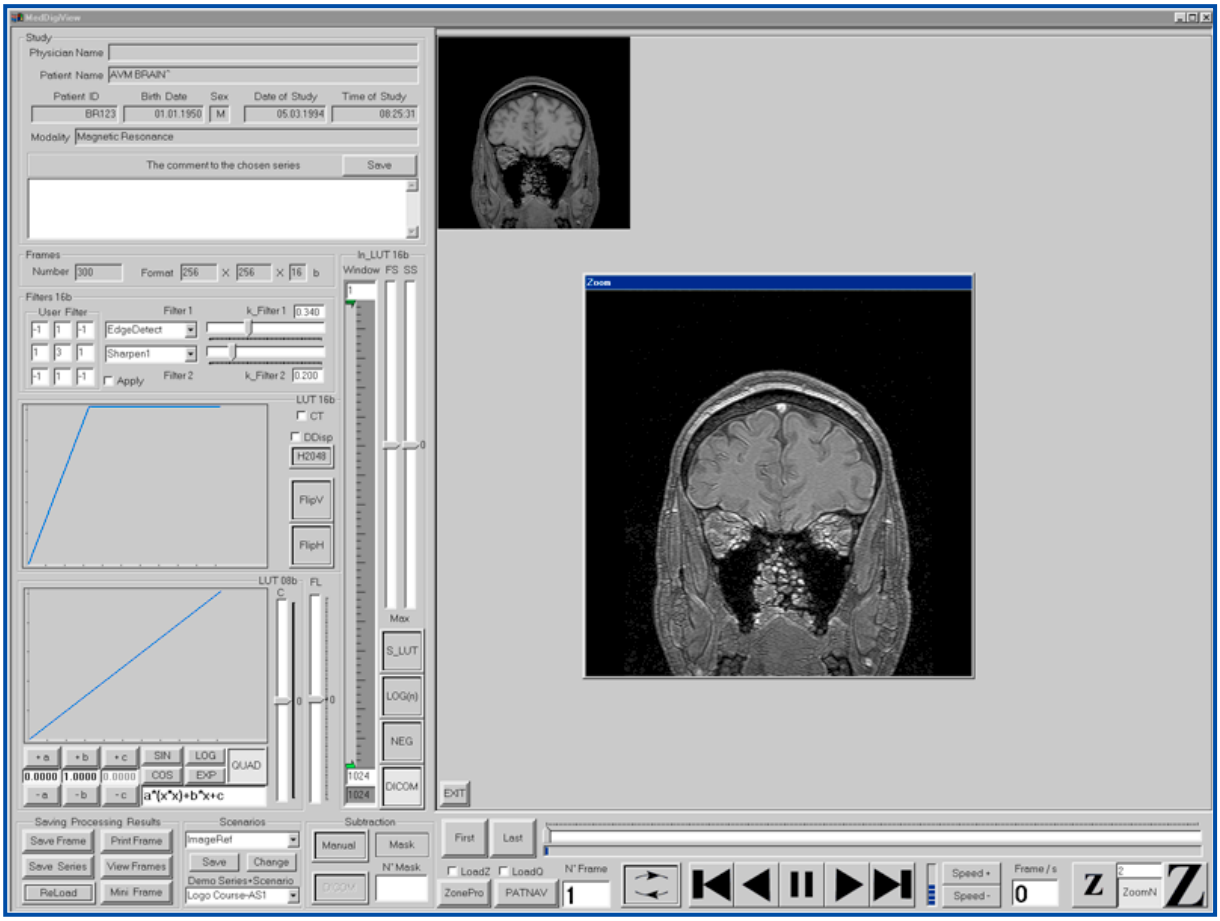
The streaming processing window where the streaming image is deduced, can be subjected to fast zooming with scaling factors as integers, both aside reduction, and aside enlargement of the image. Such manipulation is carried out by two **Zoom+ (Z)** and **Zoom- (Z)** buttons accordingly. The scaling factor is displayed in **Zoom Factor** window.

All operation of images streaming processing can be called by **ZoomN** button activation in parallel **Zoom** window in "Modal" mode, which could be moved on monitors screens. It allows moving high resolution images display to other high resolution monitors. Zooming by the same **Zoom+** and **Zoom-** buttons could be used to **Zoom** window.

At deactivation of **ZoomN** button the **Zoom** window is deleted and development of images streaming processing comes back in a standard window of visualization. The result of processing and visualization does not depend on at what window the image either in standard or **Zoom** is deduced. Inclusion of **LoadZ** option is extended as well to **Zoom** window.

Hardware zooming functions (hardware geometrical transformations). Hardware zooming is activated at not active **ZoomN** button and pressing **Z** button**,** works only on the station with one monitor. Thus there is an increase of the whole screen image to scaling factor **ZoomFactor** equal to 2.0, the image moving on the CRT screen is made with the mouse. Return the image to an initial condition occurs by pressing **Z** button. In case of two monitor modes hardware zooming is switched – off.

Fig. 14. Application of **ZoomN** Function



• Group 3. Controlling of dynamic streaming process development

The group includes everything that concerns to dynamic process controlling of 16 bit streaming conveyor development **(In_Lut16b),** which can be divided into two subgroups:

