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Instructions for Use – *syngo*.CT Single Source Dual Energy (dual spiral)

VB10A

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VB10A

Legend

	Indicates a hint Is used to provide information on how to avoid operating errors or information emphasizing important details
»	Indicates the solution of a problem Is used to provide troubleshooting information or answers to frequently asked questions
■	Indicates a list item
✓	Indicates a prerequisite Is used for a condition that has to be fulfilled before starting a particular operation
◆	Indicates a one-step operation
1 2 3	Indicates steps within operating sequences
Italic	Is used for references and for table or figure titles
→	Is used to identify a link to related information as well as previous or next steps
Bold	Is used to identify window titles, menu items, function names, buttons, and keys, for example, the Save button
Blue	Is used to emphasize **particularly** important sections of the text
Courier	Is used for on-screen output of the system including code-related elements or commands
`Courier`	Is used to identify inputs you need to provide
Menu > Menu Item	Is used for the navigation to a certain submenu entry
<variable>	Is used to identify variables or parameters, for example, within a string
⚠ CAUTION	CAUTION Used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury or material damage. CAUTION consists of the following elements: ■ Information about the nature of a hazardous situation ■ Consequences of not avoiding a hazardous situation ■ Methods of avoiding a hazardous situation

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

WARNING consists of the following elements:

- Information about the nature of a hazardous situation
- Consequences of not avoiding a hazardous situation
- Methods of avoiding a hazardous situation

WARNING

Legend

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1 *syngo*.CT Single Source Dual Energy

In the following sections, you find procedural information and background information on *syngo*.CT Single Source Dual Energy.

Indications for use / Intended use

syngo.CT Single Source Dual Energy is designed to operate with CT images which have been acquired with Siemens Dual Spiral Single Source scanners. The various materials of an anatomical region of interest have different attenuation coefficients, which depend on the used energy. These differences provide information on the chemical composition of the scanned body materials. *syngo*.CT Single Source Dual Energy combines images acquired with low and high energy spectra to visualize this information. Depending on the region of interest, contrast agents may be used.

The functionality of the *syngo*.CT Single Source Dual Energy applications are as follows:

- Monoenergetic
- Monoenergetic Plus
- Brain Hemorrhage
- Liver VNC
- Gout Evaluation
- Bone Marrow
- Rho/Z

- Kidney Stones*

  *) Kidney Stones is designed to support the visualization of the chemical composition of kidney stones and especially the differentiation between uric acid and non-uric acid stones. For full identification of the kidney stone additional clinical information should be considered such as patient history and urine testing. Only a well-trained radiologist can make the final diagnosis under consideration of all available information. The accuracy of identification is decreased in obese patients.

Contraindications

There are no known specific situations that contraindicate the use of this device.

Legal notes

The functions described in this document are not commercially available in all countries. Some functions may be protected by a software license that is currently restricted for regulatory reasons. Some functions may be available with an optional software license. Please contact your local Siemens representative for further details.

2 Safety advice

Caution

Not observing the Instructions for Use of the software and its applications!

Wrong basis for diagnosis.

- Always use this Instructions for Use in conjunction with all Instructions for Use provided.
- Follow the safety instructions.

Caution

Loading image data sets of different patients!

Mix-up of patients and incorrect diagnosis possible.

- When loading reference and model series, make sure that you select the data of the correct patient.

Caution

User is not instructed in how to operate the applications!

Wrong basis for diagnosis.

- The operator must be qualified to use the applications.

Caution

Compression method is set to irreversible compression (Lossy JPEG)!

The resulting images are no longer completely identical to the original images. Information of medical relevance may be lost.

- Lossy compressed images should not be used for primary diagnosis, the image quality may not be sufficient.
- Lossy compression is indicated in the image displayed. The indication will be displayed except if "No Text" is in effect.
- Pay attention to corresponding entries in the image text.

Caution

Wrong selection of corresponding set of images!

Wrong diagnosis caused by wrong image information.

- Verify the appropriate set of images before operating the Dual Energy application.

Caution

Images of single source Dual Energy: Suspicious lesion on result images due to motion or registration artifacts!

Wrong diagnosis

- After detecting or assessing a lesion, verify the absence of motion or registration artifacts.

Caution

Automatically saved results may be sent to another DICOM node!

Wrong diagnosis caused by wrong information.

- Check all results of the currently active workflow. If applicable, remove intermediate or incorrect results.

  Send only correct results to other DICOM nodes, such as image viewers or PACS.

Caution

Displayed information about changed patient data is not observed!

Wrong diagnosis caused by wrong information.

- Always read and observe the displayed information about changed patient data.

  Follow the instructions provided with the displayed information, if applicable.

  Check all results and delete results that include outdated patient data.

Caution

Patient data is changed using the correct and rearrange function while a time-critical workflow for this patient is in progress!

Delayed diagnosis due to restart of workflow.

- Do not perform correct and rearrange actions while time-critical cases are in progress. Always check the **Workflows** section in the **Job View** for time-critical workflows.

Caution

The semiautomatic algorithm used for bone removal may remove tissue, for example, vessels, stents, or plaques, or leave bone fragments!

Not all relevant structures of the tissue may be visible or not relevant fragments impact further calculations.

- Verify the masking using the parameter for the threshold, size and noise and add or remove relevant items in the bone mask or the non-bone mask.

Caution

Operation of the system by non trained users!

Incorrect diagnosis or treatment due to misinterpretation of image information.

- The system must only be used by persons with the necessary specialist knowledge, for example, physicians, trained radiologists, or trained technologists, after an appropriate application training.

3 About *syngo*.CT Single Source Dual Energy

syngo.CT Single Source Dual Energy is a diagnostic tool that can be used to evaluate the chemical composition of body tissue. It combines images acquired with low and high energy spectra to visualize this information. The two energy spectra are also referred to as low energy and high energy. Depending on the organs of interest, this tool provides different application classes. These application classes combine parameters and algorithms that are optimized for the visualization of the organs of interest.

The following steps represent a typical workflow:

- Navigate through the loaded images to identify lesions. To display the data according to your needs, use the functions of General Viewing.
- Perform the application class specific workflow steps.
- Document and review your findings and complete the task.

3.1 *syngo*.CT Single Source Dual Energy application classes

Different body regions and different types of diagnoses require specific tools that allow for the correct evaluation of data sets. *syngo*.CT Single Source Dual Energy (**CT Dual Energy**) provides a range of single source application classes with diagnostic tools that meet the requirements of each evaluation type. Different application classes can be combined into one workflow. Be aware that for optimal postprocessing, patient motion should be avoided during, and in between, the low and high energy scan.

The following single source application classes are provided by *syngo*.CT Single Source Dual Energy:

- **Monoenergetic**

  The **Monoenergetic** mode simulates images that are equivalent to images scanned with a single photon energy beam, depending on the energy (keV) value. In general, contrast enhanced data is not recommended. However, Monoenergetic can be used for contrast enhanced scans that have been acquired with the dedicated scan protocols for Liver VNC and Brain Hemorrhage.

- **Monoenergetic Plus**

  The **Monoenergetic Plus** application class provides additional features to the **Monoenergetic** mode, for example, an improved algorithm for noise reduced images or the parallel display of multiple Monoenergetic Plus ROIs.

- **Brain Hemorrhage**

  This application class allows for the distinction between a hemorrhage and contrast agent in the brain. Scans are to be performed shortly after the angiography examination; no additional contrast agent is required.

- **Liver VNC** (virtual non-contrast)

  This application class visualizes the concentration of contrast agent in the liver without a non-contrast scan. The data evaluation in **Liver VNC** requires contrast enhanced data.

- **Kidney Stones**

  This application class provides tools to analyze kidney stones and navigate through them. Potential kidney stones are already analyzed during the preprocessing. The scans for kidney stones reading should be performed without contrast agent.

- **Bone Marrow**

  This application class visualizes the bone marrow composition based on non-enhanced CT data and should be performed without contrast agent.

- **Gout**

  This application class visualizes the status of gout. The scans for gout reading should be performed without contrast agent.

- **Rho/Z**

  This application class enables you to measure electron density as well as effective atomic number and thus perform a basic characterization of the material of interest.

You can add, delete, or configure application classes according to your needs. See (→ Page 103 *Configuration of CT Dual Energy*).

3.2 Common Dual Energy image types

The **CT Dual Energy** workflow provides different image types for the reading. The chapter lists and describes image types that are used in more then one application class. A description of specific image types, you find in the respective chapters of the application classes.

3.2.1 Mixed image

A mixed image is a weighted average of the original CT image. The CT values of a mixed image depend on three values: the CT value of the low energy image, the CT value of the high energy image, and the Dual Energy composition. Mixed images obtained with the standard Siemens CT scan protocols are similar to 120 kV images in terms of noise, contrast enhancement, and radiation dose.

The Dual Energy composition is the low energy fraction of the image. It is determined by the **DE Composition** parameter of the scan protocol.

The CT values of a mixed image are calculated according to the following formula.

$x = w \cdot x_{low} + (1 - w) \cdot x_{high}$

x: CT value (HU) in image

w: Dual Energy composition

x_{low}: CT value (HU) in low energy image

x_{high}: CT value (HU) in high energy image

3.2.2 Virtual non-contrast image

The virtual non-contrast (VNC) image is comparable to a real non-contrast image reconstructed with the same Dual Energy composition. During the preprocessing, the Dual Energy algorithms perform a material decomposition and subtract the iodine from the mixed image.

3.2.3 Iodine overlay image

The overlay image displays the iodine enhancement in the mixed image in Hounsfield units.

3.2.4 Fused image

A fused image combines two different images types of two different data sets that are available after the preprocessing, for example, original CT images and overlay images. With the **Mixing Ratio** mini toolbar, you can control the composition of the displayed fused images. Depending on the slider position, either more CT data or more overlay data is displayed. Fused images are temporary and cannot be saved.

However, you can generate a range or create a single screenshot of a fused image. Consider that images of that kind cannot be used for measurements.

For the image type combinations **MPR/MPR** and **MIP Thin/MIP Thin**, you can change the properties of the fused image in the respective dialog box.

3.3 Loading strategy for single source data

If you load single source data sets in CT Dual Energy, they must be corrected for patient motion between the scans. This correction is called registration and is automatically performed, if necessary, by a dedicated algorithm.

To load single source data into CT Dual Energy, the following image requirements must be met:

- One low energy and one high energy data set of one patient are available.
- Low energy and high energy scans must be performed with identical patient position and patient orientation.
- Low energy and high energy scans must be performed with identical table height.
- Between the low energy and the high energy scan, less than 180 seconds have elapsed.
- The minimum number of axial CT images for each energy setting is 6, that is, at least 12 different axial images are required.
- The images must have a matrix of 512 x 512.
- The images must originate from the same reconstruction.
- The two series must have the same number of images.
- The slices of the two series must have the same position and thickness.

Compressed data cannot be loaded into CT Dual Energy.

syngo.CT Single Source Dual Energy only accepts images that have been reconstructed with one of the following options: extended FOV, HD FOV, or extended CT scale. These options can be selected in the Siemens scanner protocol.

3.4 Automatic archiving of Dual Energy data

On Siemens scanners, you can assign *syngo*.via data roles for each reconstruction job. For Dual Energy, the data roles can be used to preselect the application classes that must be executed.

If the name of the data role contains the label "AA", for example "Optimum Contrast (AA)", automatic archiving is performed in addition. For "AA" data roles, no user interaction is required.

When the series arrives on the *syngo*.via server:

- the preprocessing task calculates the result volume(s) of the selected data role automatically.
- all archiving rules that are set in the Dual Energy configuration for this body region are disabled, but manual archiving is still possible.
- the result volume(s) is/are published to the Short Term Storage (STS).

  The processing state of Rapid Results Technology jobs is displayed in a separate entry in the **Job View**.
- the result volume(s) is/are sent to the PACS.
- in the Case Navigator the application profile **Customized** is displayed.

  Untagged series display the body region and the status of the contrast medium instead.

If you complete the patient during preprocessing, the Rapid Results Technology processing runs in the background. If you cancel the workflow, the processing will be restarted.

Thin slice results are automatically archived in the default archive (PACS). It is not possible to configure another archive in Dual Energy.

The automatic archiving is supported by all scanners beginning with version SOMARIS/5 VC20 and SOMARIS/7 VA44.

4 Working with Dual Energy

The evaluation of Dual Energy data can be split into two parts:

- You perform a standard diagnosis by using the General Viewing tools.
- You perform a case-specific data evaluation by using one of the application classes.

4.1 *syngo*.CT Single Source Dual Energy tools and shortcuts

syngo.CT Dual Energy tools are provided in the Case Navigator and on the corner menus. The most frequently used tools are accessible via the context menu of each segment. You can also use the keyboard shortcuts that are described in the corresponding tooltips.

The following table shows available tools and functions, and corresponding keyboard shortcuts:

Icon	Description	Available in				Keyboard shortcut
		Case Navigator	Corner menu	Context menu	Mini toolbar	
General viewing tools						

Icon	Description	Available in				Keyboard shortcut
		Case Navigator	Corner menu	Context menu	Mini toolbar	
	**DE FOV** Shows or hides the Dual Energy field of view Complete Dual Energy information is only available inside the boundary lines of this field. (→ Page 44 *Displaying the Dual Energy field of view*)	Yes	–	–	–	–
	**Extended ROI Annotation** Shows or hides additional evaluation results in ROI annotations (→ Page 41 *Displaying Dual Energy ROI labels*)	Yes	–	–	–	–
	**Reset Display and Settings** Resets the display and settings to the default of the currently active layout (→ Page 37 *Resetting the display*)	Yes	–	–	–	–

Icon	Description	Available in				Keyboard shortcut
		Case Navigator	Corner menu	Context menu	Mini toolbar	
	**Show Monoenergetic** Activates or deactivates the **Monoenergetic** viewing mode, which simulates images acquired with a single photon energy beam (→ Page 46 *Activating the Monoenergetic viewing mode*)	Yes	–	–	–	–
	**Table Removal** Automatically removes the table and head holder from 3D images (→ Page 44 *Showing or hiding the patient table*)	Yes	–	–	–	–
	**Apply Punch Mask** Enables or disables an existing punch mask for the currently selected application class (→ Page 44 *Applying the punch mask*)	Yes	–	–	–	–
Common tools of the application classes						

Icon	Description	Available in				Keyboard shortcut
		Case Navigator	Corner menu	Context menu	Mini toolbar	
	**Mark displayed result images as ready for archiving** The currently displayed result images become available in the Series Navigator. When closing the patient, the series is sent to the archive. (→ Page 99 *Marking series for archiving*)	Yes	–	–	–	–
	**Store displayed result images in syngo.via** The currently displayed result images become available in the Series Navigator. (→ Page 98 *Sending data to the Series Navigator*)	Yes	–	–	–	–
	**Archiving Information** Displays images that have been marked/will be marked for archiving (→ Page 99 *Displaying the archiving information*)	Yes	–	–	–	–

Icon	Description	Available in				Keyboard shortcut
		Case Navigator	Corner menu	Context menu	Mini toolbar	
	**Default Parameters** Restores the default values that are predefined in the **Configuration Panel** (→ Page 116 *Recalculating with new application class parameters*)	Yes	–	–	–	–
	**Recalculate** Starts a new calculation (→ Page 116 *Recalculating with new application class parameters*)	Yes	–	–	–	–
	**Cancel** Stops a running recalculation (→ Page 116 *Recalculating with new application class parameters*)	Yes	–	–	–	–
	**Color LUT** Assigns the predefined color LUT to the selected CT image (→ Page 33 *Applying color LUTs*)	–	Lower right	–	–	–

Icon	Description	Available in				Keyboard shortcut
		Case Navigator	Corner menu	Context menu	Mini toolbar	
Tools of the **Kidney Stones** application class						
	**Restart Kidney Stones Navigation** Returns to the first potential kidney stone (→ Page 69 *Navigating through potential kidney stones*)	–	–	–	Yes	–
	**Navigate backward and view Kidney Stones** Navigates backward through the data set and displays the previous potential kidney stone (→ Page 69 *Navigating through potential kidney stones*)	–	–	–	Yes	Alt + B
	**Navigate forward and view Kidney Stones** Navigates forward through the data set and displays the next potential kidney stone (→ Page 69 *Navigating through potential kidney stones*)	–	–	–	Yes	Alt + F

Icon	Description	Available in				Keyboard shortcut
		Case Navigator	Corner menu	Context menu	Mini toolbar	
	**Set Kidney Stone Marker** Sets a marker for the currently selected kidney stone (→ Page 70 *Marking potential kidney stones*)	–	Upper right	–	Yes	–

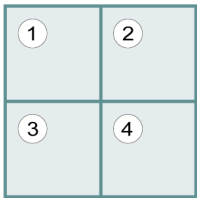
4.2 Layouts for single and dual monitor configuration

syngo.CT Dual Energy provides different layouts that display images required in a typical workflow. Depending on the application class and the number of monitors used, the display types may vary.

