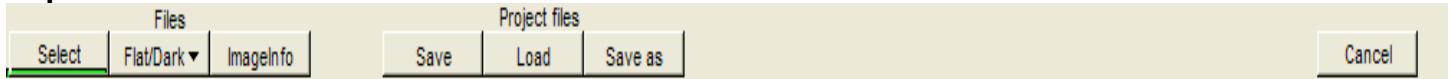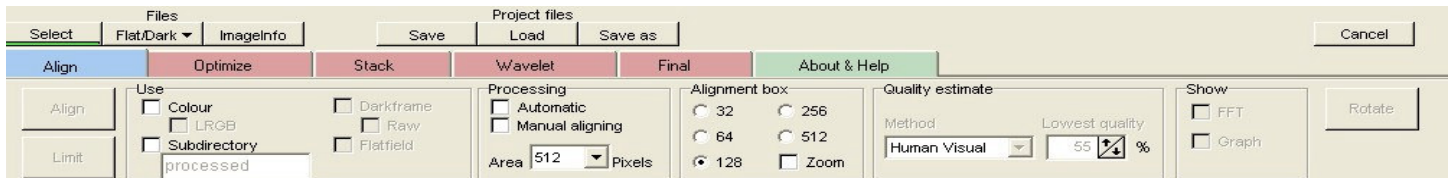# RegiStax V3 controls

The GUI.
Below are the three main sections of RegiStax that are available on most pages.

Top bar

The top bar is available on all pages and contains controls that are usable at many stages.

Control bar

Every tab page has an associated control bar with the controls/functions specific for that tab page. The active tab page is shown in blue, other available tab pages are shown in green. A red tab page is not available at the current stage.

## Image area, sidebar and status bar

The image area is the section where the images or image related information will be displayed. The sidebar (tabs on the right) can come in one or two sections. The top section of tabs is related to specific functions, their associated tool windows will show up when the tab is selected. But only one tool window at a time will show. The tool windows associated with the lower section can be active at the same time. The status bar (lower portion) will show information during processing. A green progress bar (shown at 100%) will show (at the left-side of the statusbar) how far the processing has progressed during sequence processing. On the right-lower corner a sizegrip is visible, RegiStax V3 allows you to resize its window (you can also work "maximized" by setting the windows-link (icon) on your "desktop" to this mode).

Tool windows

All tool windows can be moved around by dragging them (select them by point/click the blue caption bar). You can shrink the tool window by pressing the up-arrow-button on the left side of its caption bar. This button also serves to unroll the full window after shrinking it. Several tool windows can be shown at the same time, when you select a tool window by clicking at the caption-bar it will be shown in front of all others.