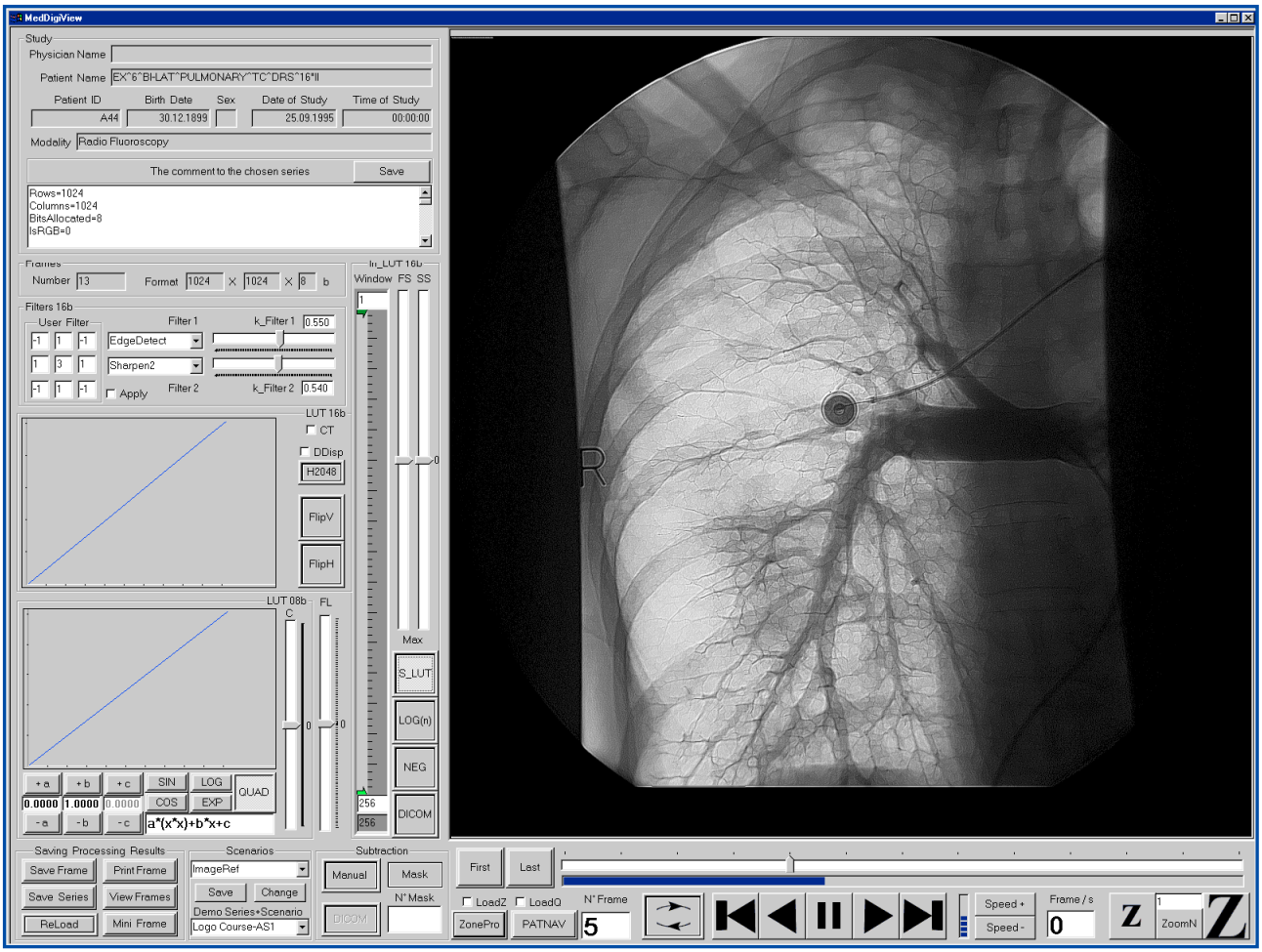
- **16 bit streaming processing** (completely 16 bit sequence conveyor of processing).
- **8 bit streaming visualization** of 16 bit streaming processing results.

3.1. 16 bit functions subgroup of nonlinear transformations In_LUT16b.

We mark out the following basic kinds of the integrated 16 bit processing.
Described below 16 bit functions transformation of the frame images is carried out by processors of station.

3.1.1. **16 bit** function of linear transformation **LIN_LUT** is active at an inactive condition of **DICOM, LOG (n)** and **S_LUT** buttons at the same time. 16-bit window function is realized by the dual slider, it allows to establish the low and high values of a **Window** through which the data are transformed linear, S-shaped or logarithmic transformation which results are displayed on **LUT16b** diagram.
Limiting value of a 16-bit transformation scale is deduced in the bottom window of a scale and, if necessary, can be changed by a new record of value (manually) and fixed by pressing on **Enter**.
The high and low values of a **Window** are displayed in the appropriate windows by the position change of the appropriate those regulators of the dual slider, which defines the low and the high value of a **Window**. They also can be changed manually by recording of the new values fixed by pressing on **Enter**.

Fig. 4. Application of **LIN_LUT** Function



At fixing any of three above-stated values or a regulators slider changed position there is a recalculation of 16 bit functions transformation and the image in accordance with the new parameters.

3.1.2. **16 bit** functions of **DICOM** transformation **DICM_LUT** are chosen by pressing **DICOM** button**.** Processing function is connected to those parameters which are written in a **DICOM** file, at its creation on the medical device.
Application of **DICM_LUT** seeing the frames of a series how they were seen by the user creating a **DICOM** file on the device.

3.1.3. **16 bit** function of **S-shaped** transformation **S-LUT,** with the changeable form of a transformation curve**,** is chosen by pressing **S_LUT** button.
S-shaped function transformation uses two additional sliders for changes parameters: forms and steepness.
Slider **FS** changes the form, and slider **SS** changes a steepness of a **S-shaped** curve that allows to generate transformation functions starting with exponential curve to logarithmic, passing through **S-shaped** in all its different types.