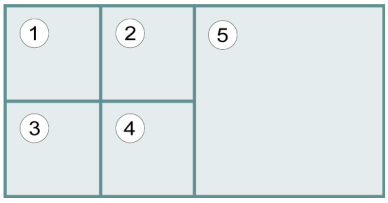
There are dedicated layouts for single monitor and dual monitor configurations that are independent from the application class. They are valid for different aspect ratios (4:3 and 16:10) and orientations (portrait and landscape). They are not valid for the **Side-by-Side** layouts.

These layouts contain the following segments:

- Single monitor configuration:



- Dual monitor configuration:



You find the description of the application classes and their associated layouts in the respective chapter of the application class.

4.3 Loading data with a broken link

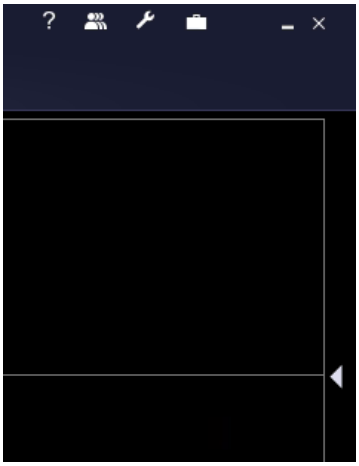
If the low energy and high energy data of a data set do not contain the link information required for Dual Energy, the data set cannot be loaded into the Dual Energy workflow and the displayed application profile will be **no data**. In this case, you must select the two data sets manually.

✓ The data set is assigned to the Dual Energy workflow.

✓ In the segments, no data is shown.

✓ In the Case Navigator, the application profile **no data** is displayed.

1 Open the Dual Energy data set.



2 In the viewing area on the right side of the screen, move the mouse pointer over the arrow head icon.

3 Click the first data set.

4 Press the **Ctrl** button and click the seconds data set.

5 Drag both selected data sets into the viewing area.

A message box informs you that the data set does not match and that images might have been manipulated.

If one or both data sets do not fulfill the loading requirements, the mouse pointer changes into the no-drop symbol. The series cannot be loaded.

6 Click **OK** to confirm the loading of the selected data.

The selected data sets are loaded into the viewing area.

7 In the Case Navigator, check the assigned body region in the **Application Profile** list. If necessary, select another one.

The corresponding application classes are loaded. The data is processed accordingly.

The data sets remain linked if you suspend or complete the workflow. After canceling and exiting the workflow, you must link the data set again.

4.4 Applying color LUTs

In Dual Energy, you can apply a distinct color LUT to fused images. The quality of the results depends on the applied color LUTs and the mixing ratio set for the fused images. Several color LUTs are available, depending on the images displayed in the segment.

1 In the desired segment, enter the lower right corner menu.

The menu displays all entries available for the respective display type.

2 Select one of the following entries:

Color LUT for non fused MPR or MPR Thick images.

Color LUT CT Low Energy for fused low energy MPR images.

Color LUT CT High Energy for fused high energy MPR images.

Color LUT CT for fused CT images.

Color LUT Overlay for fused overlay MPR/MIP Thin images.

The default color LUT assignments are defined in the **Configuration Panel** on the **Visualization** tab of the respective application classes.

4.5 Adapting the mixing ratio of images

You can use the **Mixing Ratio** mini toolbar to control the composition of the displayed images.

The mini toolbar is available in all segments displaying fused MPR and fused MIP thin images.

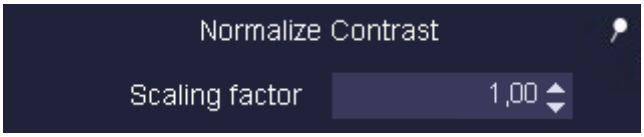
- In the **Mixing Ratio** mini toolbar, move the slider to the left to display more CT data (default value is 50 %).

  – or –

  In the **Mixing Ratio** mini toolbar, move the slider to the right to display more overlay data (default value is 50 %).

4.6 Adjusting the windowing values in overlay images

You can use the **Normalize Contrast** mini toolbar to adjust the windowing values that are applied to the overlay images.



✓ Fused overlay images are available.

1 From the upper right corner menu, choose **DE Normalize Contrast**.

The mouse pointer changes into a circle.

2 Draw the normalize contrast ROI on the tissue you want to analyze. The ROI must be within the usable FoV that is marked by the yellow line.

The ROI and its text are displayed in blue.

Keep in mind, that a normalize contrast ROI is not listed in the **Findings Navigator**.

3 In the **Normalize Contrast** mini toolbar of the relevant segments, adapt the scaling factor according to your needs.

The window center and window width of the images are calculated as follows:

Center C = scaling factor × contrast enhancement value of the ROI

Width W = 2 × Center C

Only one normalize contrast ROI is possible. If you draw a new ROI, it automatically replaces an already existing normalize contrast ROI.

4.7 Adjusting the windowing values in VRT images

The VRT Highlighting mini toolbar allows you to exactly window the overlay data in the VRT image according to your needs.

✓ A VRT image with overlay data is available.

1 In the VRT Highlighting mini toolbar, move the **C** slider to change the window center.

– or –

Enter the value in the **C** field.

2 In the VRT Highlighting mini toolbar, move the **W** slider to change the window width.

– or –

Enter the value in the **W** field.

3 Click the **Default** button to restore the settings.

4.8 Showing or hiding the color bar

The color bar allows the pixel values for fused MPR and MIP thin images to easily be determined. Depending on the application class, the scale covers a different range of pixel values. The color bar is automatically updated when you window an image segment or assign a new color LUT.

◆ Press the **Alt** + **C** key to show or hide the color bar in the segments.

4.9 Changing the Application Profile

If the selected application profile, for example **Abdomen (CA)**, does not offer you the required application classes, for example **Liver VNC**, you can select another application profile.

- In the Case Navigator, select another application profile in the **Application Profile** list.

  – or –

  Instead of an application profile, you can also select an application class directly from the **Application Profile** list.

All findings will be kept when you change the application profile.

4.10 Resetting the display

At any time, you can restore the following default settings of the display:

- Orientation (zooming, rotating, panning)
- Look-up table (LUT)
- Windowing values
- Mixing ratio

- In the Case Navigator, click the **Reset Display and Settings** icon.

  The default values of the display-related settings which are defined for the currently active layout are restored.

  Markers, findings, and measurements are not affected.

4.11 Modification of preselected series

Depending on the body regions and the types of diagnoses, it may be helpful to evaluate additional patient data, for example, a second or third image series at a different time point of contrast agent enhancement. If such series are available, you can drag them from the Series Navigator to the image area.

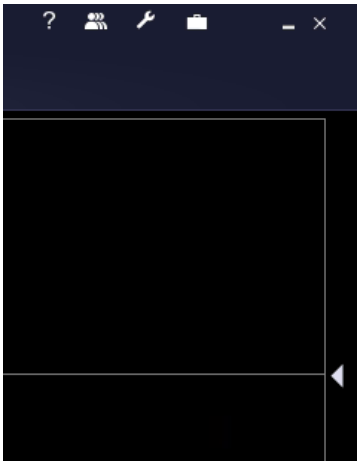
The Series Navigator lists all loaded data of the currently processed workflow, that is, the data of the whole study. There are two ways of displaying the data:

- Replacing the loaded data in the image area; this way requires the original Dual Energy patient data.
- Displaying the data in a floating segment (preview window); this way does not require the original Dual Energy patient data.

New data sets can only be loaded to the image area if the preprocessing has been completed for them. This may take some time. Otherwise also valid original series will be displayed in the preview window.

4.11.1 Replacing loaded data

✓ Original Dual Energy patient data is available.



1 On the right side of the screen, move the mouse pointer over the small triangle.

2 Click the data and drag it into the viewing area.

The new data is displayed in General Viewing.

Or, if the evaluation results of the loaded data are not saved, a message box pops up asking how you want to continue.

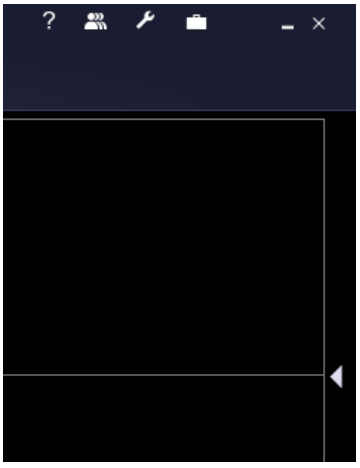
3 Click **Cancel** to save the results and to repeat the data replacement.

– or –

Click **OK** to replace the data without saving the results.

4.11.2 Displaying data in a floating segment

You can use the floating segment, for example, to display the preprocessing results. The recalculation of data is not possible in a floating segment.



1 On the right side of the screen, move the mouse pointer over the small triangle.

2 With the right mouse button pressed, drag the data into the viewing area.

3 Click **Quick View**.

The data is displayed in a separate floating segment; the currently loaded data of the image area remains unchanged.

Also valid Dual Energy data sets will be loaded into a floating segment, if the preprocessing has not yet produced mixed images for the selected series. You have to wait till the mixed images are generated.

4.12 Dual Energy ROI label

The following table lists all ROI properties that can be displayed in a Dual Energy ROI label. These properties are application class specific, that is, not every ROI property is available for every application class.

The displayed properties of a standard ROI label depend on the Dual Energy ROI settings. An extended ROI label displays all available properties.

Mean [HU]	Mean value in HU
Stddev [HU]	Standard deviation in HU

Min [HU]	Minimum CT value in HU
Max [HU]	Maximum CT value in HU
Area [cm^2]	Area of ROI in cm^2
Iodine Density [mg/ml]	Equivalent iodine concentration
Relative Enhancement [%]	Ratio (in %) of the iodine enhancement in the ROI relative to the iodine enhancement in the normalize overlay ROI. The calculation of the relative enhancement requires a normalize overlay ROI first.
Fat Fraction [%]	Calculated fat fraction assuming a mixture of soft tissue and fat
Dual Energy Index	DEI = $(x_{low} - x_{high}) \div (x_{low} + x_{high} + 2000$ HU) DEI: Dual Energy index x_{low}: CT value (HU) in low energy image x_{high}: CT value (HU) in high energy image
Effective Atomic Number	For pure chemical elements, the effective atomic number is the same as the atomic number. For mixtures of chemical elements, the following equation is used to calculate the effective atomic number: $Z_{eff} = \left(\frac{\sum_i n_i Z_i^{n+1}}{\sum_i n_i Z_i} \right)^{1/n}$ n_i: number density of atom type i Z_i: atomic number of atom type i n: recommended value 3.1

Normalized Uptake [HU]	Iodine enhancement in soft tissue compartment (corrected for air fraction)

If values cannot be measured, three question marks are displayed instead of a value.

4.12.1 Displaying Dual Energy ROI labels

The Dual Energy ROI labels combine information and measurement values that support you in reading. In Dual Energy, you can choose between the display of the standard ROI label and the extended ROI label.

1 From the upper right corner menu, choose **ROI**.

The mouse pointer changes into a circle.

2 Draw a ROI on the tissue you want to analyze.

The standard ROI label is displayed.

3 In the Case Navigator, click the **Extended ROI Annotation** icon.

All Dual Energy ROIs that were already drawn as well as all new ones are labeled with all measured ROI properties.

4 Click the **Extended ROI Annotation** icon again to switch back to the standard ROI label.

4.12.2 Changing the standard Dual Energy ROI label

You can change the properties of the standard ROI label according to your needs.

There are two types of Dual Energy ROIs: circle and freehand. A change of any standard Dual Energy ROI label is also valid for all other Dual Energy ROI types. The change of the standard Dual Energy ROI circle label serves as an example.

1 From the upper left corner menu, choose **Dual Energy ROI Circle**.

2 Right-click **Dual Energy ROI Circle** and select **Dual Energy ROI Circles Properties**.

The **Dual Energy ROI Properties** dialog box opens.

3 Select the required properties.

– or –

Click the **Default** button to reset the specific ROI label settings.

4 Click **OK** to confirm the new settings.

The next Dual Energy ROIs you draw display the new properties setting. The ROI label of already drawn ROIs remain unchanged.

Changes are user and application class specific. They are valid until you change the settings again.

5 General Viewing

General Viewing combines the basic functions of **CT Dual Energy**. It provides tools to perform an initial diagnosis.

In addition to the basic viewing mode, General Viewing provides the **Monoenergetic** mode. This mode allows you to simulate images that are equivalent to images scanned with a single photon energy beam.

5.1 MPR layout

The default layout of General Viewing provides fused MPR images and mixed 2D axial images.

The fused and mixed images combine the information of the low energy and high energy data sets. In the segments with fused MPR images, you can change the mixing ratio of the data sets with a mini toolbar.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: blank
- Segment 5: mixed 2D axial

5.2 Side-by-Side layout

The **Side-by-Side** layout provides coronal and axial MPR images of the low energy and high energy data sets as well as mixed 2D axial images.

The segments display the following display types:

- Segment 1: low energy MPR coronal
- Segment 2: high energy MPR coronal
- Segment 3: low energy MPR axial
- Segment 4: high energy axial
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

Some display functionalities are synchronized in the different segments.

5.3 Displaying the Dual Energy field of view

- In the Case Navigator, click the **DE FOV** icon to show or hide the Dual Energy field of view.

  In the segments, the field of view is marked with yellow lines.

  Only within the yellow lines is full dual energy information available for the current task.

5.4 Showing or hiding the patient table

✓ A VRT segment is displayed.

- In the Case Navigator, click the **Table Removal** icon.

  The table and the head holder are removed from the VRT segment.

5.5 Applying the punch mask

For the same data set all application classes use the same punch mask. In order to enable or disable an existing punch mask for the currently selected application class, the **Apply Punch Mask** button can be used. The mask itself is not modified or deleted when using this button.

✓ A VRT segment is displayed.

- In the Case Navigator, click the **Apply Punch Mask** icon to show or hide the masked area.

5.6 Composing fused images

You can use the **DE Composer** mini toolbar to control the composition of the fused images.

✓ You are in the General Viewing mode.

1. In the **DE Composer** mini toolbar, move the slider to the left to display more data from the low kV energy spectrum (default 50 %).

   – or –

   Move the slider to the right to display more data from the high kV energy spectrum (default 50 %).