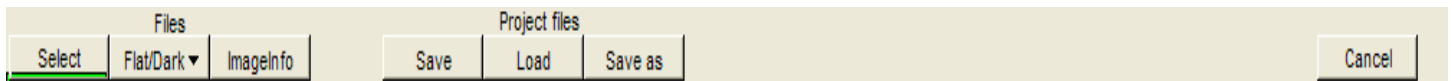Tool windows are only available at their specific tab page.
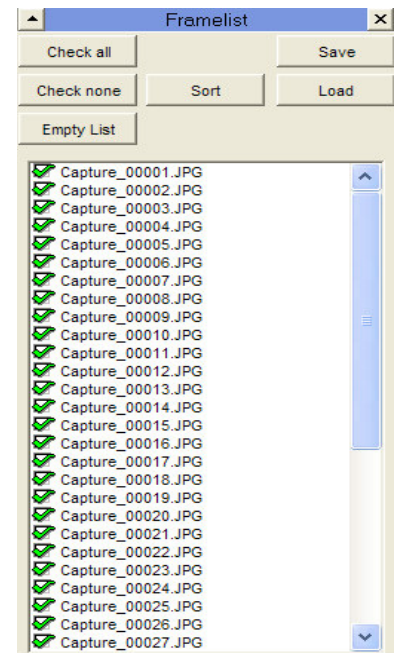
Dialogs
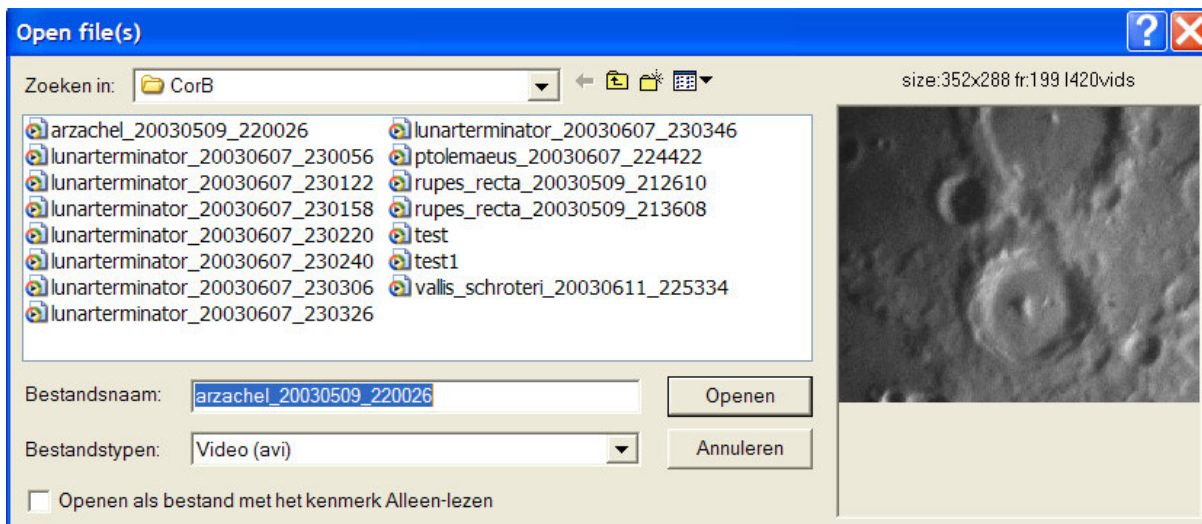
This is a standard file selection dialogue; all available types of image can be shown in preview on the right-hand side in the dialogue. You can select multiple files by simultaneously pressing the ctrl- or shift-key on the keyboard (keep pressed) in combination with the left mouse-button.

TOP BAR

Section FILES

Select Button: This opens the standard file selection dialogue. You can select AVI, BMP, JPG, FITS, TIFF and PNG images. Be aware that the dialogue is limited to selecting a group of files by the Windows operating system. When the space to record the filenames and paths of the selection is larger than 64Kb Windows will truncate the selection. Use the drag & drop functionality of RegiStax (you can select files in Windows Explorer and drop these on the RegiStax program-area).

### Flat /Dark Button:

This button opens a menu, with four options:
- Load darkframe: select a darkframe
- Load flatfield: select a flatfield
  Two options are only available after loading a set of images.
- Create darkframe : This creates a darkframe from the set of images. It will simply stack all the images without registering.
- Create flatfield: This creates a flatfield based on the set images. Again only a simple stacking routine will be used.

Note: images for darkframes and flatfields should be recorded using a specific setup. To record a darkframe keep the capture-settings (fps, gain etc) the same but completely cover the camera. For a good flatfield, images should be shot using the same setup but now recording an equally-lit area.

Imageinfo Button:

This shows the image information window. Using this window you can control the file name during saving. Several processing settings are saved in the filename The user sets the object-name, the program suggests a date-time based upon the input files. Several parameters can be saved, Waveletscheme(WS), Waveletvalues(WV), Contrast& Brightness(CB), Stacksize(ST), Gamma (GA). When the USEIMAGEINFO checkbox is set the information will be used during saving. When the STAMP_BELOW_IMAGE is set, RegiStax will save the text in a separate text-section (white) below the image.
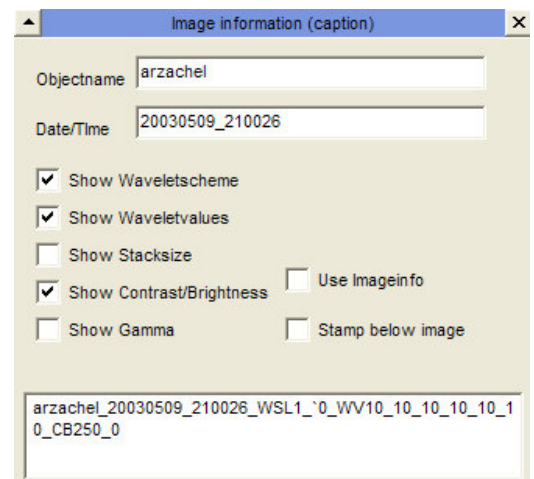
Section PROJECT FILES