Fig. 5. **In_LUT16b** Function

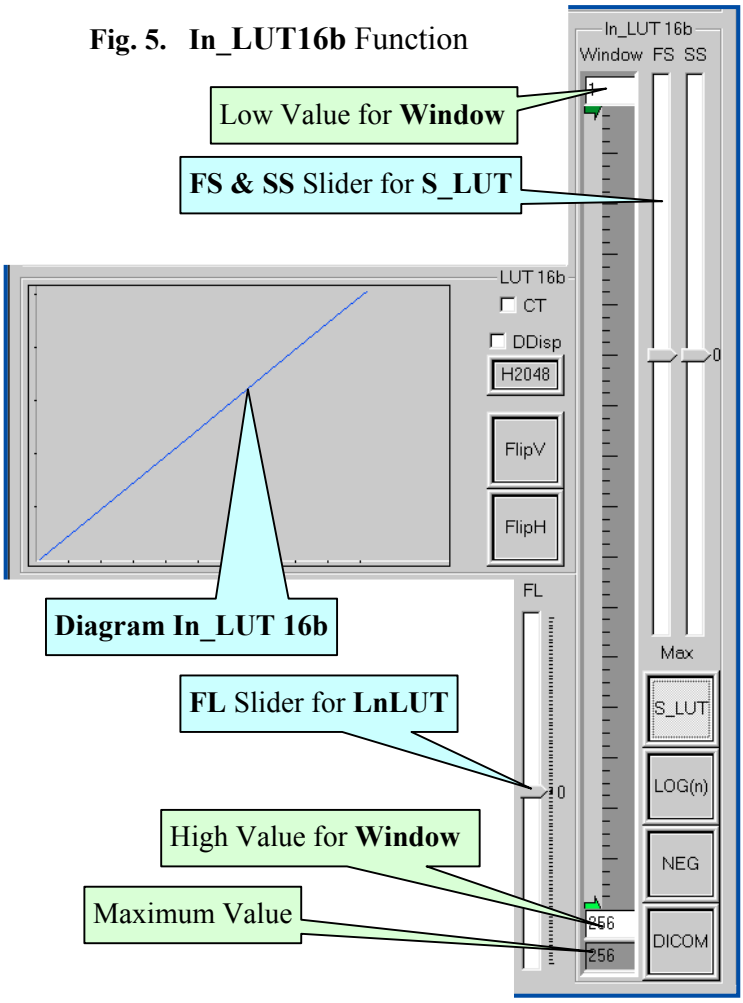
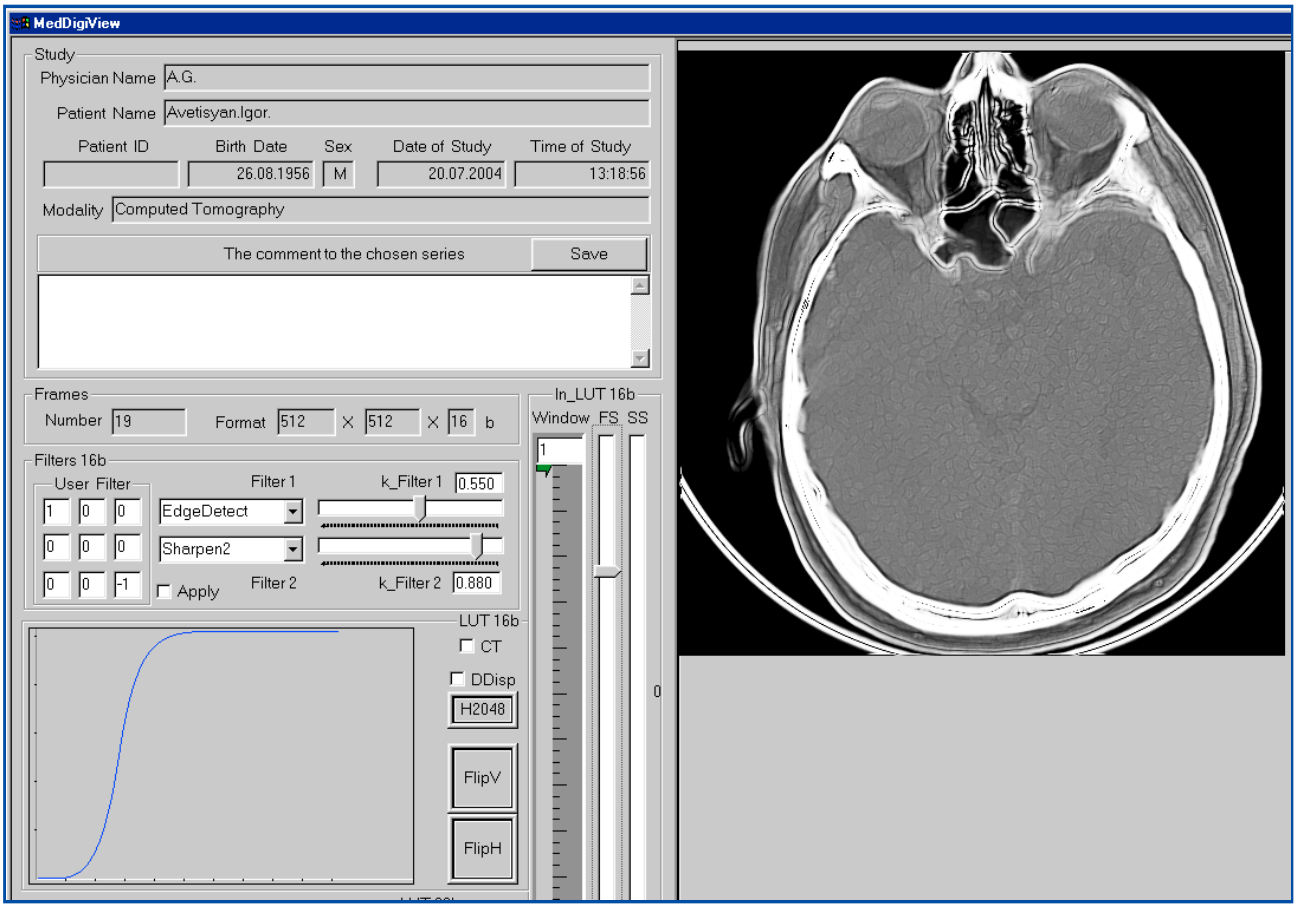
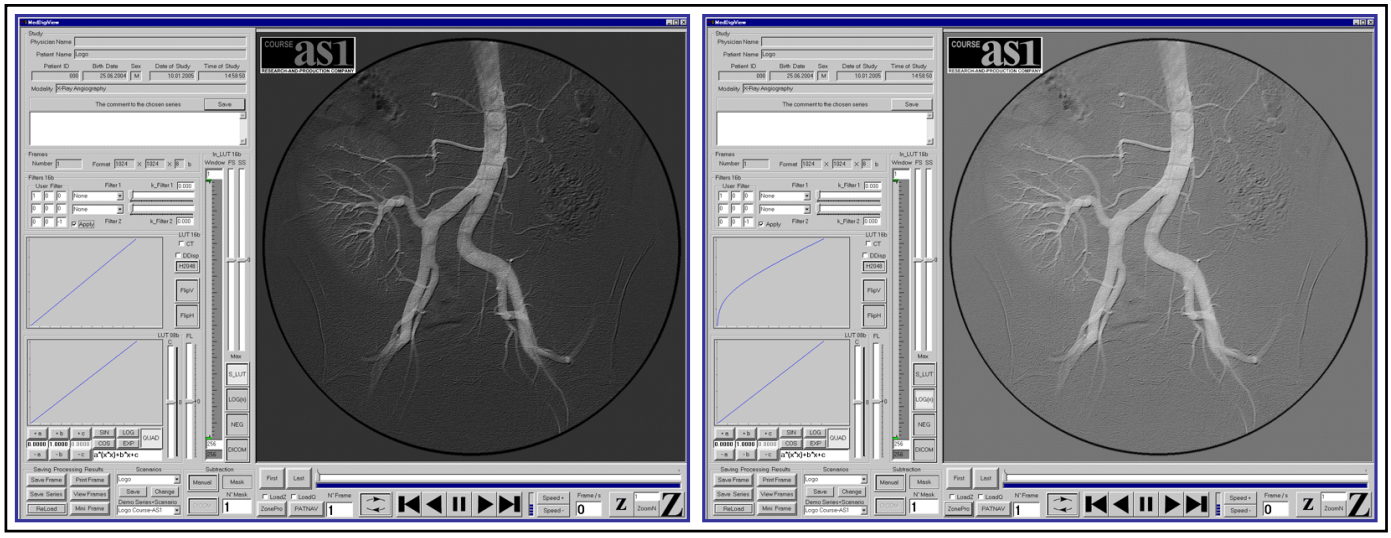