   The default value is the same as the Dual Energy composition reconstruction parameter set on the CT scanner.

2. Select the **Link Windowing** check box to simultaneously window base data and fused data independent of the mouse position.
3. Deselect the **Link Windowing** check box to window either the base data (left part of an image segment) or the fused data (right part of an image segment), depending on the position of the mouse in the image segment.

5.7 Monoenergetic viewing mode

The **Monoenergetic** mode is one of the viewing modes of General Viewing. This mode simulates images that are equivalent to images scanned with a single photon energy beam, depending on the energy (keV) value.

By changing the energy (keV), you can enhance the contrast between different materials.

This viewing mode should not be confused with the **Monoenergetic Plus** application class, which offers additional functionality but requires an additional license and may not be available in all countries.

5.7.1 Activating the Monoenergetic viewing mode

The **Monoenergetic** mode is one of the viewing modes of General Viewing.

1 In the Case Navigator, click the **Viewing** palette.

2 Click the **Show Monoenergetic** icon to switch to the **Monoenergetic** viewing mode.

Images equivalent to images acquired with a single photon energy beam are calculated.

3 Click the **Show Monoenergetic** icon again to switch to the General Viewing mode.

The original images are displayed again (default).

5.7.2 MPR/2D layout

This layout is the default layout of the General Viewing **Monoenergetic** mode. It offers monoenergetic MPR images, mixed 2D axial images, and a diagram with an evaluated curve of a monoenergetic ROI measurement.

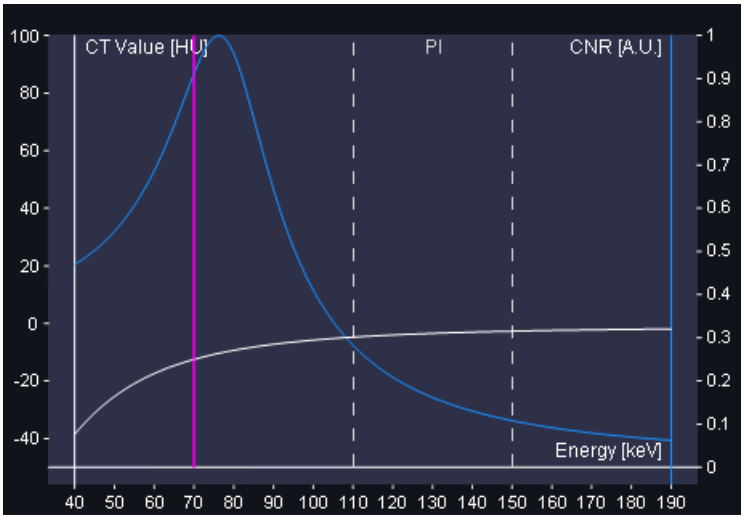
The segments display the following display types:

- Segment 1: monoenergetic MPR sagittal
- Segment 2: monoenergetic MPR coronal
- Segment 3: monoenergetic MPR axial
- Segment 4: diagram
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

5.7.3 Monoenergetic diagram and calculation formula

The lower right segment displays various spectral information about a drawn Monoenergetic ROI:

- The white curve (left scale) shows the calculated CT value of the tissue on which the Monoenergetic ROI is drawn (HU depending on the monoenergetic photon energy in keV). This curve allows for the differentiation between regions with different contrast agent uptake.
- The blue curve (right scale) shows the calculated contrast-to-noise ratio (CNR) for iodine, depending on the energy level (keV). The curve is normalized to its maximum value. This curve allows you to optimize the CNR for the present patient diameter, X-ray tube currents, and voltages.
- The purple vertical line shows the monoenergetic value. If you move this line, the images are recalculated according to the new keV value.
- If applicable, the white dotted vertical lines indicate the energy range of optimal metal artefact reduction (110 - 150 keV).



The CT values are calculated according to following formula:

$x = w(E) \cdot x_{low} + (1 - w(E)) \cdot x_{high}$

x: CT value (HU)

w(E): value calculated on the basis of the following parameters:

- Patient diameter
- Result of phantom measurements
- Iodine X-ray absorption

x_{low}: CT value (HU) in low energy image

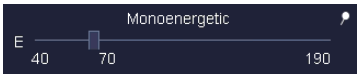
x_{high}: CT value (HU) in high energy image

The CT value at the optimum CNR is always between the values of x_{low} and x_{high}.

5.7.4 Changing the Monoenergetic keV setting

By changing the energy (keV), you change the contrast-to-noise-ratio (CNR). This allows you to visualize regions of interest according to your needs.

✓ The **Monoenergetic** mode is activated.



◆ In the mini toolbar of an MPR segment, move the Monoenergetic slider to the desired keV value.

– or –

In the diagram segment, move the vertical line to the desired keV value.

The recalculated images are shown.

5.7.5 Creating a Monoenergetic ROI

You can show the CT value (HU) and the contrast-to-noise-ratio (CNR) curves of a tissue of interest. First, however, you must create a Monoenergetic ROI. You can draw a Monoenergetic ROI in any MPR segment.

✓ The **Monoenergetic** mode is activated.

1 From the upper right corner menu, choose **ROI Monoenergetic**.

The mouse pointer changes into a circle.

2 Draw the Monoenergetic ROI on the tissue you want to analyze.

The appropriate HU and CNR curves are displayed in the diagram segment.

If you draw another ROI, the curves are replaced according to the new results.

5 General Viewing

6 Monoenergetic Plus application class

The **Monoenergetic Plus** application class simulates images that are equivalent to images scanned with a single photon energy beam, depending on the energy (keV).

By changing the energy (keV), you can enhance the contrast between different materials.

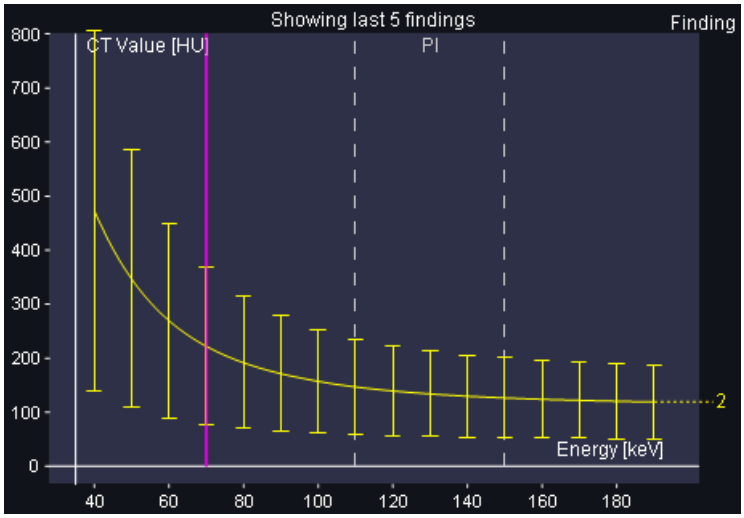
Compared to the **Monoenergetic** viewing mode, the **Monoenergetic Plus** application class provides the following additional features:

- Improved algorithm for noise reduced images
- Parallel display of multiple Monoenergetic Plus ROIs and their respective attenuation curves
- Saving of Monoenergetic Plus ROI information for statistical evaluations

6.1 Monoenergetic Plus diagram and calculation formula

The Monoenergetic Plus diagram in the lower right segment displays spectral information on the drawn Monoenergetic Plus ROIs:

- The colored curves show the calculated CT value of the tissue on which the Monoenergetic Plus ROI is drawn (HU depending on the monoenergetic photon energy in keV). Error bars indicate the standard deviation in HU. The curves allow the differentiation between regions with different contrast agent uptake.
- The purple vertical line shows the Monoenergetic energy. If you move this line, the images are recalculated according to the new keV value.
- The white dotted vertical lines and PI (prosthesis imaging) indicate the energy range of optimal metal artefact reduction (110 - 150 keV), if applicable.



In principle, the CT values are calculated according for the following formula:

$x = w(E) \cdot x_{low} + (1 - w(E)) \cdot x_{high}$

x: CT value (HU)

w(E): value calculated on the basis of the following parameters:

- Patient diameter
- Result of phantom measurements
- Iodine X-ray absorption

x_{low}: CT value (HU) in low energy image

x_{high}: CT value (HU) in high energy image

Advanced image filters reduce noise, especially for very high and very low energy (keV).

6.2 MPR/2D layout

This layout is the default layout of the **Monoenergetic Plus** application class. It offers monoenergetic MPR images, mixed 2D axial images, and a diagram with an evaluated curve of a monoenergetic ROI measurement.

The segments display the following display types:

- Segment 1: monoenergetic MPR sagittal
- Segment 2: monoenergetic MPR coronal
- Segment 3: monoenergetic MPR axial
- Segment 4: diagram
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

6.3 Monoenergetic Plus ROI label

The label of a drawn Monoenergetic Plus ROI provides the following ROI properties:

App [keV]	Low energy, high energy, and Monoenergetic energy in keV
Mean [HU]	Mean values of low energy, high energy, and Monoenergetic Plus data sets in HU
Stddev [HU]	Standard deviation of low energy, high energy, and Monoenergetic Plus data sets in HU The CT values of the original voxels are evaluated to maximize the measurement precision of the standard deviation.
Area [cm^2]	Area of Monoenergetic Plus ROI in cm^2

These label properties and a screenshot of each image segment are added to the report if a Monoenergetic Plus ROI is selected in the **Findings Navigator**.

6.4 Exporting the Monoenergetic Plus ROI properties

Independent of the report that is based on the findings in the **Findings Navigator**, you can export the following data of all created Monoenergetic Plus ROIs to the file system, for example, for statistical evaluation or research evaluation:

- Snapshots of all segments as png files, Segment_<n>.png

  <n> indicates the image segment.

- Snapshots of all Monoenergetic Plus ROIs, [<m>]Mono +ROI_<n>.png

  <m> indicates the number of the Monoenergetic Plus ROIs, <n> indicates the image segment.

- A text file, MonoenergeticROISettings.txt, that lists mean values and standard deviations of all Monoenergetic Plus ROIs.

1 In the Monoenergetic Plus step, click the **Export Monoenergetic ROIs to File System** icon.

  The **Browse For Folder** dialog box opens.

2 Select the desired folder and click **OK**.

6.5 Changing the Monoenergetic keV setting

By changing the energy (kV), you can visualize regions of interest according to your needs. For example, to visualize iodine, energies between 40 kV and 70 kV are recommended.

- In the mini toolbar of an MPR segment, move the Monoenergetic slider to the desired kV value.

  – or –

  In the diagram segment, move the vertical line to the desired kV value.

  The recalculated images are displayed.

6.6 Creating a Monoenergetic Plus ROI

By creating ROIs, you can define regions of interest according to your needs. The number of Monoenergetic Plus ROIs is not limited. Eight different colors help to distinguish the different CT value curves in the diagram.

1 From the upper right corner menu, choose **Monoenergetic Plus ROI**.

The mouse pointer changes into a circle.

2 Draw the Monoenergetic Plus ROI on the tissue you want to analyze.

The CT value curve is displayed in the diagram in the lower right segment.

The Monoenergetic Plus ROI is added to the **Findings Navigator**.

The CT value curve is labeled with a consecutive number which can be also found in square brackets in the **Findings Navigator**.

3 If necessary, change the name of the finding to rename the CT value curve.

The first two characters of the name of the finding replace the curve number.

If the Monoenergetic Plus ROI does not contain voxels with CT values below minimum or above maximum in the mixed image, no curve is displayed and the measured values are displayed as **???**.

6.7 Displaying the Monoenergetic Plus ROIs in the diagram

✓ At least one Monoenergetic Plus ROI is created.

1 Right-click the lower right segment with the Monoenergetic Plus diagram.

2 From the context menu, choose **Show all findings** to display all created Monoenergetic Plus ROIs.

– or –

Choose **Show reported findings only** to display only Monoenergetic Plus ROIs that are marked for reporting in the **Findings Navigator**.

– or –

Choose **Show last 5 findings** (default) to display the last five created Monoenergetic Plus ROIs.

– or –

Choose **Show error bars** to switch the error bars of all Monoenergetic Plus ROIs on/off.

You can change the default settings for all data sets in the **CT Dual Energy Configuration** blind of the **Configuration Panel**.

6.8 Adapting the calculation parameters of the loaded data

In the Monoenergetic Plus step you can change the calculation parameters of the loaded data.

1 Enter the resolution value in the **Resolution** field to adapt the range of the smoothing filter (in units of the pixel size).

Low resolution values are better for spatial resolution.

High resolution values are better for low contrast resolution.

2 Enter a threshold in the **Minimum [HU]** field to define that below this value the mixed image is displayed instead of the Monoenergetic Plus image.

3 Enter a threshold in the **Maximum [HU]** field to define that above this value the mixed image is displayed instead of the Monoenergetic Plus image.

4 Click the **Basic Algorithm** icon to switch off the Monoenergetic Plus image filter.

The images are identical to the Monoenergetic Plus image.

The values for **Resolution**, **Minimum [HU]**, and **Maximum [HU]** are not used and cannot be changed.

5 Click the **Recalculate** icon to apply the new value to all images.

6 Click the **Default Parameters** icon to restore the default values that are predefined in the **Configuration Panel**.

6 Monoenergetic Plus application class

7 Brain Hemorrhage application class

Brain Hemorrhage is an application class that allows you to distinguish contrast agent from a hemorrhage in the brain.

The main indication for a head scan with *syngo*.CT Single Source Dual Energy is to examine the outcome of an interventional procedure intended to resolve intracranial clots (intra-arterial embolectomy or thrombolysis).

If you scan shortly after the angiography examination, contrast agent can be recognized as diffuse staining in the parenchyma. The contrast agent concentration is stable enough for the evaluation of *syngo*.CT Single Source Dual Energy data in the **Brain Hemorrhage** application class. The scan does not require additional contrast agent.

For the same data set, the Monoenergetic mode of General Viewing allows you to interactively adapt the CT-values of calcium and iodine.

Before you start working with this application class, you should have performed a standard diagnosis by using the General Viewing tools in the Case Navigator.

7.1 Brain Hemorrhage scan requirements

If you perform a single source Dual Energy scan for an evaluation with Brain Hemorrhage, the scan has to meet the following requirements:

- The scan is performed with the scan protocol DE_Head_BrainHem_post_intervention or a scan protocol derived from it.
- The images have to be reconstructed with the standard kernels as defined in the standard protocol for Brain Hemorrhage, for example, D24, D34, or Q34 for the Definition Edge.

- No additional contrast agent is injected.
- The patient does not move his head during the scan. Otherwise, the two single source Dual Energy data sets may not be registered successfully.

7.2 Brain Hemorrhage image types

The **Brain Hemorrhage** application class provides the following image types:

- Mixed images

  (→ Page 21 *Mixed image*)

- Virtual non-contrast images

  (→ Page 22 *Virtual non-contrast image*)

- Iodine overlay images

  (→ Page 22 *Iodine overlay image*)

- Fused images

  (→ Page 22 *Fused image*)

7.3 MPR/VNC layout

The MPR/VNC layout is the default layout of the **Brain Hemorrhage** application class. It displays fused MPR images and mixed 2D axial images. The fused images combine the information of the virtual non-contrast (VNC) and overlay data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: blank
- Segment 5: mixed 2D axial

7.4 MPR/Mixed layout

The MPR/Mixed layout provides fused MPR images and mixed 2D axial images. The fused images combine the information of the mixed MPR and overlay data sets. The mixed MPR images combine the information of the low energy and high energy data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: blank
- Segment 5: mixed 2D axial

7.5 Side-by-Side layout

The **Side-by-Side** layout provides mixed MPR, VNC MPR, and mixed 2D axial images. The mixed MPR images combine the information of the low energy and high energy data sets. The Dual Energy composition is already set during the reconstruction of the data at the scanner system.