Save: This saves the current stage (align, optimize, stack, wavelet) and all important calculated information (shifts/quality per image) in a RegiStax project file for later use.
Load: This loads RegiStax project files and restores a saved situation.
Save as: This is specifically aimed at saving/renaming an AVI-file project. The dialogue will suggest a new name for the AVI-file based upon the date and time of recording e.g. _20030623_1123. The user can simply add the object name to this information. After this both AVI-file and project file will carry the same name.

Cancel Button: When pressed the program will try to stop with the current activity. This is known to increase the chance for errors during processing. Try using this as little as possible. When RegiStax becomes unstable after pressing cancel, it is recommended to close and start the program again.

TABPAGE ALIGN
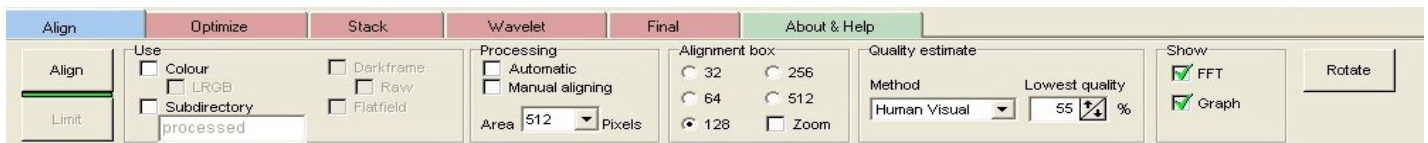
This tabpage is the 1st you will see when starting RegiStax. Its controls will become active as soon as you have loaded a sequence of images. The default control is the Align-button.

A common processing sequence after loading a sequence:
- select alignment-box size.
- set additional options (eg. quality estimator)
- point/click on the alignment-feature in image
- decide if the output (fftspectrum, qualityestimate graph) are as expected (change as needed and select the alignment-feature once again)
- set tracking options
- Press ALIGN, starts alignment and aligns all images in sequence
- After alignment, move the slider to the worst image you still want to include in the processing. Images are ordered from best (leftmost on slider) to worst (rightmost).
- press LIMIT, selects the OPTIMIZE tabpage.

Control bar: (⊕= new in V3)

Buttons:
Align (DEFAULT): Will start the alignment process. Make sure all other settings are done before pressing this.

⊕**Limit**: Available only after pressing Align. This will limit the number of images used for further processing (eg. Optimizing/stacking). This is used in combination with the slider below the image area. When pressed, all images to the left of the current slider position have been selected and will be used for optimizing. After pressing this button the program will automatically proceed to the OPTIMIZE tab page.

⊕**Rotate (still experimental)**: This function allows you to de-rotate a sequence of images. After pressing the rotate button the alignment process will start by asking for the 1st alignment feature. Move the mouse over the image and press the left-mouse button on the feature you want to use for rotation. This will automatically start an initial alignment run (like pressing the Align button) for this feature. When your images are changing rotation rapidly, its probably more logical to use the manual alignment option (tick box). After the alignment the program will ask you to select a 2nd feature. Try keeping the 1st and 2nd feature as far apart as possible. Also make sure they are visible in all images and are high-contrast areas. After selecting the 2nd feature the initial alignment will start once again. After this, use the LIMIT button as explained above. During the optimizing stage you will notice that the program will try rotating the images and also optimize on rotation. This will slow down processing.

Section Use:

Colour (SAVED FEATURE): set this when you want to process in colour, optionally this can also be set after alignment/optimizing at the stacking tab page
⊕RegiStax now detects if your input is colour or B/W and will ask to change this setting if necessary.

LRGB: only available when Colour is checked. This allows you to work at the wavelet tabpage with several special options (see Tabpage-wavelet, below, for more information) to enhance the image based on specific colour layers (e.g. Mars images show more details in red, you can – at the wavelet stage – decide to use only the image intensity from the red channel to enhance the details whilst still keeping the colour-balance).