Fig. 6. Application of 16b **S-LUT** Function



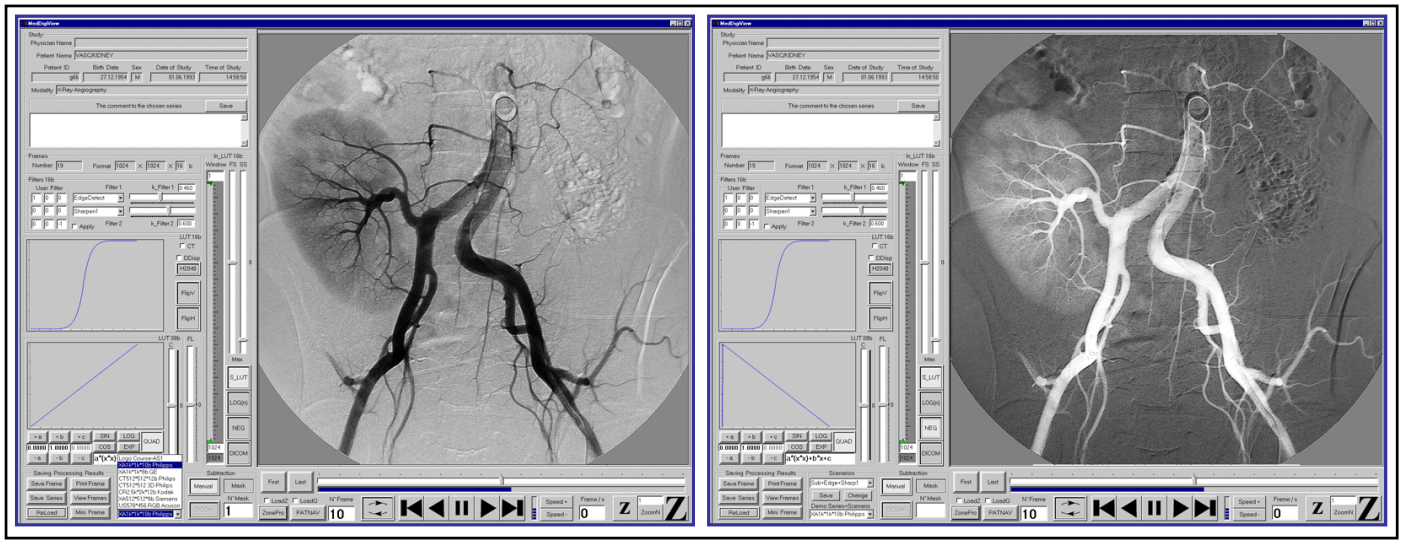
3.1.4. **16 bit** function of logarithmic transformation **LnLUT** on the basis of the natural logarithm is chosen by pressing **LOG(n)** button**.** Slider **FL** changes the form and parameters of a logarithmic curve that allows generating functions of the frames logarithmic transformation.

Fig. 7. Application of 16b **LnLUT** Function



3.1.5. **16 bit** function of transformation negative - positive **NEG/POS** is chosen by pressing **NEG** button**.** Independent application of function **NEG/POS**, as against functions **DICM_LUT**, **S-LUT** and **LnLUT**, each of which can be chosen only with switching-off of two others. It allows at any moment to invert the image on negative with respect to previous. Thus there is a switching between negative and positive type of displayed frames.

Fig. 8. Application of 16b **NEG/POS** Function



3.1.6. 16 bit turn function of images across **FlipHoriz** is performed by pressing **FlipH** button , and 16 bit turn function of images on vertical **FlipVert** is performed by pressing **FlipV** button. Return of images to loading position is performed by **FlipH** and **FlipV** buttons release .

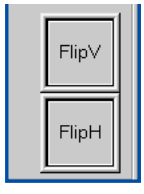
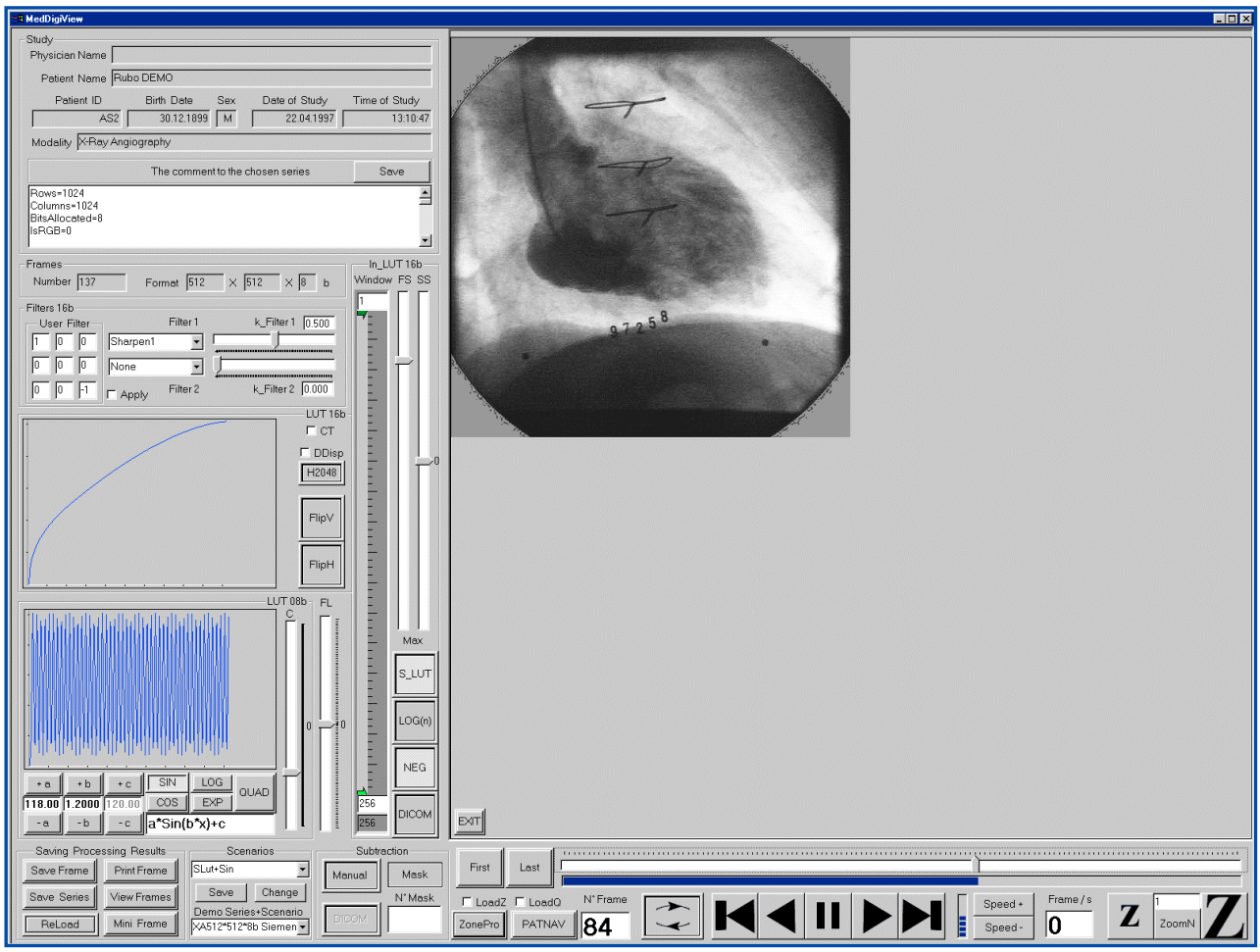


Fig. 8. Flip Functions

3.2. **8 bit visualization functions subgroup LUT08b** of 16 bit streaming processing results, differing to destination: functions of nonlinear hardware transformations and functions of hardware zooming.

Fig. 9. Application of 8b **SIN** Function



3.2.1. 8 bit functions of nonlinear hardware transformations. Chosen from the display of the formula list, the diagram and three adjustable parameters which are included in the function formula, and one function is chosen only, where:

- **a**, **b** and **c** represent parameters of transformation function,
- **x** and **y** are input and output values of transformation functions.