The segments display the following display types:

- Segment 1: mixed MPR coronal
- Segment 2: VNC MPR coronal
- Segment 3: mixed MPR axial
- Segment 4: VNC MPR axial
- Segment 5: mixed 2D axial

Some display functionalities are synchronized in the different segments.

7.6 Adapting the calculation parameters of the loaded data

In the Brain Hemorrhage step you can change the calculation parameters of the loaded data.

1 Enter the resolution value in the **Resolution** field to adapt the range of the smoothing filter (in units of the pixel size).

Low resolution values are better for spatial resolution.

High resolution values are better for low contrast resolution.

2 Enter a threshold in the **Maximum [HU]** field to remove all voxels in mixed images that are above this value.

3 Enter a value in the **Iodine Ratio** field to change the ratio of contrast and enhancement to low energy and high energy.

4 Click the **Recalculate** icon to apply the new value to all images.

5 Click the **Default Parameters** icon to restore the default values that are predefined in the **Configuration Panel**.

8 Kidney Stones application class

The **Kidney Stones** application class visualizes the chemical differences between kidney stones by decomposing the kidney stones into its component parts: tissue, uric acid, and oxalate (calcium stone).

This application class provides tools to analyze kidney stones, navigate through them, and supports you in the fast evaluation of kidney stones. Potential kidney stones are already analyzed during the preprocessing.

The **Kidney Stones** application class requires non-enhanced CT data. Be aware that for an optimal postprocessing, patient motion should be avoided during and in between the low and the high energy scan.

Before working with this application class, perform a standard diagnosis with the General Viewing tools in the Case Navigator.

8.1 Differentiation of stone types

In the kidney stone application class, there are two methods of evaluating the algorithm results: using the dominating color or using the overlay value.

Although the color is sufficient to distinguish between uric acid/ urate stones and non uric acid stones, the overlay value measured in the center of the stone is more robust, especially for non-ideal reconstruction parameters.

Each stone type has a characteristic overlay value. This value also allows for obtaining more information about the chemical composition of blue stones.

8.2 Limitations for differentiation of kidney stones

There are limitations for the differentiation between uric acid stones (red) and non-uric acid stones (blue) regarding the stone properties, the patient diameter and the dose.

The following limitations depend on the stone properties:

- Independent of their size, stones with central CT-values below 230 HU may be wrongly colored or not detected at all. In case of larger stones, it is extremely probable that the stone is a uric acid stone, a 2,8-dihydroxyadenine or xanthine stone, a drug induced stone or a foreign body, for example surgical material or catheters.
- Mixed stones with a urate content of at least 70 % are classified as a urate stone; below 60 % the stone is typically classified as non-urate stone.
- For mixed stones, it is not possible to perform a detailed analysis of the composition. Stones with overlay values between uric acid and calcium compounds can be arbitrary mixtures of several materials. These stones may also be marked in red.
- Stones with a diameter of less than 5 mm may be falsely colored or not detected at all.

The following limitations depend on the patient diameter:

- If the default scan protocol contains a tin filter, results can be achieved for patients with a water-equivalent diameter of up to 40 cm.
- If the default scan protocol does not contain a tin filter, results can be achieved for patients with a water-equivalent diameter of 35 cm.

The following limitations depend on the dose:

- To generate stable Dual Energy evaluation results, do not reduce the dose of the standard scan protocol by more than 50 %.
- For voltage combinations without a tin filter the patient must be less than 40 cm in diameter for best dose efficiency.

The use of SAFIRE (Sinogram Affirmed Iterative Reconstruction) reduces noise. This does not degrade the classification results.

The following limitation depend on the slice thickness:

- The slice thickness should be between 1 and 2 mm with an overlap of approximately 30 %.

8.3 Processing the Kidney Stones protocol

For optimum image quality, perform the following workflow steps:

1. Use the default scan protocol **DE_Abdomen_KidneyStones** for a targeted scan of the kidney. For a scan of the kidneys, ureters and bladder, you may consider reducing the dose by up to 50 %.
2. Send the reconstructed thin slice images with the Dual Energy reconstruction kernel to a workstation that has the post-processing software syngo Dual Energy installed.
3. Open the images with *syngo*.CT Dual Energy and select **Kidney Stones**. Follow the directions in the user hints, if applicable.

Do not change the default processing parameters, color lookup tables or windowing to evaluate the kidney stones.

8.4 Kidney Stones image types

The **Kidney Stones** application class provides the following image types:

- Mixed images

  (→ Page 21 *Mixed image*)
- Fused images

  (→ Page 22 *Fused image*)
- Iodine overlay images

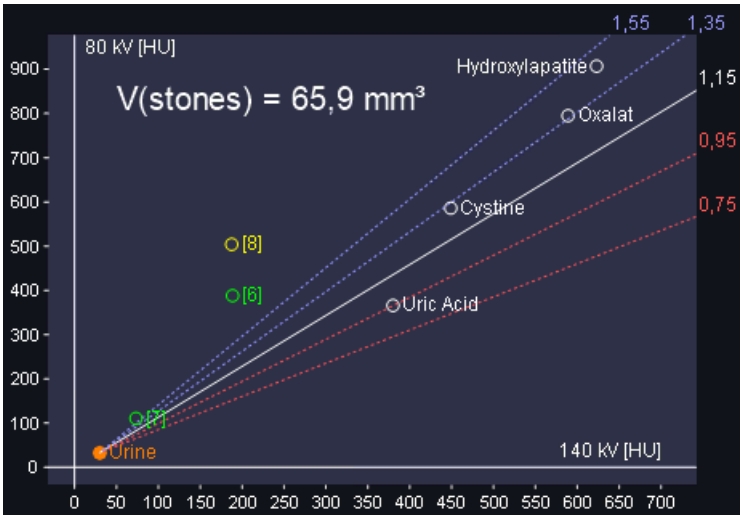
  (→ Page 22 *Iodine overlay image*)

8.5 Kidney Stones Parameter diagram

The Kidney Stones Parameter diagram in the lower right segment provides the following information:

- The volume of all shown kidney stones is displayed.
- All findings that you confirmed by setting a kidney stone marker are displayed with colored circles and the respective number of the finding in square brackets.
- Reference points for typical stones such as uric acid, cystine, hydroxylapatite, and oxalat support you in classifying a potential kidney stone. They are displayed with white circles.

  Depending on the ratio, the resolution, and the HU values you have entered, the reference points may be located at different positions.
- The white line represents the ratio of the low energy and high energy values. You can change this value in the **Configuration Panel**.
- Findings on the red dotted lines indicate uric acid stones.
- Findings on the blue dotted lines indicate calcium stones.



8.6 VRT layout

The default layout of the **Kidney Stones** application class provides fused MPR images, VRT images, and the Kidney Stones Parameter diagram supporting you in classifying the kidney stones.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2:
  - Single monitor configuration: mixed VRT coronal
  - Dual monitor configuration: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4: diagram
- Segment 5: mixed VRT coronal

8.7 MPR layout

The MPR layout provides fused MPR images, mixed 2D axial images, and the Kidney Stones Parameter diagram supporting you in classifying the kidney stones.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4: diagram
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

8.8 Side-by-Side layout

The **Side-by-Side** layout provides coronal and axial MPR images.

The mixed MPR images combine the information of the low energy and high energy data sets. The overlay MPR images explicitly show the information extracted by the algorithms of the application class.

The segments display the following display types:

- Segment 1: mixed MPR coronal
- Segment 2: overlay MPR coronal
- Segment 3: mixed MPR axial
- Segment 4: overlay MPR axial
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

Some display functionalities are synchronized in the different segments.

8.9 Adapting the calculation parameters of the loaded data

In the Kidney Stones step you can change the calculation parameters of the loaded data.

1 Enter the resolution value in the **Resolution** field to adapt the range of the smoothing filter (in units of the pixel size).

Low resolution values are better for spatial resolution.

High resolution values are better for low contrast resolution.

2 Enter a threshold in the **Minimum [HU]** field to define the minimum HU value for mixed images.

As soon as the HU value of the mixed image is below this threshold, the overlay image is set to 0 HU and no calculation is performed.

3 Click the **Recalculate** icon to apply the new value to all images.

4 Click the **Default Parameters** icon to restore the default values that are predefined in the **Configuration Panel**.

8.10 Navigating through potential kidney stones

The **Kidney Stones Navigator** mini toolbar allows you to navigate between the views of potential kidney stones that were found during preprocessing. The mini toolbar is available in all segments that display fused MPR images.

1 In the respective segment, move the mouse pointer over the **Kidney Stones Navigator** watermark.

The **Kidney Stones Navigator** mini toolbar is displayed.

2 Click the **Navigate forward and view Kidney Stones [Alt+F]** icon to navigate to the next potential kidney stone.

3 Click the **Navigate backward and view Kidney Stones [Alt+B]** icon to navigate to the previous potential kidney stone.

4 Click the **Restart Kidney Stones Navigation** icon to navigate to the first potential kidney stone.

8.11 Kidney stone marker

Markers are used to confirm measures that have been identified as potential kidney stones. When you have set a marker, the following information is provided:

- Annotations are displayed next to the marker.

  (→ Page 69 *Kidney stone marker*)

- The measured position of the stone is displayed in the Kidney Stones Parameter diagram.
- A review finding is created containing a screenshot of the selected segment and the Kidney Stones Parameter diagram.

If you delete a kidney stone marker, you also delete the annotations and the related information in the Kidney Stone Parameter diagram and the **Findings Navigator**.

8.12 Kidney stone annotations

Annotations provide additional information about the marked potential kidney stones. They are only displayed if the marker was set on an area that was identified as potential kidney stone.

<n>	Name consisting of the abbreviation for kidney stone and a consecutive number
App	Application result volume identifier
CT-Value	CT values of stone on the low energy, high energy, and mixed images, corrected for partial volume effects
Ratio	Ratio of the low energy and high energy values. It is independent of the estimated **Precision**.
Volume	Calculated volume of the potential kidney stone (in mm^3 or cm^3)
Diameter	Calculated diameter of the long axis and the short axis of the potential kidney stone
Precision	Estimation of the reliability of the measured **CT-Value**, **Volume**, and **Diameter**. Depending on the spatial resolution, the size of the voxels, and the size of the stone, it can be high, medium, or low: ■ High: The dimensions of the potential kidney stone allow for reliable measurement results. ■ Medium: Due to the small size of the potential kidney stone, its measurement is difficult. The results might be incorrect. ■ Low: A reliable measurement is not possible.

8.13 Marking potential kidney stones

✓ The application class has identified potential kidney stones.

1 In the **Kidney Stone Navigator** mini toolbar, navigate to the potential kidney stone.

– or –

Scroll through the images to find the potential kidney stone manually.

2 In the **Kidney Stone Navigator** mini toolbar, click the **Set Kidney Stone Marker** icon to mark the potential kidney stone.

This works for identified kidney stones only.

– or –

From the upper right corner menu, choose **Kidney Stone Marker** and click the potential kidney stone.

The marker of the selected kidney stone and its annotations are displayed in yellow.

8 Kidney Stones application class

9 Liver VNC application class

The Liver VNC application class allows you to visualize the contrast agent concentration in the liver without an additional non-contrast scan, even if there are irregular fatty infiltrations or necrotic areas. The application class generates virtual non-contrast (VNC) images by subtracting iodine from the Dual Energy data sets. The VNC images can be used for baseline density measurements.

The main requirement for a single source Dual Energy scan is to perform late phase liver scans with a delay of more than 75 s after the start of the contrast agent injection. In this late phase, the iodine concentration in the liver is stable enough to avoid significant changes between the two spiral scans.

Be aware that for optimal postprocessing, patient motion should be avoided during and in between the low and high energy scan.

For the same data set, the Monoenergetic mode of General Viewing allows you to interactively adapt the CT values of calcium and iodine.

Before working with this application class, perform a standard diagnosis with the General Viewing tools in the Case Navigator.

9.1 Liver VNC scan requirements

If you perform a single source Dual Energy scan for an evaluation with Liver VNC, the scan must meet the following requirements:

- The scan is performed with the scan protocol DE_Abdomen_LiverVNC_late or a scan protocol derived from it.
- The first scan starts in a venous phase at least 75 s after the start of the contrast agent injection.
- The contrast agent injection does not take longer than 45 s.

9.2 Artifacts in VNC images

Although the quality of the liver displayed in the VNC images meets your expectations, two typical artifacts in other organs might occur:

- The organs are very bright in the VNC images because of a sudden increase of the iodine concentration.
- There are indefinable black areas in the VNC images because of a sudden decrease of the iodine concentration.

Do not evaluate organs that show these artifacts. Use instead the mixed images for the evaluation of these organs. If necessary, confirm the evaluation with an additional non-contrast scan at a later point in time.

9.3 Liver VNC image types

The **Liver VNC** application class provides the following image types:

- Mixed images

  (→ Page 21 *Mixed image*)
- Virtual non-contrast images

  (→ Page 22 *Virtual non-contrast image*)
- Iodine overlay images

  (→ Page 22 *Iodine overlay image*)
- Fused images

  (→ Page 22 *Fused image*)
- Fat map

  (→ Page 74 *Fat map*)

9.3.1 Fat map

The fat map can be evaluated for contrast enhanced CT-scans as well as for non-contrast scans. It is obtained from the VNC image, by linear rescaling and applying a weak noise reduction filter.

The base material *soft tissue* corresponds to 0 % fat. The base material *fat* corresponds to 100 % fat. The Dual Energy configuration can be used to refine this calibration.

The fat map uses a specific color lookup table. The default settings and water and liver with more than 30 % fat content are shown in grey; since fatty livers with less than 10 HU in the non-contrast image are rare.

In addition to the configured text, all ROI tools will also show the fat content in this layout.

The following limitations are known:

- The displayed fat content is only valid for liver. It is not valid for any other organs.
- The displayed fat content is not correct for tumors, metastases, necrotic tissue, bile ducts, gall bladder, macroscopic vessels or cysts in the liver.
- The displayed fat content is not correct for accumulations of fluids or calcifications.
- For comparison with other methods, the fat content in % may have to be rescaled with an appropriate proportionality factor.

9.4 MPR/VNC layout

This layout is the default layout of the **Liver VNC** application class. It displays fused MPR images and mixed 2D axial images.

The fused images combine the information of the virtual non-contrast (VNC) and overlay data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial

- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: blank
- Segment 5: mixed 2D axial

9.5 MPR/Mixed layout

This layout offers fused MPR images and mixed 2D axial images.

The fused images combine the information of the mixed MPR and overlay data sets. The mixed MPR images combine the information of the low energy and high energy data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: blank
- Segment 5: mixed 2D axial

9.6 Side-by-Side layout

The **Side-by-Side** layout provides mixed MPR, VNC MPR, and mixed 2D axial images.

The mixed MPR images combine the information of the low energy and high energy data sets.

The segments display the following display types:

- Segment 1: mixed MPR coronal
- Segment 2: VNC MPR coronal
- Segment 3: mixed MPR axial

- Segment 4: VNC MPR axial
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

Some display functionalities are synchronized in the different segments.

9.7 Fat Map layout

This layout offers fused MPR images and mixed 2D axial images. The fused images combine the information of the mixed MPR and fat map data sets. The mixed MPR images combine the information of the low energy and high energy data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: blank
- Segment 5: mixed 2D axial

9.8 Adapting the calculation parameters of the loaded data

In the Liver VNC step, you can change the calculation parameters of the loaded data.