Subdirectory: when selected your results will be saved to a subdirectory of your original files. If you, for instance, retrieve from C:\images, and set subdirectory to "processed" it will save the results to c:\images\processed.

Darkframe: Only available after loading a darkframe using the Flat/Dark button from the topbar. When this checkbox is marked during all processing stages the selected darkframe will be subtracted from any image.

⊕**Raw:** Only available when a darkframe was loaded and when processing raw-AVI in debayer mode (see toolwindow ADDITIONAL on the ALIGN tabpage). This will apply a darkframe to a non-debayered AVI before debayering. This is therefore only useful with a darkframe created from a non-debayered set of images.

Flatfield: Only available after loading a Flatfield using the Flat/Dark button from the topbar. When this checkbox is marked during all processing stages the images will be divided with the selected flatfield.

Section Processing:

⊕**Automatic:** When this is checked and the ALIGN button is pressed the program will run fully automatically until the wavelet section using default settings. The settings for image-quality (lowest) will limit the images used for further processing.

Manual alignment: If checked the user will be asked to align the images by pointing the mouse-cursor on the alignment feature for every image!

Area (Default 512): This sets the size of the area that will be automatically updated during the wavelet processing. A larger area will demand a great deal more memory. Compared to V2 the option "full" has been removed. It is recommended to leave the setting at 512. At the wavelet-section the DO_ALL button will process the full image.

Section Alignment Box:

⊕**Size(SAVED FEATURE):** The alignment box can be set at the following sizes; 32, 64,128, 256, and 512 pixels. Smaller boxes will lead to faster processing but increase the chance for error. Bigger boxes reduce the processing-speed but will create a better chance for a good alignment. A box larger than one of the image-dimensions (width or height) cannot be chosen (automatically changed). Always choose your alignment boxes so that they surround the feature of interest or are covering an area rich in contrast.

⊕**Zoom:** This opens a special tool window that helps in pointing more accurately at a specific alignment feature. The image will be shown 2x zoomed around the mouse-cursor. This option is mainly useful in combination with manual alignment.

Section Show:

FFT: This will open the FFT-spectrum window (for more information see FFT Window on page 11). It is opened automatically when an the alignment-feature is chosen, its closed after the Align-button is pressed.
⊕: in V3 The FFT-spectrum setting is automatically estimated

Graph : This will open the registration-graph window (for more information see Quality Window). It is opened automatically when an the alignment-feature is chosen.

Section Quality estimate:

⊕**Method (SAVED FEATURE):**
The quality of images can now be estimated in 4 different ways instead of the single option in V2. The controls work in combination with the "Quality" tool window.

*-Classic (as in V2):*Based upon the settings of the quality controls (see quality tool window) this method will estimate image-quality based on a so-called power-spectrum. The user specifies a band within the power-spectrum that serves as an estimator of image-quality.
-Human Visual: This uses the same approach as the classic system but assigns weights according to the spatial sensitivity of the human eye. This option uses both the controls associated with the Classic option as well as a specific control (see quality tool window).
-Compress: This uses a completely different system to estimate image-quality. The estimated alignment-area is saved as a jpeg-file (using the compression setting from the quality tool window) and the size of the resulting file is used as a quality estimator. This seems to work very well, at least with B/W images.
*-Local contrast:* This estimator calculates the average local contrast in the alignment-area and saves this. Local contrast is calculated in sections of 8x8 pixels. This runs without further control-settings.

Lowest quality(SAVED FEATURE):
After alignment and quality estimation images will be ordered according to quality from best to worst. Images with a quality (best = 100%) lower than the setting of this control (default 80%) normally will be neglected for further processing and shown as a dotted line in the graphs.

Sidebar: (collection of tool windows)

✛**Quality WINDOW:** This has controls associated with the quality estimators. Both the Classic and Human Visual system use a power spectrum (see below) method. The setting for compression is a JPEG compression setting, setting this high will make estimates based on a saved jpeg of high-quality and setting it low will estimate based on a lower quality JPEG.
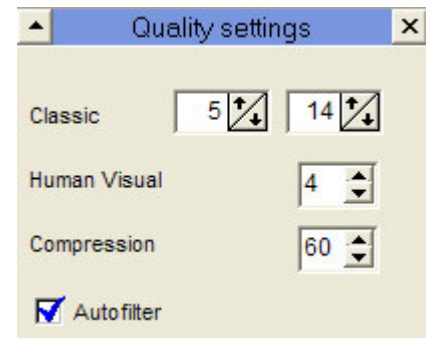
The auto-filter-setting is related to the Classic/Human Visual filters. This is set by default and will estimate a setting for the band-start and band-width using the power-spectrum(see green lines on the graph below). When this checkbox is unchecked the user can control (during this session of RegiStax) the settings by hand.