At presence of the specialized graphic adapters these functions are performed in real time by the graphic processor, without use of station processor capacities. In structure of 8 bit visualization functions there are three non periodical 8-bit functions of nonlinear transformations:

- The function of quadratic transformation **QUAD** described by quadratic function such as
  $y = a * x^2 + b * x + c$,
- The function of logarithmic transformation **LOG** described by logarithmic function such as
  $y = a * Logb(x) + c$,
- The function of exponential transformations **EXP**, described by exponential function such as
  $y = a * b^x + c$.

3.2.2. And two trigonometrically 8-bit functions of nonlinear transformations:

- Sinusoidal transformation function **SIN** of type
  $y = a * Sin(b * x) + c$.
- Cosine transformation function **COS** of type
  $y = a * Cos(b * x) + c$.

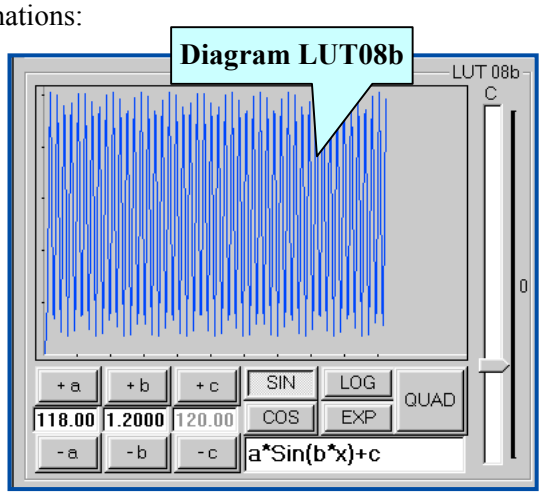


Fig. 10. **LUT 08b** Functions

Parameters **a**, **b** and **c** of 8 bit visualization functions have the regulators varying their value both in positive, and in the negative side. By a certain function call from preliminary installations there come values of parameters **a**, **b** and **c** which are registered in the initial **Scenario** and are revealed as the most optimal initial parameters.

The result of 8 bit visualization functions work is displayed on diagram **LUT08b**.

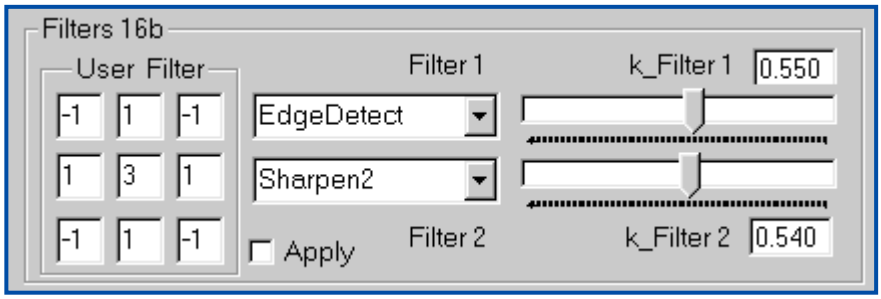
Values of **a** and **b** parameters can be quickly changed manually, by recording of the appropriate meanings in windows, and value of **c** parameter changes quickly by appropriate slider.

Slow (step-by-step) change of parameters **a**, **b** and **c** is made accordingly by buttons **(+a)**, **(+b)** and **(+c)** to the positive side and buttons **(-a)**, **(-b)** and **(-c)** accordingly to negative.

It is necessary to take into account, that trigonometrical functions application violently changes the image spectrum, and application not for all kinds of images yields qualitative results of visualization (about filters of trigonometrical functions application see (… …).

3.3. **This subgroup consists of three consecutive 16 bit filters Filters16b**, two of which are chosen from the list, and one user matrix filter it is possible to set manually. For streaming filtration can be applied up to 3 filters sequence. It is necessary to take into account that filters work by way of their numbering, i.e. at first **User Filter**, then the **Filter 1** and further the **Filter 2**.

Fig. 11.
Filters16b Functions



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3.3.1. First two filters **Filter1** and **Filter2** are chosen from the list of the standard filters, having positions:

- **None** – **The filter is not active.**
- **Sharpen1** – **Sharpness.**
- **Sharpen2** – **High Sharpness.**
- **Smooth** – **Blurring.**
- **EdgeHorizontal** – **Horizontal Gradient.**
- **EdgeVertical** – **Vertical Gradient .**
- **EdgeDetect** – **Full Gradient.**
- **EdgeLaplasian1** – **Laplasian1.**
- **EdgeLaplasian2** – **Laplasian2.**

First two filters at position **None** are not activated, but at a choice of a filter's concrete kind they are applied in the conveyor of a frame streaming processing at once.

3.3.2. Sliders of the weighed filtration **k_Filter1** and **k_Filter2** work according with filters **Filter1** and **Filter2.**

- The applied values levels of the weighed filtration are deduced at the appropriate windows.
- At work without **Filter1** and **Filter2** it is applied **k_Filter1 = 0** and **k_Filter2 = 0** accordingly.
- For **Filter1** at work with **Sharpen1/2, Smooth, EdgeHorizontal, EdgeVertical, EdgeDetect, EdgeLaplasian1 and EdgeLaplasian2** filters the all range of adjustments **0 < = k_Filter1 < =1.00** with step equal 0.01 **(1%)** are used.
- For **Filter2** at work with **Sharpen1/2, Smooth, EdgeHorizontal, EdgeVertical, EdgeDetect, EdgeLaplasian1 and EdgeLaplasian2** filters the all range of adjustments **0 < = k_Filter2 < =1.00** with step equal 0.01 **(1%)** are used.

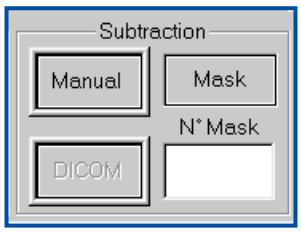
3.3.3. Appointed by the user **User Filter** which is filled by default from special installations and the parameters can be changed by a user at own discretion for concrete tasks decision of streaming processing. The **User Filter** turns on into work of the frames streaming processing conveyor by activation of **Apply** option.

• Group 4. Streaming Processing Specialized Manipulations

In the group are concentrated:

4.1. **Subtraction** subgroup for work in **Digital Subtraction Angiography** mode.
4.2. Scenario subgroup of frames streaming processing.
4.3. Saving subgroup of streaming processing results.
4.4. A subgroup of the specialized streaming processing options.