1 Enter the resolution value in the **Resolution** field to adapt the range of the smoothing filter (in units of the pixel size).

  Low resolution values are better for spatial resolution.

  High resolution values are better for low contrast resolution.

2 Enter a threshold in the **Maximum [HU]** field to remove all voxels in mixed images that are above this value.

3 Enter a value in the **Iodine Ratio** field to change the ratio of contrast and enhancement to low energy and high energy.

4 Click the **Recalculate** icon to apply the new value to all images.

5 Click the **Default Parameters** icon to restore the default values that are predefined in the **Configuration Panel**.

9.9 Calculating and archiving a fat map

✓ The data contains liver.

1 In the Case Navigator, click the **Layout** icon.

2 Select the **Fat Map** layout.

The fat map is calculated.

3 In the Case Navigator, click the **Store displayed result images in syngo.via** button to create a report and publish the fat map to the STS.

4 In the Case Navigator, click the **Mark displayed result images as ready for archiving** button to send the fat map to the default archive.

It is not possible to archive the fat map automatically, for example by changing the configuration.

10 Gout application class

The Gout application class images allow you to distinguish between urate, bone, bone marrow, and contrast agent. Urate and contrast agent are highlighted with different colors.

10.1 Gout image types

The **Gout** application class provides the following image types:

- Mixed images

  (→ Page 21 *Mixed image*)

- Fused images

  (→ Page 22 *Fused image*)

- Overlay images

  (→ Page 22 *Iodine overlay image*)

10.1.1 Overlay images

The overlay image supports you in distinguishing urate, bone, and iodine from each other. Potential urate is displayed in green and iodine in purple, by default.

It may be necessary to change the windowing width of the overlay image to get iodine displayed in purple.

The overlay image is based on a calculation of:

- The low energy and the high energy value of the CT images
- The reference values of the low energy and the high energy value of soft tissue

  They are defined by the **Gout** application class and can be changed in the **Configuration Panel**.
- The ratio that is optimized by default for a differentiation between urate and contrast agent or bone

The CT values of an overlay image are calculated according to the following formula:

$x = ((x_{low} - o_{low}) \div (x_{high} - o_{high}) - ratio) \cdot 100\ HU$

x: CT value (HU) in overlay image

x_{low}: CT value (HU) in low energy image

o_{low}: configured CT value of soft tissue (HU) in low energy image

x_{high}: CT value (HU) in high energy image

o_{high}: configured CT value of soft tissue (HU) in high energy image

ratio: configured **Ratio** parameter

Changing the calculation parameters usually reduces the image quality.

10.2 VRT layout

This layout is the default layout of the **Gout** application class. It displays fused MPR images and mixed 2D axial images.

The fused images combine the information of the mixed and overlay data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial

- Segment 4:
  - Single monitor configuration: VRT mixed coronal
  - Dual monitor configuration: mixed 2D axial
- Segment 5: VRT mixed coronal

10.3 2D layout

This layout displays fused MPR images and mixed 2D axial images.

The fused images combine the information of the mixed and overlay data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: VRT mixed coronal
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

10.4 Side-by-Side layout

The **Side-by-Side** layout provides mixed MPR and VRT images.

The mixed MPR images combine the information of the low energy and high energy data sets.

The segments display the following display types:

- Segment 1: mixed MPR coronal
- Segment 2: overlay MPR coronal
- Segment 3: mixed MPR axial
- Segment 4: overlay MPR axial
- Segment 5: mixed VRT coronal

Some display functionalities are synchronized in the different segments.

10.5 Adapting the calculation parameters of the loaded data

In the Gout step you can change the calculation parameters of the loaded data.

1 Enter the resolution value in the **Resolution** field to adapt the range of the smoothing filter (in units of the pixel size).

Low resolution values are better for spatial resolution.

High resolution values are better for low contrast resolution.

2 Enter a threshold in the **Minimum [HU]** field to define the minimum HU value for mixed images. As soon as the HU value of the mixed image is below this threshold, the overlay image is set to 0 HU and no calculation is performed.

3 Enter a value in the **Iodine Ratio** field so that the overlay image is positive for the majority of the contrast agent and bone voxels and negative for the majority of the urate voxels (gout).

4 Set the value in the **Air Distance** field to zero to visualize potential urate that is close to air but not close to bone.

The value defines the size of a measurement volume between air (skin surface) and bone. It can be between 0 and 10 voxels. Within this distance to the skin surface, negative overlay values are set to 0 HU and are not visualized as potential urate but, only if the negative overlay value is not simultaneously located within the defined bone distance.

5 Click the **Recalculate** icon to apply the new value to all images.

6 Click the **Default Parameters** icon to restore the default values that are predefined in the **Configuration Panel**.

10.6 Negative overlay volume

The visible negative overlay volume V (<0) is displayed in the VRT segment of the **Gout** application class. The value in cm^3 is calculated by counting all voxels with negative values in the overlay image that are visible in the VRT. These voxels are displayed in green by default.

Voxels are excluded from the negative overlay volume calculation when they are not visible as a result of being masked by one of the following functions:

- **Clip Box**
- **Clip Plane**
- **Clip Slab**
- **Punch**
- **Table Removal**

The message **Table Removal!** is displayed instead of the negative overlay volume value, if the algorithm has identified a table in the image series but **Table Removal** is switched off. This is to avoid contamination by plastic parts outside the human body.

10 Gout application class

11 Rho/Z application class

With the **Rho/Z** application class you can measure electron density as well as effective atomic number and thus perform a basic characterization of the material of interest.

Before you start working with this application, you should have performed a standard diagnosis by using the General Viewing tools in the Case Navigator.

11.1 Rho/Z image types

The **Rho/Z** application class provides the following image types:

- Mixed images

  (→ Page 21 *Mixed image*)

- Fused images

  (→ Page 22 *Fused image*)

- Electron density image

  (→ Page 85 *Electron density image*)

- Effective atomic number image

  (→ Page 86 *Effective atomic number image*)

11.1.1 Electron density image

The electron density image shows the electron density relative to water by using the Hounsfield Unit (HU) scale. This means that air receives a value of -1000 HU and water receives a value of 0 HU. The electron density of bone (measured in HU) is substantially lower than the CT-values of bone in standard CT-images.

By default, the electron density image is shown in grey scale.

Limitations:

- This image type is only valid for natural body materials such as fat, soft tissue or bone. Results for materials with higher atomic number and especially contrast agent may not be correct.
- This image type is not valid if there are obvious image artifacts in the original images such as metal artifacts.

11.1.2 Effective atomic number image

The effective atomic number image shows the effective atomic number in units of **1**. For pure chemical elements, the effective atomic number is equal to the real atomic number.

For mixtures of chemical elements, the following equation is used to calculate the effective atomic number:

$$Z_{eff} = \left(\frac{\sum_i n_i Z_i^{n+1}}{\sum_i n_i Z_i} \right)^{1/n}$$

n_i: number density of atom type i

Z_i: atomic number of atom type i

n: recommended value 3.1

By default, the effective atomic number is shown as colored overlay image.

Limitations:

- This image type is only valid for natural body materials such as fat, soft tissue or bone. Results for materials with higher atomic number and especially contrast agent may not be correct.
- This image type is not valid if there are obvious image artifacts in the original images such as metal artifacts.

The effective atomic number is displayed using the Pixel Lens tool.

11.2 Side-by-Side layout

The segments display the following display types:

- Segment 1: Rho MPR coronal
- Segment 2: Z MPR coronal
- Segment 3: Rho MPR axial
- Segment 4: Z MPR axial
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

Some display functionalities are synchronized in the different segments.

11.3 Side-by-Side Mixed layout

The segments display the following display types:

- Segment 1: Mixed MPR coronal
- Segment 2: Rho MPR coronal
- Segment 3: Mixed MPR axial
- Segment 4: Rho MPR axial
- Segment 5: mixed 2D axial (only available in dual monitor configuration)

Some display functionalities are synchronized in the different segments.

11.4 Adapting the calculation parameters of the loaded data

In the Rho/Z step you can change the calculation parameters of the loaded data.

1 Enter the resolution value in the **Resolution** field to adapt the range of the smoothing filter (in units of the pixel size).

Low resolution values are better for spatial resolution.

High resolution values are better for low contrast resolution.

2 Enter a threshold in the **Minimum [HU]** field to define the minimum HU value for mixed images.

As soon as the HU value of the mixed image is below this threshold, the mixed image is displayed instead of the electron density image and the effective atomic number is set to zero. No calculation is performed.

3 Enter a threshold in the **Maximum [HU]** field to define the maximum HU value for mixed images.

As soon as the HU value of the mixed image is above this threshold, the mixed image is displayed instead of the electron density image and the effective atomic number is set to zero. No calculation is performed.

All voxels containing iodine should be below the maximum value.

4 Click the **Recalculate** icon to apply the new value to all images.

5 Click the **Default Parameters** icon to restore the default values that are predefined in the **Configuration Panel**.

12 Bone Marrow application class

The **Bone Marrow** application class allows you to visualize the bone marrow composition which is based on non-enhanced CT data. The application class generates virtual non-calcium (VNCa) images by subtracting calcium from the Dual Energy data sets.

Before working with this application class, perform a standard diagnosis with the General Viewing tools in the Case Navigator.

12.1 Limitations of the Bone Marrow application class

Increased CT-values in the **Bone Marrow** application class image do not always indicate pathology because of the variability of marrow composition in the human body, consideration should therefore be made to patient age, body part and relevant clinical history such as anemia.

12.2 Bone Marrow image types

The **Bone Marrow** application class provides the following image types:

- Mixed images

  (→ Page 21 *Mixed image*)

- Fused images

  (→ Page 22 *Fused image*)

- Overlay images

  (→ Page 90 *Overlay image*)

12.2.1 Overlay image

The overlay image is a mixed image with subtracted calcium and, for example, can make bone bruises visible. It displays the bone marrow CT value in the mixed image in Hounsfield units. The Dual Energy algorithms perform this calcium subtraction by applying a base material decomposition during preprocessing.

With the **Mixing Ratio** mini toolbar, you can control the composition of the displayed fused images. Depending on the slider position, either more CT data or more overlay data is displayed.

12.3 MPR/VRT layout

This layout is the default layout of the **Bone Marrow** application class. It displays fused MPR images and mixed 2D axial images.

The fused images combine the information of the mixed images and the bone marrow images.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: VRT mixed coronal
  - Dual monitor configuration: mixed 2D axial
- Segment 5: VRT mixed coronal

12.4 MPR/2D layout

This layout offers fused MPR images and mixed 2D axial images.

The fused images combine the information of the mixed MPR and overlay data sets. The mixed MPR images combine the information of the low energy and high energy data sets.

The segments display the following display types:

- Segment 1: fused MPR sagittal
- Segment 2: fused MPR coronal
- Segment 3: fused MPR axial
- Segment 4:
  - Single monitor configuration: mixed 2D axial
  - Dual monitor configuration: VRT mixed coronal
- Segment 5: mixed 2D axial

12.5 Adapting the calculation parameters of the loaded data

In the Bone Marrow step, you can change the calculation parameters of the loaded data.

1 Enter the resolution value in the **Resolution** field to adapt the range of the smoothing filter (in units of the pixel size).

Low resolution values are better for spatial resolution.

High resolution values are better for large, compact bones.

2 Enter a threshold in the **Maximum [HU]** field to exclude all voxels with higher CT-values in the mixed image from analysis.

3 Enter a lower value in the **Bone Threshold** field if the bone marrow segmentation does not provide proper results.

4 Click the **Recalculate** icon to apply the new value to all images.

5 Click the **Default Parameters** icon to restore the default values that are predefined in the **Configuration Panel**.

12 Bone Marrow application class

13 Documenting results

In **CT Dual Energy**, you can use common Viewer tools, such as markers and ROI measurements, to document your examination results. Generated ranges allow you for a selection of images displaying the regions of interest only.

All review results are listed in the **Findings Navigator**.

13.1 Functionality of *syngo*.via

syngo.via is a software solution intended to be used for viewing, manipulation, communication, and storage of medical images. It can be used as a stand-alone device or together with a variety of cleared and unmodified *syngo* based software options. The functionality of the *syngo*.via software that is used in combination with a *syngo*.CT medical device is described in the *syngo*.via Basic Operator Manual. The *syngo*.via Basic Operator Manual and the *syngo*.via Administrator Manual are the Instructions for Use of *syngo*.via.

Caution

Not observing the Instructions for Use of the software and its applications!

Wrong basis for diagnosis.

- Always use this Instructions for Use in conjunction with all Instructions for Use provided.
- Follow the safety instructions.

13.2 Loading patient data into the Viewer

1 In the **Result list** of the **Patient Browser**, select the corresponding study.

2 To open the study with the assigned workflow, click the **Open** icon.

When you open a study that has no workflow assigned, a default workflow is assigned and the workflow is started.

– or –

To assign another workflow to the study before opening, click the **Open with** icon and select the appropriate workflow.

The Patient tab is opened, the workflow is started, and the images are loaded into the Viewer.

If you re-open a workflow, the workflow will be displayed in the previous user's view. Ensure that the segments are displaying the data you expect

If the image area remains empty after loading:

- The workflow assignment may not match. Use the **Series Navigator** to drop data into the image area.
- The default layout may not match. Select another layout.

13.3 Generating ranges of fused images

In general, the procedure used for generating ranges of fused images is similar to the generating procedure of other image volumes. The only difference is the possibility to choose between different image volumes with which the range is generated.

See the *syngo*.via documentation for information on the standard procedure.

✓ A fused image is selected.

1 From the upper left corner menu, choose **Ranges Tools**.

The **Parallel Ranges** segment is displayed.

2 Click the **Fusion** tab.

3 From the **Fusion** list, select **Dataset 1**.

Only grayscale images of the first image volume are generated.

– or –

Choose **Dataset 2**.

Only grayscale images of the second image volume are generated.

– or –

Choose **Dataset 1+2**.

Colored fused images of both image volumes are generated.

The result images cannot be used for measurements or windowing.

4 Click the **Start** icon.

5 Save or reject the result images according to the standard procedure used for generating ranges.

13.4 Marking structures of interest

You can use markers for quickly marking and viewing structures of interest.

1 From the upper right corner menu, choose **Marker**.

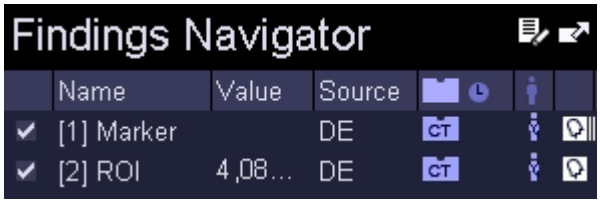
2 In the image, click the structure of interest.

A cross hair marker is displayed in the image. The marker label consists of a consecutive number and the default annotation text.

3 Double-click the annotation text of a marker and edit the annotation according to your needs.

4 Press **Return** to confirm your entry.

The findings are listed in the **Findings Navigator**. Additionally, one snapshot image is saved for each finding. You can inspect these in the Image Gallery of the **Findings details** window.



5 To delete a marker, right-click the label of a marker.

6 From the context menu, choose **Delete Measurement**.

You can display a finding in the viewing area by clicking the finding in the **Findings Navigator**.

13.5 Reviewing findings

In the **Findings Navigator**, you can use findings as bookmarks. Findings made in the currently loaded series can be reviewed and edited in the current layout, application, or workflow step. As a precondition, the original data has to be available.

- In the **Findings Navigator**, click a finding to focus the segments to the position of the finding.