When using the **Classic option** two green lines will be shown in the Registration/quality graph. The user can control the start and width of the quality-filter. The leftmost green bar is associated with value 5 in the quality-window, this is the starting position of the quality filter. And the 2nd green line shows a position that is 14 units away from the starting position (width). The quality value shown is 0.22. That is the sum of the values in the section between the green lines as a ratio of the total sum of values below the red line. The power spectrum shows the amount of information in the image divided over large spatial features (left side) to small spatial features (rightmost). The largest features are not important to estimate image quality, theoretically the smallest features (right side of the graph) should be more dominant in sharper images. However, noise in images tends to show up as a small feature. That is why a band-filter is used that mainly focuses on mid-range details.
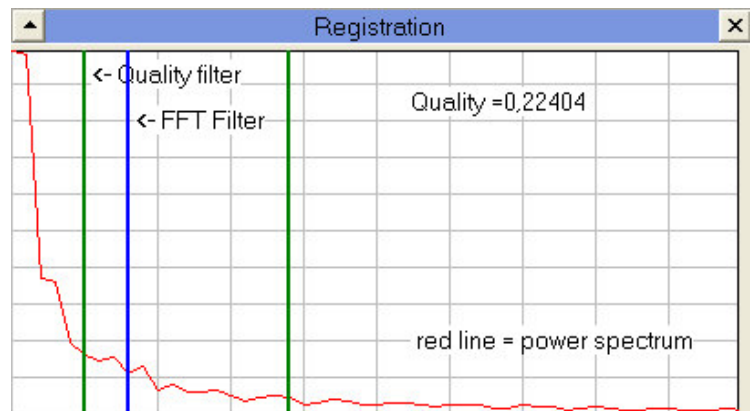
✛RegiStax now estimates a "best" position when this option is used.

When using the ✛ **Human visual** option on the same image the graph changes dramatically. All the values from classic are multiplied with a function that is related to the human visual sensitivity for spatial information. The mid-range detail area is now clearly raised whilst both the large-scale and small detail areas are lowered. The filtering does not use the bandwidth anymore.
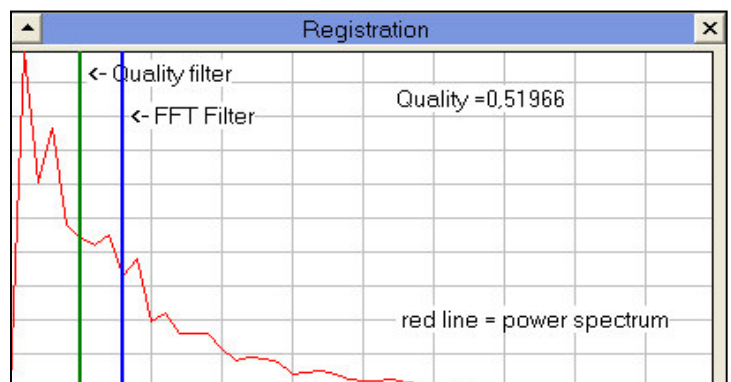
The ✛**Compress** option specifies the JPEG-compression setting associated with the compress-quality estimate. A larger value means less compression (100=maximum).

✛Additional options WINDOW:

Interlaced: When using interlaced images set this checkbox. The default setting is vertical, when horizontal interlacing is needed set that checkbox too.

Alignment Luminance:
During alignment and optimization only the image luminance is used. When processing in colour this is calculated based on a mix of the Red, Green and Blue channels. The values for a, b, c show the default mix of these colours to estimate the luminance. Users can change these at will for instance to use mainly the red layer (mars images) to compose the luminance. The reset button restores the default values.

Bias subtract: When selected a numerical setting will be shown (default 50). This value will be subtracted from every pixel in images. The use of this feature is mainly in sequences where "static noise" is giving problems during alignment.