Fig. 12. **DSA** Function

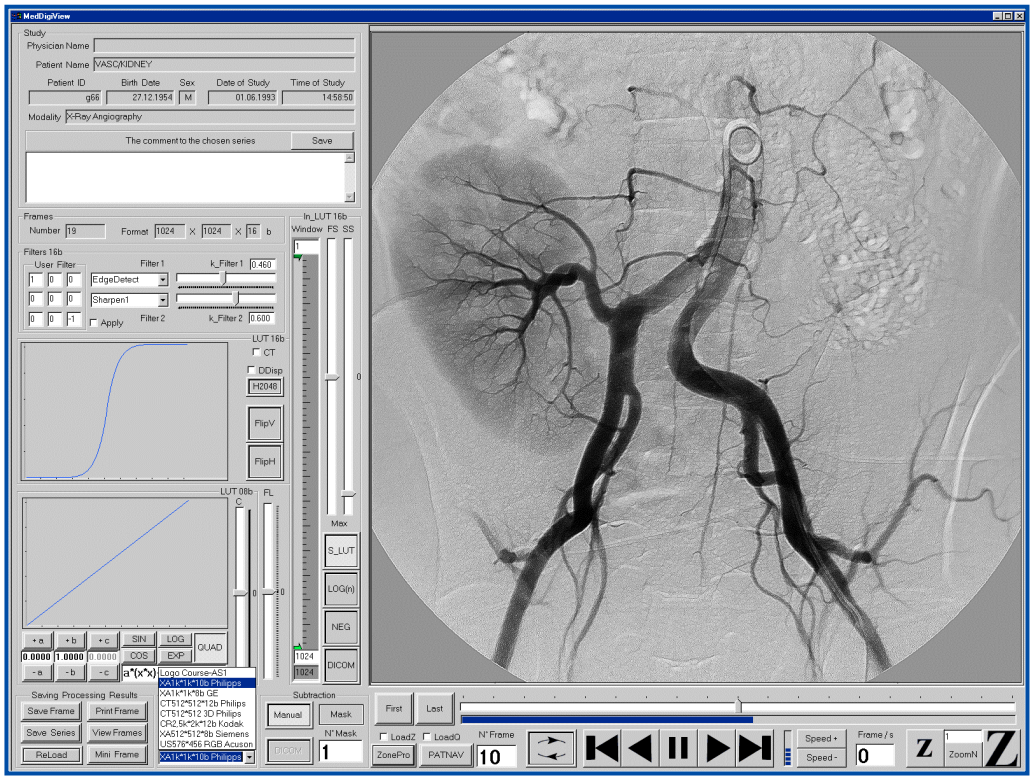


4.1. DSA mode (Digital Subtraction Angiography Playing)

The **Digital Subtraction Angiography** mode **(DSA)** can be realized by two ways:

- The manual mode (**Manual**) when the user manually chooses a mask and determines the initial and final frame with the contrast, subject to playing in **DSA** mode.
- An automatic way **(DICOM)** when parameters of playing and masks are taken from **DICOM** file.

Fig. 13. Application of 16b **DSA** Mode and 16b **S_LUT** Function



Process of creation **DSA** is divided on two stages:

- A choice by a slider frame position of the mask frame with its number indication.
- A choice of a manual subtraction kind or automatic by **DICOM** criterion (if it exists).

The manual user way of **DSA** creation begins with initialization of **Mask** button and a frame mask assignment by finding necessary frame due to slider frame position and fixation of this value by **Last** button. At that the number of the mask frame will be displayed in a window **(N° Mask).** By pressing **Manual** button we pass to **DSA** mode.

The range of playing at **DSA** is determined similarly of playing range described earlier in **Playing** section, at that the number of the initial frame playing can not be less than a number of the mask frame. All playing elements work similarly to standard variant of playing.

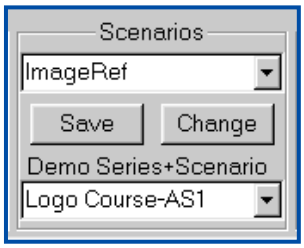
During playing, by record in window **N° Mask** could be set any frame's number, which becomes a mask and is automatically applied at **DSA** (dynamic purpose of a mask).

DSA automatic method consists that each contrast frame is correlated to one of mask frame that should be registered in a **DICOM** file. Thus, the initial and final frames of a playing range are determined and each frame with contrast appropriate to frame mask. This function will be active only in case of presence in a **DICOM** file of necessary parameters. **DSA** modes can be visualized in the **Zoom** window, with required zooming; all playing modes remain the same, as well as in standard variant.

4.2. Scenarios.

Scenario in streaming processing is a totality of parameters and the criterions, allowing at rise of the same frames series and application of these parameters and criterions to receive the identical image at any station under streaming processing control.

Fig. 13. Scenarios Functions



Scenario parameters are collected from streaming playing group, groups of 16 bit and 8 bit processing and subtraction subgroup. The **Scenario**, as the result of the user manipulations, is saved under the certain name in **GDB** for concrete frames series.

Any **Scenario** of a series can be called from **GDB** for visualization at any streaming processing station by its choice from a created **Scenarios** list. By default there is always the zero **Scenario** registered in special setting and the using of it (selection) returns the image in a condition of initial frame loading.

In **GDB** creation is foreseen up to 8 **Scenarios** on every **DICOM** series. Function of the change **Scenario** is accessible in standard variant. The number of **Scenario** to a series can be changed under separate coordination.

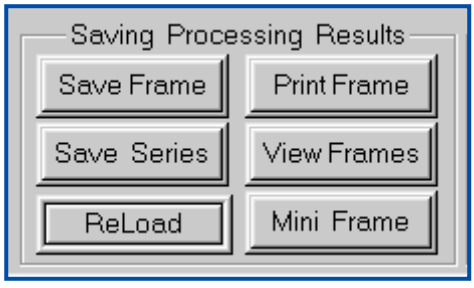
At work without **GDB** the **Scenario** is remembered as a file and called through **FileOpen** dialogue operated by the user. Files of **Scenario** are kept in a special **Scenarios** directory in a subdirectory with a name **ID** of the patient, as a file freely appointed by the user. The call of the **Scenario** is carried out through search in **FileOpen** dialogue by the user.

Comment: The **Scenario** is always adhered to a concrete **DICOM** series and its processing.

4.3. Saving Processing Results.

Into a saving subgroup of processing results includes:

Fig. 13. Saving Functions



4.3.1. Creation and saving of the representative frame series for the **Patient Navigator** on the chosen frame streaming processing. It is carried out by pressing **Mini Frame** button. These images undertake from special descriptor **DICOMDIR**, or are generated from the average frame of a assembled series at the first viewing, or can be created in streaming processing, by a choice of the required processed frame on the screen, with subsequent its converting in a format of the representative frame for **GDB**. Visualization representative frames of every series occurs in the **Patient Navigator** by a call of concrete patient.

4.3.2. Creation and saving of the processed frame is made by a call of **Save Frame** option. Saving of the seen processing frame in 8 bit graphic **Tiff** format of variant for gray scale images and of 24 bit variant for color **RGB** images occurs by pressing **Save Frame** button.
In the special directory registered in operation system and in a subdirectory (in case of work with **GDB**) with **ID** patient parameters any selected files on the concrete patient, selected in all its series, independently of a research kind are kept.

Comment: As result of processing, on each frame of a series can be kept only one with file **Save Frame** button. Each new saving will cause rewriting kept before a file of given frame processing result if such existed.

4.3.3. Creation, saving and printing of the processed frame is made by pressing **Print Frame** button. Saving of the seen processing frame in 8 bit graphic **Tiff** format of variant for gray images and of 24 bit variant for

color **RGB** images occurs by pressing **Print Frame** button. In the special directory registered in operation system and in a subdirectory (in case of work with **GDB**) with **ID** patient parameters any selected files on the concrete patient, selected in all its series, independently of a research kind are kept. Further, using functions of a multi-frames printing, it is possible to carry out any grouping of these files (the selected frames) at discretion of the user.