  – or –

  In the **Findings Navigator**, double-click a finding to open it in the application or workflow step in which the finding was created.

  – or –

  In the **Findings Navigator**, double-click the image icon of a finding to review the snapshot image in a floating window.

13.6 Adding snapshot images

In addition to the automatically saved snapshot image that is created with a finding, you can add one or more snapshot images to a finding.

1 Select a segment.

2 In the **Findings Navigator**, select a finding.

3 In the Common Tools area, click the **Add Snapshots to Active Finding** icon.

The snapshot image is added to the finding. You can inspect it in the Image Gallery of the **Findings details** window.

13.7 Findings details

At any time, you can check the findings in the **Findings details** window.

The **Findings details** window provides different tabs, which contain the following information:

- **General Viewing**: This tab refers to findings created in the general viewing mode.

  It contains the following subordinate tabs:

  – The **Findings** tab provides the findings and their related measurements. Additionally, the assigned snapshots are displayed.

  – The **Evaluation** tab displays additional parameters, for example, the iodine concentration. This tab is application-specific. The additional parameters are only available after a lung analysis has been performed.

- Application tabs: For each application of the currently selected application profile with at least one dedicated finding, a tab is displayed. Like the **General Viewing** tab, each application tab provides the **Findings** and **Evaluation** tabs.

- **DE Parameters**: This tab shows the values of the parameter sets that were used to generate the current results. The parameter sets displayed depend on the available application profile and viewing modes.

Though visible on the **Findings** tabs, locations are not available in this version of *syngo*.CT Dual Energy.

13.7.1 Checking images in the Findings details window

1 In the **Findings Navigator**, click the **Finding Details** icon.

  The **Findings details** window is displayed.

2 Press **Ctrl + A** to select all findings and their data.

3 Press **Ctrl + C** to copy the finding of the selected row and its data to the window clipboard.

4 Press **Del** to delete the finding of the selected row and its data.

13.7.2 Preparing the report generation

If there are findings or screenshots that you do not want to include in the report, clear the respective check boxes on the **Findings** tabs.

1 Clear the check boxes in the **R** (Add to Report) column of the table apply to include the findings in the report.

2 Clear the **Add to report** check boxes below the screenshots apply to include the screenshots in the report.

3 In the **Summary** field, enter a text.

All changes in the **Findings details** window are saved automatically. You can close it at any time.

13.8 Sharing and archiving of result images

You can send data to the Series Navigator and additionally to the archive.

13.8.1 Sending data to the Series Navigator

1 In the Case Navigator, click the **Store displayed result images in syngo.via** icon.

The current status of the data is sent to the Series Navigator.

2 As soon as the data is listed in the Series Navigator, drag it into another workflow step for ongoing evaluations.

This data is temporarily. If you complete the workflow the data is archived according to the configured archiving settings.

13.8.2 Marking series for archiving

✓ You have finished the reading and the results shall be archived but also be available in the Series Navigator for ongoing evaluations in another workflow.

- In the Case Navigator, click the **Mark displayed result images as ready for archiving** icon.

  The current status of the data is sent to the Series Navigator and additionally marked for archiving.

  The configured archiving settings do not apply to this data.

13.8.3 Displaying the archiving information

- In the Case Navigator, click the **Archiving information** icon.

  The **Current Archiving State** window lists all data that is archived when completing the workflow.

13.9 Generating the report

✓ Findings are available in the **Findings Navigator**.

1 In the **Findings Navigator**, select the findings, which you want to describe in the report.

2 In the **Patient Tab** list, click the **Report Editor** icon.

  The **Report Editor** opens with a report template, which matches the current workflow. All finding data are automatically imported.

If the default report template, which is assigned to the current workflow, does not match your needs, you can switch the report template.

3 Customize your report.

4 To store a report and to schedule it for archiving, click the **Save and Send** icon.

In the **Reporting Configuration**, the administrator configures the **Settings** for report distribution.

– or –

To just save a report, click the **Save** icon.

The report will be saved, but it will not be distributed.

– or –

In the **Close Patient** dialog, click the **Discard Changes** icon to discard all changes and to close the active patient.

The report is saved automatically. You can complete the saved report.

5 To end report editing, click the **Close** button on the top right of the floating window.

Depending on license and settings, reports are automatically stored in the STS as a DICOM encapsulated PDF or as a Secondary Capture as soon as the workflow status is set to *Completed*. In the **Reporting Configuration**, report storage can also be disabled.

13.10 Closing the workflow

To close the workflow, you can save and send, save, and discard the work item. Save and send the work item if the evaluation is completed and the results can be published. Save the work item if the evaluation has to be continued later, for example, by a colleague, or if a supervisor has to cross-check the results. Discard the work item if you want to restore its original status.

13.10.1 Completing a workflow

When you complete a workflow, the workflow is closed and all unsaved results are saved in the Short Term Storage (STS). The results are sent to the configured archive.

The result series are saved as DICOM series. If you open the workflow again, the result series will be displayed in the **Current**, **Later** or **Prior** section of the **Series Navigator**.

✓ A workflow has been started and images are loaded in the Viewer.

- Click the **Save and Send** icon.

  The workflow is closed.

  In the **Result list** of the **Patient Browser**, the state of the workflow is set to **Completed**.

In case of an error, after 15 minutes, all storable results are saved and the workflow is set to **Completed**.

The error is reported in the log file.

13.10.2 Saving a workflow

When you save a workflow, the workflow is closed and all unsaved results are saved in the Short Term Storage (STS).

All result series in the **Results** section of the **Series Navigator** will remain in this section upon re-opening the study.

✓ A workflow has been started and images are loaded in the Viewer.

- Click the **Save** icon.

  The workflow is closed.

  In the **Result list** of the **Patient Browser**, the state of the workflow is set to **Saved**.

13.10.3 Discarding a workflow

When you discard a workflow, the workflow is closed, and all unsaved results are lost.

✓ A workflow has been started and images are loaded in the Viewer.

1 In the Patient tab, click the **X** icon to open the **Close Patient** dialog box.

  Click **Discard Changes**.

2 Confirm the message.

The workflow is closed and unsaved results are lost.

In the **Result** list of the **Patient Browser**, the state of the workflow stays unchanged (**Ready** or **Scheduled**).

14 Configuration of CT Dual Energy

CT Dual Energy provides predefined application profiles, application classes, and application subclasses.

- Application subclass

  An application subclass is a specific set of parameters and algorithms.

- Application class

  An application class contains one or more application subclasses for a certain diagnostic task. One application class can be assigned to different workflows and body regions.

- Application profile

  An application profile defines which **CT Dual Energy** application classes are performed in one particular workflow depending on the body region and contrast agent status.

A modification of the configured values requires **CT Dual Energy** administrator rights. If the configuration does not fit your needs, contact your **CT Dual Energy** administrator. Consider that the modified configuration will affect all users.

14.1 Default assignments of the application classes

By default, the **CT Dual Energy** application classes are assigned to different body regions. The following overview summarizes these default assignments for the **CT Dual Energy** workflow.

Liver VNC	The **Liver VNC** application class is assigned to the following body region: ■ **Abdomen** The application class is listed in the **With CM** tab since it requires and evaluates contrast enhanced CT data.
Brain Hemorrhage	The **Brain Hemorrhage** application class is assigned to the following body regions: ■ **Head** ■ **Neck** ■ **Skull** For **Head**, the application class is listed in the **With CM** tab and in the **Without CM** tab since it evaluates contrast enhanced and non-enhanced CT data. For **Neck** and **Skull**, the application class is listed in the **With CM** tab since it requires and evaluates contrast enhanced CT data.
Kidney Stones	The **Kidney Stones** application class is assigned to the following body region: ■ **Abdomen** The application class is listed in the **Without CM** tab since it requires, and evaluates, non-enhanced CT data.

Gout	The **Gout** application class is assigned to the following body regions of the **CT Dual Energy** workflow: ■ **Ankle** ■ **Arm** ■ **Elbow** ■ **Extremity** ■ **Foot** ■ **Hand** ■ **Knee** ■ **Leg** The application class is listed in the **Without CM** tab since it requires, and evaluates, non-enhanced CT data.
Rho/Z	The **Rho/Z** application class is assigned to the following body regions of the **CT Dual Energy** workflow: ■ **Special** The application class is listed in the **With CM** tab and in the **Without CM** tab since it evaluates contrast enhanced and non-enhanced CT data.

Monoenergetic Plus	The **Monoenergetic Plus** application class is assigned to the following body regions in the **With CM** tab: ■ **Heart** ■ **Hip** ■ **Spine** ■ **C-Spine** ■ **L-Spine** ■ **S-Spine** ■ **T-Spine** ■ **Pelvis** ■ **Shoulder** The **Monoenergetic Plus** application class is assigned to the following body regions in the **Without CM** tab: ■ **Chest** ■ **Neck** ■ **Spine** ■ **C-Spine** ■ **L-Spine** ■ **S-Spine** ■ **T-Spine** ■ **Hip** ■ **Pelvis** ■ **Shoulder**

Bone Marrow	The **Bone Marrow** application class is assigned to the following body regions: ■ **Abdomen** ■ **Extremity** ■ **Foot** ■ **Knee** ■ **Leg** ■ **Pelvis** ■ **Shoulder** The application class is listed in the **Without CM** tab since it requires, and evaluates, non-enhanced CT data.

14.2 Opening the CT Dual Energy configuration

You can configure **CT Dual Energy** in two tabs of the **Configuration Panel**: the **Application Profiles** tab and the **Application Classes** tab.

1 In the Access Bar, move the mouse pointer over the wrench icon.

2 From the menu, choose **Configuration Panel**.

The **Configuration Panel** opens.

3 Click the **Reading** tab.

4 On the **Reading** tab, choose the **CT Dual Energy Configuration** blind.

5 Click the **Application Profiles** tab if you want to modify the application assignments and to adapt them to the workflows and body regions of your choice.

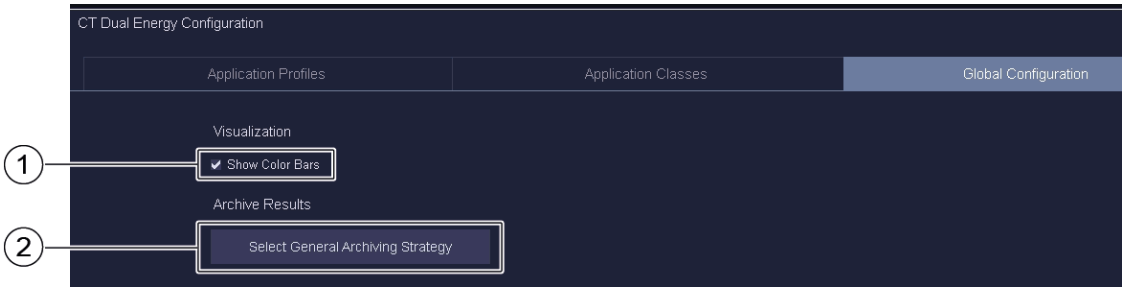
– or –

Click the **Application Classes** tab if you want to define the parameters and settings of the application classes.

– or –

Click the **Global Configuration** tab if you want to switch on or off the display of the color bar or to select the archiving mode as a general setting.

14.3 Global Configuration tab

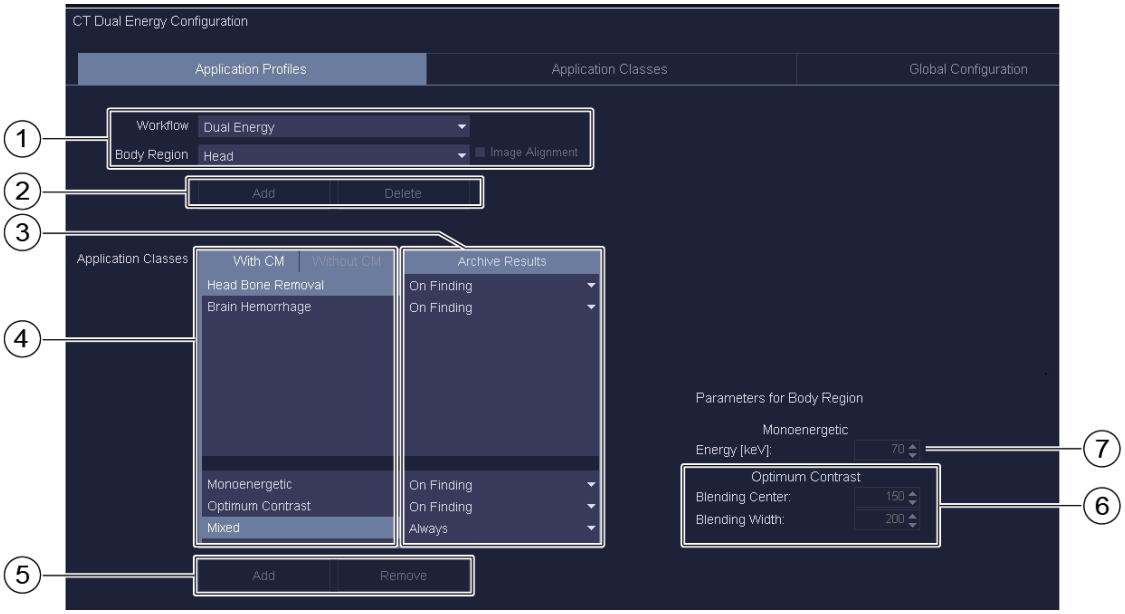


The settings of the **Global Configuration** tab apply for the complete Dual Energy workflow, including all body regions, application classes, and application subclasses.

(1)	**Show Color Bars**	Displays the color bar in all fused images after loading the data.

(2)	**Select General Archiving Strategy**	Opens the **General Archiving Strategy** dialog box to specify the global archiving strategy for the resulting images of the application classes. You can specify the archiving strategy for each application class individually on the **Application Profile** tab. *Note: When changing the general archiving mode, you instantly reset all archiving settings previously set for single application classes or mixed images.* The following archiving modes are available: ■ **Always** All images are sent to the archive. ■ **Never** No images are sent to the archive. ■ **On Finding** Only images with a marked finding are sent to the archive. ■ **Always for single source** Only mixed images based on single source data are sent to the archive. This option is only available for mixed images.

14.4 Application Profile window



(1)	**Workflow**	Specifies the workflow
	Body Region	Specifies the body region Note: The term “Body Region” of Dual Energy is identical to the term “Body part examined” of the scanner software and the corresponding DICOM tag “Body Part Examined”.
	Image alignment	If the Image Alignment is selected, motion artifacts can be reduced. During the preprocessing, images that were scanned with the smaller FoV are aligned with the corresponding images scanned with the bigger FoV. This setting is recommended for heart and chest evaluations.

(2)	**Add**	Opens the **Add A New Body Region** dialog box to create a new Body Region.
	Delete	Deletes the selected Body Region from the **Body Region** list. If the **Delete** button is dimmed, the selected body region is a predefined body region. You cannot delete predefined body regions.
(3)	**Archive Results** column	Specifies, whether the resulting images of the application class are archived. The following archiving modes are available: ■ **Always** All images are sent to the archive. ■ **Never** No images are sent to the archive. ■ **On Finding** Only images with a marked finding are sent to the archive. ■ **Always for single source** Only mixed images based on single source data are sent to the archive. This option is only available for mixed images.
(4)	**Application Classes** column	Lists all application classes for the selected workflow and body region. ■ **With CM** (with contrast media) These application classes require enhanced CT data Dual Energy can only assign data to an application class that is listed in the **With CM** tab if the injection of contrast agent was added to the scan protocol during the scan preparation. ■ **Without CM** (without contrast media) These application classes require non-enhanced CT data
(5)	**Add**	Opens the **Add A New Application Class** dialog box to add an application class from a predefined list of application classes.
	Remove	Removes the application class from the **Application Classes** column

(6)	**Blending Center**	Specifies the default windowing settings for the **Optimum Contrast** viewing mode
	Blending Width	
(7)	**Energy [keV]**	Specifies the default energy value for the **Monoenergetic** viewing mode and the **Monoenergetic Plus** application class

14.4.1 Configuring application profiles

An application profile defines which **CT Dual Energy** application classes are performed in one particular workflow depending on the body region and the contrast agent status.