✛**AVI debayer:** Due to recent advances in webcam modifications RAW-AVIs have become more common. Registax can now process these RAW-AVIs by "debayering". The 4 (GR, RG, BG, GB) options are related to the colour-mask of the CCD used during recording. This setting is recorded every time it is changed by the user. The Baymethod allows currently 2 slightly different ways to debayer the images. Changing the setting of the method and the debayer type will be shown directly in the preview image.
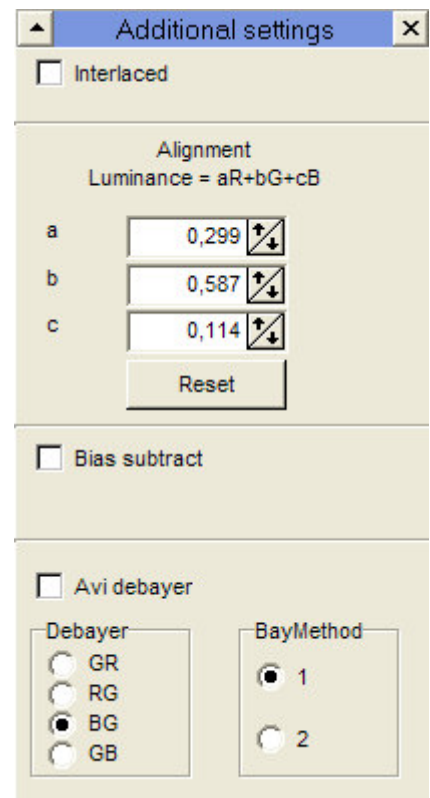
Tracking WINDOW:

Three different controls related to alignment are located in this tool window. TRACK_OBJECT is on by default, this will allow the tracking of objects moving over the whole image. When this is off, the tracking window will not shift further than its size in any direction. PREDICT_TRACK is mainly useful for fast moving objects that move in a predictable manner. When objects move in a more random fashion do NOT use this option, instead try using a large alignment-box. MISALIGN_WARNING will notify you when during registration the correlation of the images suddenly changes (drops), possibly pointing at a rather large shift of the alignment feature. This will signal such shifts and allow you to point manually at the alignment-feature to continue.
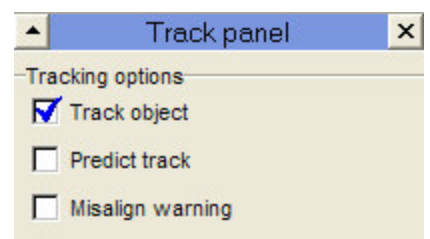
✛Language WINDOW:

RegiStax now allows translation of many controls in the interface into other languages. Language specific characters will be shown. The numerical control allows the change of size of the characters. The AUTOLANGUAGE checkbox will save the language-setting for later usage. The translated language-files automatically set the right character-set.
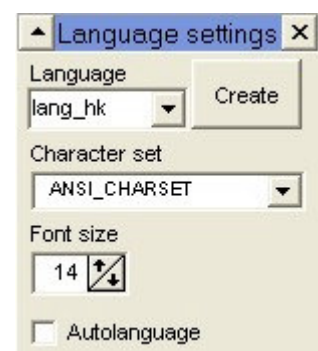
Frame list WINDOW:

After selecting an AVI or a set of images users can select/deselect individual images using the Frame list. When processing AVI's, the SAVE/SORT/LOAD options are not available.

CHECK ALL: This selects all frames in the frame list.
CHECK NONE: This will deselect all frames.
SAVE: This will save the information of the frame list into a RegiStax Frame list file for later usage.
**LOAD:** This will load a frame list from a previous saved session.
SORT: Sorts the frames according to alphabetical order.
EMPTY LIST: This function will, when used with individual images, empty the list. When using the drag & drop functionality in combination with the Windows-Explorer this can sometimes be useful.