Comment: On each frame of a series can be kept only one file for printing. Every new saving will cause rewriting a file saved before the result of given frame processing for printing if such existed.

4.3.4. Creation and viewing of the processed frame is made by pressing **View Frame** button**.** Saving of the seen processing frame in 8 bit graphic **Tiff** format of variant for gray images and of 24 bit variant for color **RGB** images occurs by pressing **View Frame** button. In parallel with saving of the selected frame, the Module of **2D** Processing and Visualization, carrying out viewing and printing **View Print** is called.

4.3.5. All frames of a series creation and saving by streaming processing criteria is performed by pressing **Save Series** button. Saving all frames of a series in a format similar to an option, described in point 4.3.2. The given option allows writing down in further result of all frames processing in a series on the optical disk. (Under the special coordination the opportunity to create a movie from a series of the processed frames in **Quick Time** format).

Comment: As results of the given series' all frames processing in this case are kept .....

4.4. Specialized Options.

4.4.1. Two monitor configurations. The choice of a mode is made by activation of **DualDisplay** function with the aid of activation **DDisp** option. At the same time, all streaming processing interface, having format 1600 x1200, is transferred to the second display with the same format. There is an interface of the patients navigator on the first display, and function of streaming processing is transferred to the second display of the high resolution. There are two modes of a display work choice with streaming processing functions:

- Mode **1600*1200*32b** and
- Mode **2048*1536*32b**, that is made by activation of **H2048** button.

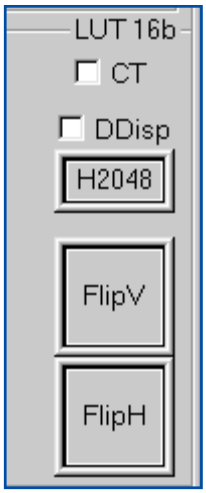


Fig. 14. DDisp Functions

The choice with higher resolution is desirable for work with the frames of the high resolution more than **1κ*1κ**. At that the **Zoom** window can be transferred to the first high resolution display.

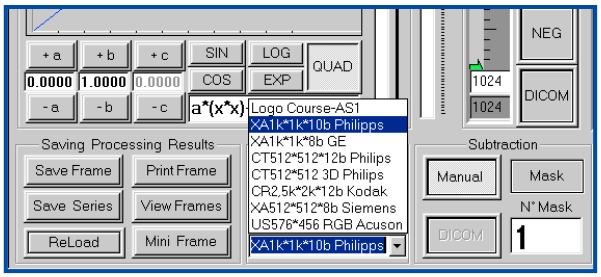
4.4.2. Calling option of **Zoned Processing**. The **Zoned Processing** Module, working with same series of the frames, but using **Zoned Processing** and visualization methods in parallel with **Stream Processing**, is activated by **Zoned Processing** button. In a configuration without **Zoned Processing** this option is not accessible.

4.4.3. The Transition to the **Patient Navigator** option is carried out by pressing **PAPNAV** button. All dynamic processes are stopped and a transition to a expectation mode occurs. The **Patient Navigator** option is activated for work with patient's series.

4.4.4. The option Transition to the **Patient Navigator** is carried out by pressing **PAPNAV** button.

• Group 5. AS_GSV Demo Series & Demo Scenarios:

Fig. 15. Demo Series & Scenarios



Stream Processing includes the following demonstration series:

- **10b** an angiographic series of **1k*1k** format obtained from Integris 3000 Philips.
- **08b** a radiological series of **1k*1k** format obtained from Legacy DRS GE.
- **12b CT** a series of **512*512** format obtained from Philips.
- **12b CT** a series of a **512*512** format obtained from Siemens.
- **24b 3D** reconstruction of a **CT** series obtained from Philips.
- **12b** image of **2,5 k*2k** format obtained from ACR-2000 Kodak scanner.
- **08b** cardiologic series of **512*512** format obtained from Siemens.
- **24b** ultrasonic series of **576*456** format images obtained from Acuson.

Each chosen series could correspond to several **Scenarios** (Up to 16 Scenarios).

At all series a ***"zero"* Scenario** necessarily is presented, appropriate to the unprocessed image, received from primary sensors. This **Scenario** is designated, as **ImageRef**, and it's the first in the list. The **ImageRef** Scenario call allows returning to the initial image without application of processing functions.

Not ***"zero"* Scenario** are created for demonstration of various elements processing opportunities and their combinations. All names of **Scenario** are conditional and are specified by implication individually in each series by the user.

Series A. **10b** angiography series with **1k*1k** format obtained from Integris 3000 Philips.

1. **SLUT+Filters** Scenario.
   SLUT+Filters Scenario uses in series **EdgeDetekt 5 %** filter and **100 % Sharpen1** filter in aggregate with **10b S-LUT** transformation with **FS =-5** and **SS = +33**, and **8b QUAD LUT** linear output established factors.
   Application of the specified type Scenario allows more qualitatively mark out a contrast passage through vessels on the research object's background. Experience of the similar scenarios use gives the precondition for their application to series of the dynamical images received from **X-Ray Flat Panel Sensor** matrixes or from digital matrixes, established on **II** (**Image Intensifier**).
2. **Sub+Edge+Sharp1** Scenario is a **DSA** process subtraction, where the series first frame acts in a role of a mask, and processing functions are similar to **SLUT+Filters** scenario.

Series B. **08b** radiological series of **1k*1k** format obtained from Legasy DRS GE.

It is similar to **A** series**,** but in application to **8b** image.

Comment. Processes of processing are strongly limited to rather small dynamic range of initial **8b** images, which demands more careful selection of processing parameters.

Series C. **12b** is a series of 512*512 format obtained from **CT** Philips.

Series **C** is used to solid bone tissue of the lower jaw.

Filters Scenario uses consistently 27 % **EdgeDetekt** filter and 100 % **Sharpen2** filter in the aggregate with **12b S-LUT** transformation with factors **FS =-12** and **SS = +6**, with **8b QUAD LUT** linear output .

Quality of the image strongly depends on the initial data in **CT** series - **CT** parameters settings and the images reconstruction algorithm.

Comment. Application of Streaming Processing for **CT** series has gotten by a mathematical method of an image restoration on projections, narrows allowable parameters boundary of Streaming Processing.
It is connected with admissions and distinctions of images reconstruction algorithms and for some **CT** and **MR** series is more effective to apply Zoned Processing.

Series D. **12b** is a series of 512*512 format obtained from **CT** Siemens.
Series **D** is similar to series **C**, but with reference to head's soft tissues it gives better results, than at solid bone tissues processing.
Scenario **Filters+S-LUT** uses consistently 52 % **EdgeDetekt** filter and 84 % **Sharpen2** filter in aggregate with **12b** S-shaped **LUT** transformation with factors **FS =-24** and **SS = 41**, and **8b QUAD LUT** linear output.