You can configure application profiles for the **CT Dual Energy** workflow but also for every other workflow that evaluates Dual Energy data during the preprocessing.

If application classes provided by Siemens are not assigned to any body region, the information window **The following application(s) are not assigned to body regions** is displayed. It lists all available, but not assigned Siemens application classes.

✓ The **Application Profiles** tab is open (**Configuration Panel** > **Reading** tab > **CT Dual Energy Configuration** blind).

1 Select the workflow and body region you want to modify.

2 If required, select the **Image Alignment** check box.

This setting is recommended for heart and chest evaluations.

3 On the **With CM** or **Without CM** tab add or remove application classes.

4 On the **With CM** and **Without CM** tab select the archiving mode for the application classes.

After completing the reading, the archiving is performed according to the selected archiving mode.

The archiving of all image types, series, or result images that the **CT Dual Energy** workflow provides may result in an unexpected high amount of data.

5 Specify the default energy settings for the **Monoenergetic** viewing mode and the **Monoenergetic Plus** application class.

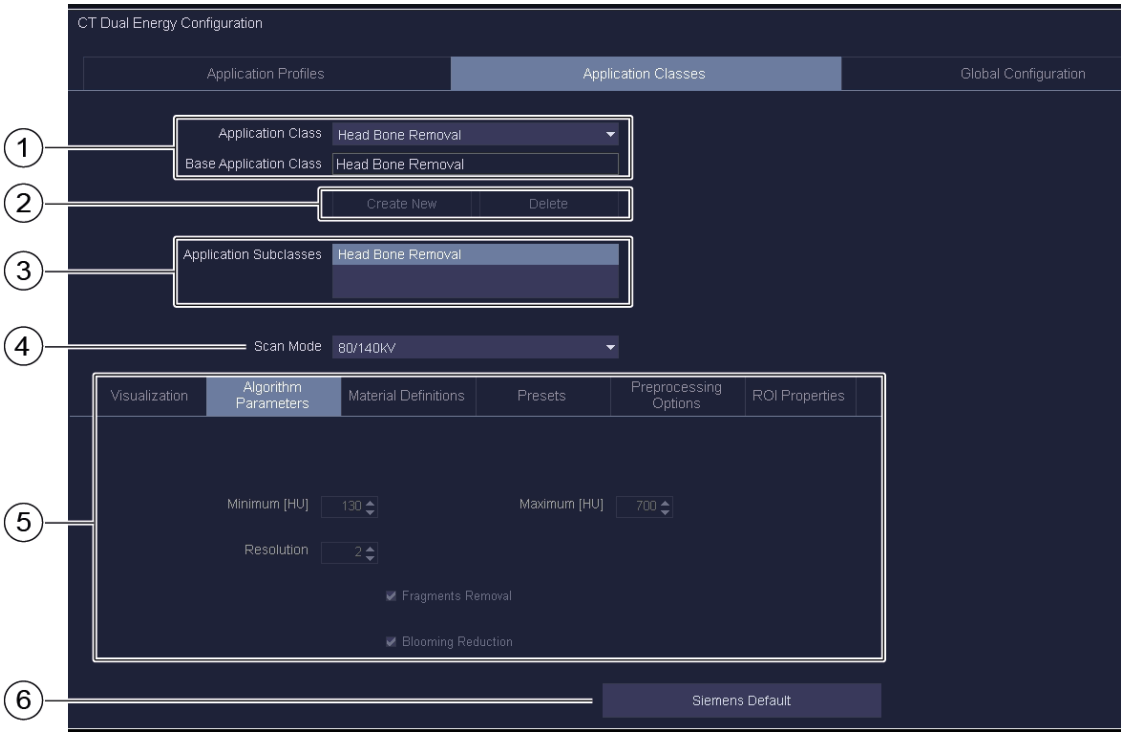
6 Specify the default windowing settings for the **Optimum contrast** viewing mode.

7 Click the **Apply** button.

– or –

Click **OK** to apply your changes and to close the **Configuration Panel**.

14.5 Application Classes window



(1)	**Application Class**	Specifies the current application class to be edited
	Base Application Class	Displays the application class the currently selected application class is derived from

(2)	**Create New**	Opens the **Create a New Application Class** dialog box to create a new user-defined application class The new application class is derived from the selected application class.
	Delete	Deletes the selected application class If the **Delete** button is dimmed, the selected base application class is a predefined application class. You cannot delete predefined application classes.
(3)	**Application Subclass**	Lists all application subclasses for the selected application class Specifies the application subclass to be edited
(4)	**Scan Mode**	Specifies the scan mode to be edited The scan mode dependent application class parameters are displayed accordingly.
(5)	Parameter tabs	Parameter tabs for the selected combination of **Application Class**, **Application Subclasses**, and **Scan mode**. *Note: Adapting the parameters for the selected scan mode affects the parameters for all other scan modes of the application subclass: the values are calculated for these scan modes accordingly.* For detailed information on the parameters, see the corresponding descriptions of the application classes.
(6)	**Siemens Default**	Resets all parameters that were modified in the selected application subclass to the default parameters

14.5.1 Configuring application classes

You can modify the parameters of the application class that will modify the application.

If you change the parameters of an application class, all workflows that are assigned to this application class are affected by this change.

If you want to try a new parameter set, create first a new application class for test purposes and modify then the appropriate application subclass.

✓ The **Application Classes** tab is open (**Configuration Panel** > **Reading** tab > **CT Dual Energy Configuration** blind).

1 Close patient data that use this application class with the **Cancel workflow for manual remapping** icon to make sure that the new parameters are used for the currently active workflows.

2 In the **Application Class** list of the **Application Classes** tab, select the application class.

If required, you can create a new application class. This application class is derived from the selected application class.

3 In the **Application Subclasses** list, select the application subclass you want to modify.

4 From the **Scan Mode** list, select the kV combination for which the configuration should be modified.

One voltage combination can be listed with different names and parameters for different scanner systems.

5 Modify the parameters of the **Visualization**, **Algorithm Parameters**, **Material Definitions**, **Presets**, **Preprocessing Options**, or **ROI Properties** tab according to your needs.

All edited parameters are automatically transferred to the other scan modes.

At any time, you can reset the default parameters of all parameters that were modified in the selected application subclass by clicking the **Siemens Default** button.

6 Click the **Apply** button.

– or –

Click **OK** to apply your changes and to close the **Configuration Panel**.

14.5.2 Recalculating with new application class parameters

The parameters for the data preprocessing are defined in the **Configuration Panel** but you can change some of these parameters and start a recalculation of the loaded data in the application class step. At any time, you can restore the default parameters.

Recalculation is an optional task that might help you in evaluating the data. You do not have to perform it for every reading.

1 In the application class step, change the parameters that you want to adapt.

– or –

Click the **Default Parameters** icon to set all changes to default.

2 Click the **Recalculate** icon to apply the changes.

All findings that were already marked are deleted.

3

Click the **Cancel** icon to stop a running recalculation.

The original parameters and images are restored.

14.5.3 Brain Hemorrhage parameters

In the **Configuration Panel** you can configure different parameters of the respective application class according to your needs. In the following, all tab cards, their function, and the displayed UI elements are described.

Tabs in the Configuration Panel	Description and UI elements
Presets	For this application class, the tab does not contain any parameters.

Tabs in the Configuration Panel	Description and UI elements	
Visualization	On the **Visualization** tab, you can choose between different color look-up tables for the CT and the overlay view and define the window of the displayed data.	
	Color Lookup Table	The selection lists offer predefined color combinations which are assigned to the displayed data. The setting in the left list is for the CT data, the setting in the right list for the overlay data.
	Window Value	The parameters **Center** and **Width** on the left define the window of the displayed CT data. The parameters **Center** and **Width** on the right define the window of the displayed overlay data.

Tabs in the Configuration Panel	Description and UI elements	
Algorithm Parameters	On the **Algorithm Parameters** tab, you can configure the algorithm parameters for **CT Dual Energy** preprocessing. You can change the parameters within certain limits according to your needs.	
	Minimum [HU]	Below the minimum HU value (mixed image), the overlay image is set to 0 HU and the mixed image information is displayed in the virtual non-contrast (VNC) image. This value should be below the HU value of water, including some noise tolerance.
	Maximum [HU]	Voxels above this threshold are displayed in the VNC image with a better resolution. All voxels containing iodine should be below the maximum HU value.
	Resolution	The resolution parameter is the range of the smoothing filter in units of pixel size. Spatial resolution improves with small values. Large values are better for low contrast resolution.
	CM Cutoff	Pixels below the specified HU value are set to zero in the overlay image.
	Resolution Enhancement	If selected, the resolution of the result images is enhanced. The calculation time is increased with this option.
	Organ Contour Enhancement	If selected, the organ contours in the overlay image are enhanced.

Tabs in the Configuration Panel	Description and UI elements	
Material Definitions	On the **Material Definitions** tab, you can configure the material parameters for **CT Dual Energy** preprocessing.	
	Hemorrhage	These parameters contain typical HU values for the respective kV values of hemorrhage.
	CSF	These parameters contain typical HU values for the respective kV values of cerebrospinal fluid.
	Rel. CM	This parameter contains the ratio of contrast enhancement at low energy and high energy that is used for the contrast agent.
	Iodine BHC	This parameter is used to activate the beam hardening correction for iodine contrast enhancement.
Preprocessing Options	With the **Minimum** and **Maximum** parameters, you define a slice thickness range. The selected application class will only be performed during the preprocessing if the slice thickness of the Dual Energy input data is within this range. Consider that this is only one loading criterion. *syngo*.via analyzes all available data sets and searches for the most suitable data set for all workflows that you can perform with this data. These parameters are only evaluated by **CT Dual Energy**. Other *syngo*.via workflows are triggered by the string #PP within the series name.	
ROI Properties	On the **ROI Properties** tab, you configure for each application class the information that a standard Dual Energy ROI label displays by default. These settings are workflow-specific. The **Evaluations** column lists all possible properties. In the **Volumes** column, you define for which volumes the properties are displayed. Regardless of these default settings, each user can configure own user-specific settings. User-specific settings are evaluated first. If no user-specific settings were configured, the label is displayed according to the **ROI Properties** tab settings.	

14.5.4 Kidney Stones parameters

In the **Configuration Panel** you can configure different parameters of the respective application class according to your needs. In the following, all tab cards, their function, and the displayed UI elements are described.

Tabs in the Configuration Panel	Description and UI elements	
Presets	From the **VRT Preset Selection** list, you can select a VRT which controls the initial color display in a VRT image.	
Visualization	On the **Visualization** tab, you can choose between different color look-up tables for the CT and the overlay view and define the window of the displayed data.	
	Color Lookup Table	The selection lists offer predefined color combinations which are assigned to the displayed data. The setting in the left list is for the CT data, the setting in the right list for the overlay data.
	Window Value	The parameters **Center** and **Width** on the left define the window of the displayed CT data. The parameters **Center** and **Width** on the right define the window of the displayed overlay data.
Algorithm Parameters	On the **Algorithm Parameters** tab, you can configure the algorithm parameters for **CT Dual Energy** preprocessing. You can change the parameters within certain limits according to your needs.	
	Minimum [HU]	Below the minimum HU value (mixed image), the overlay image is set to 0 HU and no calculation is performed.
	Maximum [HU]	This is the maximum HU value (mixed image) of kidney stones. Voxels above this threshold are set to 0 HU in the overlay image.
	Resolution	The resolution parameter is the range of the smoothing filter in units of pixel size. Spatial resolution improves with small values. Large values are better for large homogeneous stones.

Tabs in the Configuration Panel	Description and UI elements	
Material Definitions	On the **Material Definitions** tab, you can configure the material parameters for **CT Dual Energy** preprocessing.	
	Urine	These parameters contain typical HU values for the respective kV values of urine.
	Ratio	The value is optimized for the differentiation between uric acid and non uric acid kidney stones. You can change this value to differentiate between other kidney stone types.
Preprocessing Options	With the **Minimum** and **Maximum** parameters, you define a slice thickness range. The selected application class will only be performed during the preprocessing if the slice thickness of the Dual Energy input data is within this range. Consider that this is only one loading criterion. *syngo*.via analyzes all available data sets and searches for the most suitable data set for all workflows that you can perform with this data. These parameters are only evaluated by **CT Dual Energy**. Other *syngo*.via workflows are triggered by the string #PP within the series name.	
ROI Properties	On the **ROI Properties** tab, you configure for each application class the information that a standard Dual Energy ROI label displays by default. These settings are workflow-specific. The **Evaluations** column lists all possible properties. In the **Volumes** column, you define for which volumes the properties are displayed. Regardless of these default settings, each user can configure own user-specific settings. User-specific settings are evaluated first. If no user-specific settings were configured, the label is displayed according to the **ROI Properties** tab settings.	

14.5.5 Liver VNC parameters

In the **Configuration Panel** you can configure different parameters of the respective application class according to your needs. In the following, all tab cards, their function, and the displayed UI elements are described.

Tabs in the Configuration Panel	Description and UI elements	
Presets	For this application class, the tab does not contain any parameters.	
Visualization	On the **Visualization** tab, you can choose between different color look-up tables for the CT and the overlay view and define the window of the displayed data.	
	Color Lookup Table	The selection lists offer predefined color combinations which are assigned to the displayed data. The setting in the left list is for the CT data, the setting in the right list for the overlay data.
	Window Value	The parameters **Center** and **Width** on the left define the window of the displayed CT data. The parameters **Center** and **Width** on the right define the window of the displayed overlay data.

Tabs in the Configuration Panel	Description and UI elements	
Algorithm Parameters	On the **Algorithm Parameters** tab, you can configure the algorithm parameters for the calculation. You can change the parameters within certain limits according to your needs. Modify the parameters only in the following cases: ■ The image quality is not satisfactory, for example, the images are very noisy. ■ Different HU ranges are to be excluded.	
	Minimum [HU]	Below the minimum HU value (mixed image), the overlay image is set to 0 HU and the mixed image information is displayed in the virtual non-contrast (VNC) image. This value should be below the HU value of fat, including some noise tolerance.
	Maximum [HU]	Voxels above this threshold are displayed in the VNC image with a better resolution. All voxels containing iodine should be below the maximum HU value.
	Resolution	The resolution parameter is the range of the smoothing filter in units of pixel size. Spatial resolution improves with small values. Large values are better for low contrast resolution.
	CM Cutoff	Pixels below the specified HU value are set to zero in the overlay image.
	Resolution Enhancement	If selected, the resolution of the result images is enhanced. Calculation time is increased with this option.
	Organ Contour Enhancement	If selected, the organ contours in the overlay image are enhanced.
	Fat Calibration	The **Fat Calibration** values allow you to recalibrate the reference values of fat that are used by the algorithms to calculate the fat content of the liver. Both values must be measured on the same patient.