Images can be selected / deselected by clicking on the green checkmark of the image. Images will be shown on the preview area when selected.
Groups of images can be selected/deselected (see image) by pressing the shift (selects a block) or ctrl (allows random selection) key in combination with the mouse button. Selected images will be shown with a blue marker during selection, when ready with selecting double-click on the name of the last selected image (has a dotted outline) to change the status.
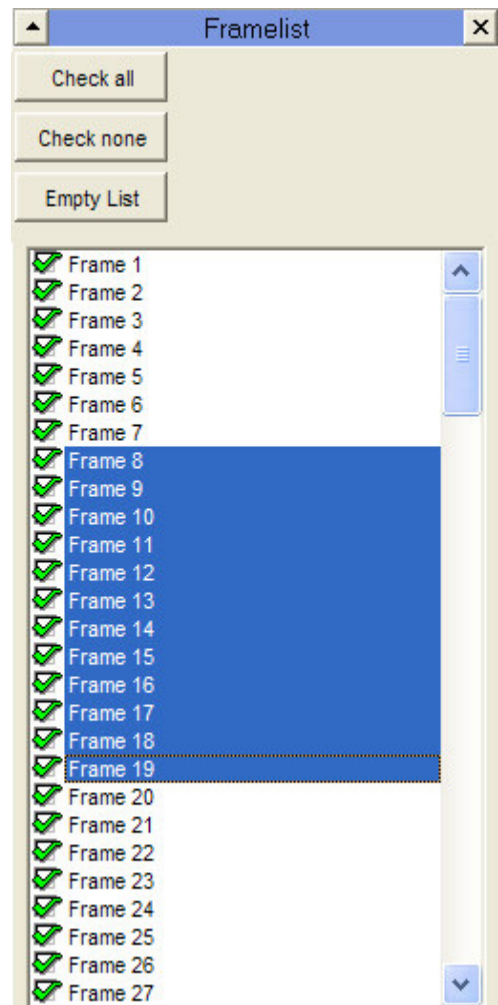
FFT WINDOW:

This window will automatically pop up when selecting an alignment feature. The aim is to see a rather clear defined single red area in the FFT image. This red area shows the estimated shift between 2 images.
⊕Compared to V2 a major change is that the program now automatically sets the FFT filter size. Manually changing the FFT-filter will set this automatic feature to manual. You can however undo this by unchecking the manual-checkbox.
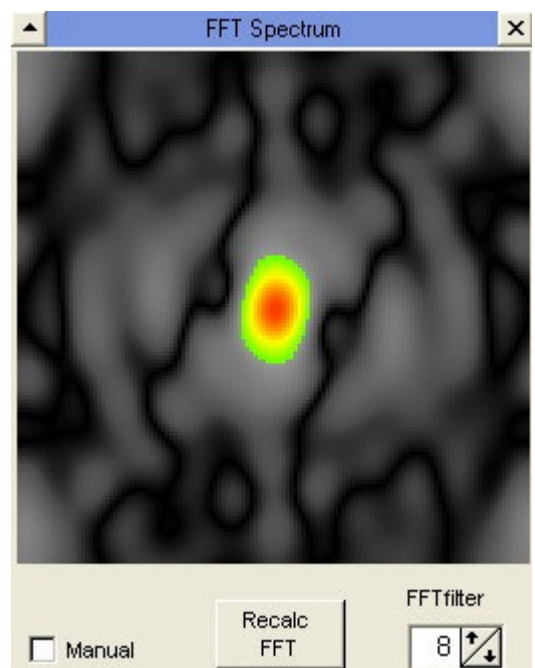
Other controls
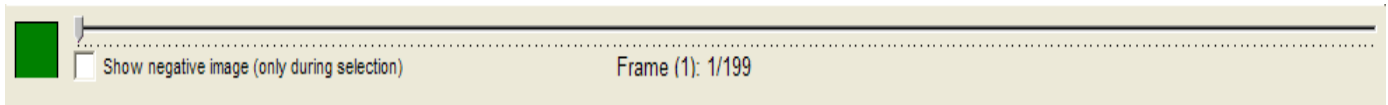
-⊕The panel below the image contains a few controls.

The green box shows the state of the current image (as selected by the slider-position), this box can turn red (deselected image) or grey (dropped frame in AVI-file).

-⊕The "Show negative image" option will allow you to inspect rather dark images more easily during selection. This will not affect the processed image.

-Slider: this is the most used control of this section. You can move the slider by selecting it with the mouse and dragging or by using the left-right arrows on the keyboard (after selecting the slider with the mouse). During inspection individual frames can be selected / deselected by pressing the space-bar.