Series E. **24b** series **3D** reconstruction obtained from **CT** Philips.
S-LUT application for reconstructed **3D RGB** images improves its visualization.

Series F. **12b** is the **2,5 κ*2κ** format image obtained from ACR2000 Kodak scanner.
For **F** series **DICM-LUT** is applied from **DICOM** file in aggregate with 41 % of **EdgeDetekt** filter and 62 % of **Sharpen2** filter**.**
For big format images, besides the above-stated functions, zooming function is applied with the subsequent application of qualitative visualization, using **LoadQ** option.
ZoomN call will open in parallel processing image in a modal window in **1:1** scale.

Series G. **08b** cardiologic series of 512*512 format obtained from Hicor DCR Siemens.
In series **G** 50 % **Sharpen 1**, **S-LUT** filter are used with the parameters resulting transformation to logarithmic type. For details representative visualization of the image function **8b** spectrum sinusoidal transformation is applied. Function **Neg** is applied for the image return to an initial positive kind of researched object representation.
Comment. **8b** range of the initial image and the format resolution less than **1k** is insufficient for High-quality visualization of **DICOM** images!

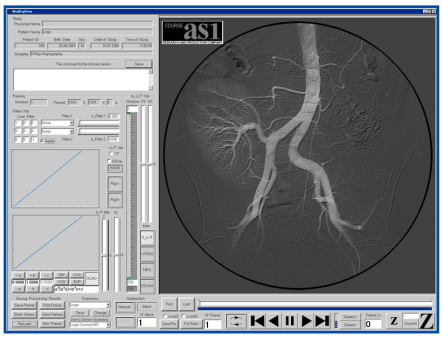
Series H. **24b** images ultrasonic series of 576*456 format obtained from Acuson Company.
A series is submitted after reconstruction from DICOM files in a natural view.

Examples demonstration of Stream Processing **DICOM** series with ready **Scenarios.**

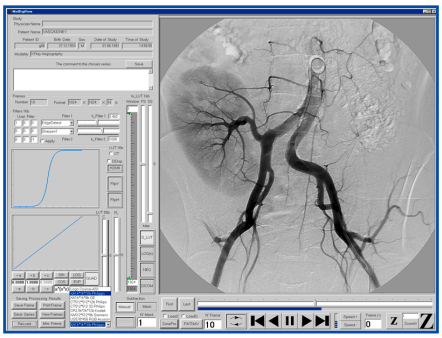
1. Logo Course-AS1
2. **XA** 10b Philips Series, format 1k*1k, 19 frames.
3. **XR** 08b GE Series, format 1k*1k, 14 frames.
4. **CT** 12b Philips Series, format 512*512, 49 frames.
5. **CT** 12b Siemens Series, format 512*512, 19 frames.
6. **CT** 3D RGB Philips Series format 512*512, 18 frames.
7. **CR** 12b Kodak Series, format 2,5k*2k, 1 frame.
8. **XA** 08b Siemens Series, format 512*512, 137 frames.
9. **US** RGB Acuson Series, format 576*456, 24 frames.

5.1. DICOM Demo Series.

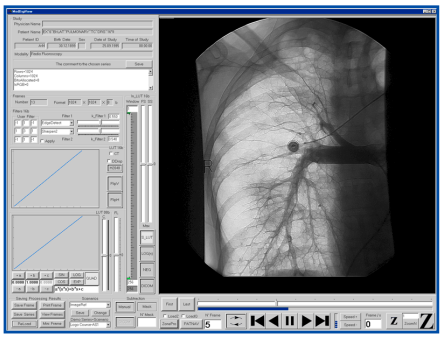
Logo Course-AS1



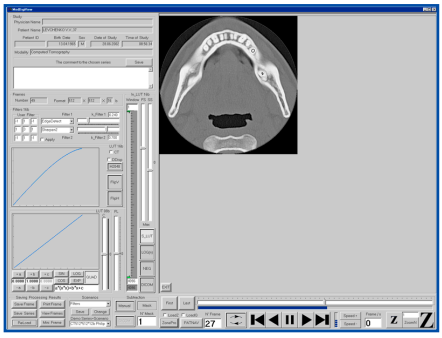
Series A. XA 10b Philips Series



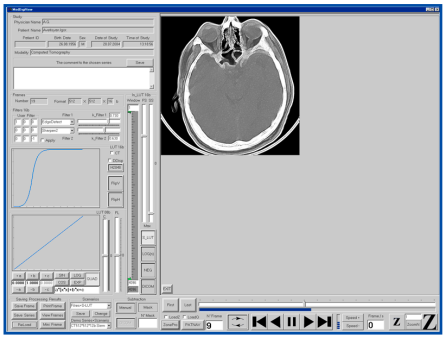
Series B. XR 08b GE Series



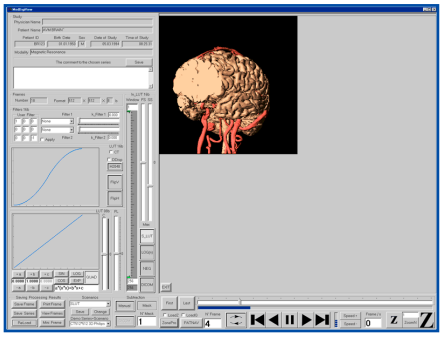
Series C. CT 12b Philips Series



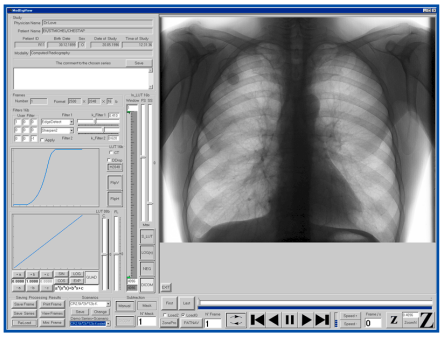
Series D. CT 12b Siemens Series



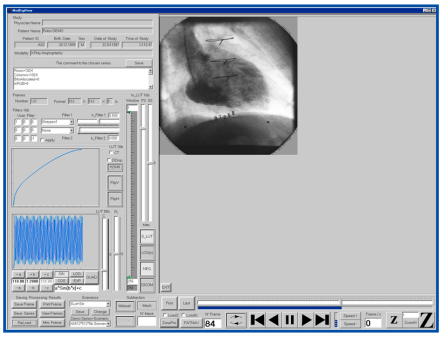
Series E. CT 3D RGB Philips Series



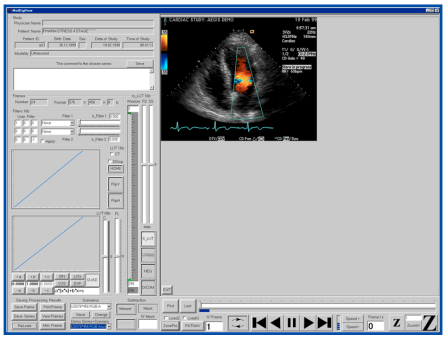
Series F. CR 12b Kodak Series



Series G. XA 08b Siemens Series



Series H. US RGB Acuson Series



- **Finish**