Tabs in the Configuration Panel	Description and UI elements	
	Fat Calibration 0 [%]	This value comes from the fat content measurement, see (→ Page 125 *Measuring the fat content*)
	Fat Calibration 100 [%]	This value comes from the fat content measurement, see (→ Page 125 *Measuring the fat content*)
Material Definitions	On the **Material Definitions** tab, you can configure the material parameters for **CT Dual Energy** preprocessing. These parameters may have to be modified for animal model studies or phantom studies.	
	Tissue	These parameters contain typical HU values for the respective kV values.
	Fat	These parameters contain typical HU values for the respective kV values of body fat.
	Rel. CM	This parameter contains the ratio of contrast enhancement at low energy and high energy that is used for the contrast agent.
	Iodine BHC	This parameter is used to activate the beam hardening correction for iodine contrast enhancement.
Preprocessing Options	With the **Minimum** and **Maximum** parameters, you define a slice thickness range. The selected application class will only be performed during the preprocessing if the slice thickness of the Dual Energy input data is within this range. Consider that this is only one loading criterion. *syngo*.via analyzes all available data sets and searches for the most suitable data set for all workflows that you can perform with this data. These parameters are only evaluated by **CT Dual Energy**. Other *syngo*.via workflows are triggered by the string #PP within the series name.	

Tabs in the Configuration Panel	Description and UI elements
ROI Properties	On the **ROI Properties** tab, you configure for each application class the information that a standard Dual Energy ROI label displays by default. These settings are workflow-specific. The **Evaluations** column lists all possible properties. In the **Volumes** column, you define for which volumes the properties are displayed. Regardless of these default settings, each user can configure own user-specific settings. User-specific settings are evaluated first. If no user-specific settings were configured, the label is displayed according to the **ROI Properties** tab settings.

Measuring the fat content

This task is necessary to obtain the **Fat Calibration 0 [%]** and **Fat Calibration 100 [%]** values. See (→ Page 121 *Liver VNC parameters*).

✓ The **Liver VNC** application class is selected.

✓ In the **Configuration Panel** the **Algorithm Parameters** tab is selected.

1 Set **Fat Calibration 0 [%]** to 0 and **Fat Calibration 100 [%]** to 100.

2 Load the patient data or the phantom data for the calibration into *syngo*.CT Dual Energy.

3 Measure the fat content (in %) of liver without fat and pure fat tissue.

4 Insert these values as new calibration values for **Fat Calibration 0 [%]** and **Fat Calibration 100 [%]**, respectively.

5 Reassign calibration data to *syngo*.CT Dual Energy and verify correct results by measuring again.

14.5.6 Gout parameters

In the **Configuration Panel** you can configure different parameters of the respective application class according to your needs. In the following, all tab cards, their function, and the displayed UI elements are described.

Tabs in the Configuration Panel	Description and UI elements	
Presets	From the **VRT Preset Selection** list, you can select a VRT which controls the initial color display in a VRT image.	
Visualization	On the **Visualization** tab, you can choose between different color look-up tables for the CT and the overlay view and define the window of the displayed data.	
	Color Lookup Table	The selection lists offer predefined color combinations which are assigned to the displayed data. The setting in the left list is for the CT data, the setting in the right list for the overlay data.
	Window Value	The parameters **Center** and **Width** on the left define the window of the displayed CT data. The parameters **Center** and **Width** on the right define the window of the displayed overlay data.

Tabs in the Configuration Panel	Description and UI elements	
Algorithm Parameters	On the **Algorithm Parameters** tab, you can configure the algorithm parameters for **CT Dual Energy** preprocessing. You can change the parameters within certain limits according to your needs. The parameters **Air Distance** and **Bone Distance** control the visualization of calluses as potential urate. Potential urate with negative overlay value is not visualized if the distance to air or to the skin surface is less than the **Air Distance** value and if the distance to bone is higher than the **Bone Distance** value. These values are voxels.	
	Minimum [HU]	Below the minimum HU value (mixed image), the overlay image is set to 0 HU and no calculation is performed.
	Maximum [HU]	Above the maximum HU value (mixed image), the overlay image is set to 1000 HU and the voxel is visualized as bone.
	Resolution	The resolution parameter is the range of the smoothing filter in units of pixel size. Spatial resolution improves with small values. Large values are better for larger uric acid accumulations.
	Air Distance	The value defines the size of a measurement volume between air (skin surface) and bone. It can be between 0 and 10 voxels. Within this distance to the skin surface, negative overlay values are set to 0 HU and are not visualized as potential urate, but only if the negative overlay value is not simultaneously located within the defined bone distance.
	Bone Distance	The value defines the size of a measurement volume between bone and air (skin surface). It can be between 0 and 10 voxels. For bone distance, the measurement starts at the bone. The parameters **Bone Distance** and **Air Distance** have to be considered together.

Tabs in the Configuration Panel	Description and UI elements	
Material Definitions	On the **Material Definitions** tab, you can configure the material parameters for **CT Dual Energy** preprocessing.	
	Soft Tissue	These parameters for low energy and high energy contain typical HU values of soft tissue.
	Ratio	This parameter is used for calculating the CT value of overlay images. It is set that the overlay image is positive for the majority of the contrast agent and bone voxels and negative for the majority of the urate voxels (gout).
Preprocessing Options	With the **Minimum** and **Maximum** parameters, you define a slice thickness range. The selected application class will only be performed during the preprocessing if the slice thickness of the Dual Energy input data is within this range. Consider that this is only one loading criterion. *syngo*.via analyzes all available data sets and searches for the most suitable data set for all workflows that you can perform with this data. These parameters are only evaluated by **CT Dual Energy**. Other *syngo*.via workflows are triggered by the string #PP within the series name.	
ROI Properties	On the **ROI Properties** tab, you configure for each application class the information that a standard Dual Energy ROI label displays by default. These settings are workflow-specific. The **Evaluations** column lists all possible properties. In the **Volumes** column, you define for which volumes the properties are displayed. Regardless of these default settings, each user can configure own user-specific settings. User-specific settings are evaluated first. If no user-specific settings were configured, the label is displayed according to the **ROI Properties** tab settings.	

14.5.7 Rho/Z parameters

In the **Configuration Panel** you can configure different parameters of the respective application class according to your needs. In the following, all tab cards, their function and the displayed UI elements are described.

Tabs in the Configuration Panel	Description and UI elements	
Presets	For this application class, the tab does not contain any parameters.	
Visualization	On the **Visualization** tab, you can choose between different color look-up tables for the CT and the overlay view and define the window of the displayed data.	
	Color Lookup Table	The selection lists offer predefined color combinations which are assigned to the displayed data. The setting in the left list is for the CT data, the setting in the right list for the overlay data.
	Window Value	The parameters **Center** and **Width** on the left define the window of the displayed CT data. The parameters **Center** and **Width** on the right define the window of the displayed overlay data.
Algorithm Parameters	On the **Algorithm Parameters** tab, you can configure the algorithm parameters for the calculation. You can change the parameters within certain limits according to your needs.	
	Minimum [HU]	Below the minimum HU value, the mixed image is displayed instead of the electron density image and the effective atomic number is set to zero. No calculation is performed.
	Maximum [HU]	Above the maximum HU value, the mixed image is displayed instead of the electron density image and the effective atomic number is set to zero. No calculation is performed.
	Resolution	The resolution parameter is the range of the smoothing filter in units of pixel size. Spatial resolution improves with small values. Large values are better for low contrast resolution.
Material Definitions	For this application class, the tab does not contain any parameters.	

Tabs in the Configuration Panel	Description and UI elements
Preprocessing Options	With the **Minimum** and **Maximum** parameters, you define a slice thickness range. The selected application class will only be performed during the preprocessing if the slice thickness of the Dual Energy input data is within this range. Consider that this is only one loading criterion. *syngo*.via analyzes all available data sets and searches for the most suitable data set for all workflows that you can perform with this data. These parameters are only evaluated by **CT Dual Energy**. Other *syngo*.via workflows are triggered by the string #PP within the series name.
ROI Properties	On the **ROI Properties** tab, you configure for each application class the information that a standard Dual Energy ROI label displays by default. These settings are workflow-specific. The **Evaluations** column lists all possible properties. In the **Volumes** column, you define for which volumes the properties are displayed. Regardless of these default settings, each user can configure own user-specific settings. User-specific settings are evaluated first. If no user-specific settings were configured, the label is displayed according to the **ROI Properties** tab settings.

14.5.8 Monoenergetic Plus parameters

In the **Configuration Panel** you can configure different parameters of the respective application class according to your needs. In the following, all tab cards, their function and the displayed UI elements are described.

Tabs in the Configuration Panel	Description and UI elements
Presets	For this application class, the tab does not contain any parameters.

Tabs in the Configuration Panel	Description and UI elements	
Visualization	On the **Visualization** tab, you can configure the display of the CT-value curves in the lower right segment of the Monoenergetic Plus layout.	
	Show all findings	All created Monoenergetic Plus ROIs are displayed.
	Show reported findings only	All Monoenergetic Plus ROIs that are marked for reporting in the **Findings Navigator** are displayed.
	Show last 5 findings	The last five created Monoenergetic Plus ROIs are displayed.
	Show error bars	Switches the error bars of all Monoenergetic Plus ROIs on or off.
Algorithm Parameters	On the **Algorithm Parameters** tab, you can configure the algorithm parameters for the calculation. You can change the parameters within certain limits according to your needs. Modify the parameters only in the following cases: ■ The image quality is not satisfactory, for example, the images are very noisy. ■ Different HU ranges are to be excluded.	
	Minimum [HU]	Below the minimum HU value, the mixed image is displayed instead of the Monoenergetic Plus image.
	Maximum [HU]	Above the maximum HU value, the mixed image is displayed instead of the Monoenergetic Plus image.
	Resolution	The resolution parameter is the range of the smoothing filter in units of pixel size. Spatial resolution improves with small values. Large values are better for low contrast resolution.
Material Definitions	For this application subclass, the tab does not contain any parameters.	

Tabs in the Configuration Panel	Description and UI elements
Preprocessing Options	With the **Minimum** and **Maximum** parameters, you define a slice thickness range. The selected application class will only be performed during the preprocessing if the slice thickness of the Dual Energy input data is within this range. Consider that this is only one loading criterion. *syngo*.via analyzes all available data sets and searches for the most suitable data set for all workflows that you can perform with this data. These parameters are only evaluated by **CT Dual Energy**. Other *syngo*.via workflows are triggered by the string #PP within the series name.
ROI Properties	On the **ROI Properties** tab, you configure for each application subclass the information that a standard Dual Energy ROI label displays by default. These settings are workflow-specific. The **Evaluations** column lists all possible properties. In the **Volumes** column, you define for which volumes the properties are displayed. Regardless of these default settings, each user can configure own user-specific settings. User-specific settings are evaluated first. If no user-specific settings were configured, the label is displayed according to the **ROI Properties** tab settings.

14.5.9 Bone Marrow parameters

In the **Configuration Panel** you can configure different parameters of the respective application class according to your needs. In the following, all tab cards, their function and the displayed UI elements are described.

Tabs in the Configuration Panel	Description and UI elements
Presets	From the **VRT Preset Selection** list, you can select a VRT which controls the initial color display in a VRT image.

Tabs in the Configuration Panel	Description and UI elements	
Visualization	On the **Visualization** tab, you can choose between different color look-up tables for the CT and the overlay view and define the window of the displayed data.	
	Color Lookup Table	The selection lists offer predefined color combinations which are assigned to the displayed data. The setting in the left list is for the CT data, the setting in the right list for the overlay data.
	Window Value	The parameters **Center** and **Width** on the left define the window of the displayed CT data. The parameters **Center** and **Width** on the right define the window of the displayed overlay data.
Algorithm Parameters	On the **Algorithm Parameters** tab, you can configure the algorithm parameters for the calculation. You can change the parameters within certain limits according to your needs. Modify the parameters only in the following cases: ■ The image quality is not satisfactory, for example, the images are very noisy. ■ Different HU ranges are to be excluded.	
	Minimum [HU]	Below the minimum HU value, the HU values of all voxels are set to 0 HU.
	Maximum [HU]	Above the maximum HU value, the HU values of all voxels are set to 0 HU.
	Resolution	The resolution parameter controls the range of the smoothing filter in units of the pixel size. Spatial resolution improves with low resolution values. High resolution values are better for large bones.
	Bone Threshold [HU]	Minimum HU value for cortical bone identification. If the bone marrow segmentation does not provide proper results lower this value. It might improve the result.

Tabs in the Configuration Panel	Description and UI elements	
Material Definitions	On the **Material Definitions** tab, you can configure the material parameters for **CT Dual Energy** preprocessing.	
	Yellow Marrow	These parameters contain typical HU values of yellow marrow for the respective kV values.
	Red Marrow	These parameters contain typical HU values of red marrow for the respective kV values.
	Calcium BHC	The **Calcium BHC** parameter is used to activate the automatic adjustment of the optimum bone mineral ratio for the scanned body region. The bone mineral ratio is calculated separately for each slice.
	Rel. Ca.	The ratio of the CT value at low energy and high energy that is used for bone mineral.
Preprocessing Options	With the **Minimum** and **Maximum** parameters, you define a slice thickness range. The selected application subclass will only be performed during the preprocessing if the slice thickness of the Dual Energy input data is within this range. Consider that this is only one loading criterion. *syngo*.via analyzes all available data sets and searches for the most suitable data set for all workflows that you can perform with this data. These parameters are only evaluated by **CT Dual Energy**. Other *syngo*.via workflows are triggered by the string #PP within the series name.	
ROI Properties	On the **ROI Properties** tab, you configure for each application subclass the information that a standard Dual Energy ROI label displays by default. These settings are workflow-specific. The **Evaluations** column lists all possible properties. In the **Volumes** column, you define for which volumes the properties are displayed. Regardless of these default settings, each user can configure own user-specific settings. User-specific settings are evaluated first. If no user-specific settings were configured, the label is displayed according to the **ROI Properties** tab settings.	

14.6 Optimizing the calculated data

The settings described in this chapter enable you to improve the visualization of images.

If you change parameters of an application class, all workflows that are assigned to this application class are affected by this change.

14.6.1 Improving the visualization of plaque and stents

For the following application classes and user-defined application classes that are based on these, it is possible to improve the visualization of calcified plaques and stents:

- **Liver VNC**
- **Brain Hemorrhage**

Set the maximum threshold to a value above the CT values of iodine enhanced vessels and tissues in the scanned volume:

1 On the **Applications** tab, select the application class you want to modify.

2 On the **Algorithm Parameters** tab, adapt the **Maximum [HU]** parameter.

Each voxel above the adapted **Maximum [HU]** parameter is decomposed assuming that it contains calcium and an appropriate smoothing is performed in the vicinity.

It is useful to have different maximum settings for arterial and venous scans.

14.6.2 Switching between new and old image processing algorithms

Dual Energy provides different image processing algorithms for the following application classes:

- **Liver VNC**
- **Brain Hemorrhage**

The new algorithm preserves the spatial resolution of the original images (low energy and high energy data sets), especially for the visualization of small calcifications, and maintains the typical noise texture of standard CT images.

For the application classes, you can switch between old and new image processing algorithms by changing the following trigger parameters in the **CT Dual Energy Configuration** blind.

The following parameter settings trigger the old or the new algorithm:

	New image processing algorithms	Old image processing algorithms
Organ Contour Enhancement	not selected	selected
Resolution Enhancement	selected	selected
Minimum [HU]	-50	-300

✓ The **Configuration Panel** is opened.

1 In the **Configuration Panel** select the **Application Classes** tab of the **CT Dual Energy Configuration** blind.

2 Select the application class you want to modify and change the trigger parameters regarding the required algorithm.

CE 0123

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