TABPAGE OPTIMIZE
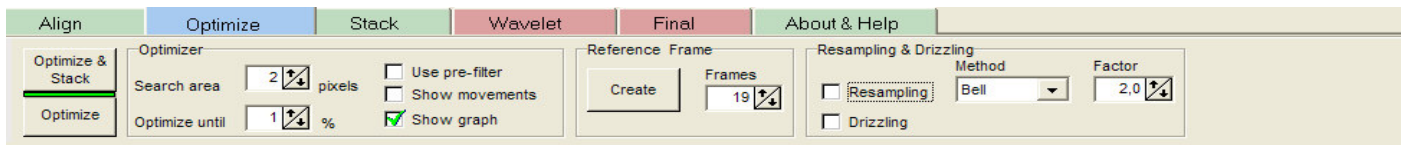
After the initial alignment and choosing the images good enough to process the user ends up on the OPTIMIZE tabpage. The aim of this stage is to optimize the alignment. You can also decide to process the images in a larger format by using the resampling and drizzling options.

A common processing sequence after loading a sequence:
- set search-area and optimize-until controls.
- (optional create a better reference using "create")
- press either optimize&stack to optimize, then go the the stack and the wavelet pages automatically, or press optimize to optimize run only.

Control bar:

Buttons:
⊕**Optimize & Stack (DEFAULT):** This will start the alignment optimizer and when finished will automatically proceed to the stacking page and after that to the wavelet page. During optimizing a graph will be shown.

Optimize: Starts a single run of the optimizer. After this the user can change settings and try once more. When ready you can go manually to the stacking section.

During optimisation a graph shows the quality (red line) of the images and the difference (blue line) between the reference-image and the individual frames. In this example (right) it's clear that the difference of the images increases with a decreasing image-quality. This is a sign of a good image-quality estimator.
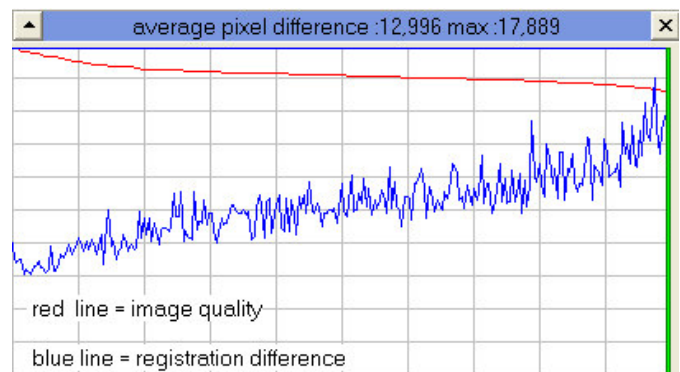
Section Optimizer

Search area: The value of this control specifies the area that is used (in all directions) to search for an optimal shift between the reference and the images to be optimized. A large value will slow down processing but increases the chance to find the best shift in a single run.

Optimize until: This is a penalty function, after every run of the optimizer the difference in estimated shifts compared to the previous run is tested. When this changes less than the value of this control (%) the optimizer will stop.

⊕**Pre-Filter:** Sometimes images are rather noisy and the noise can disturb the registration. For such images pre-filtering the image can be helpful. When using this option every image will be processed before optimisation. A simple filter-operation (3x3 filter) can be used to pre-filter the images. Several pre-defined filters can be chosen. Users can set the filter values freely, after this use the SET button. The optional Smoothing filter uses a different pre-filter that has no connection with the filter settings.
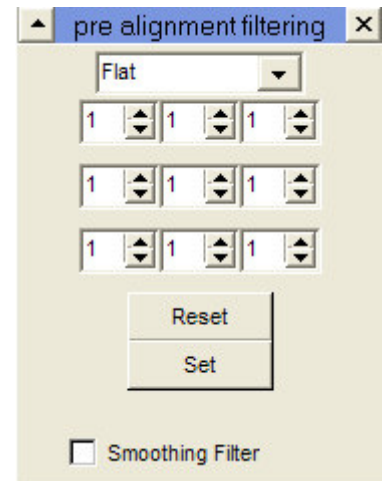
⊕**Show movements**: When this is selected the user will be able to see the estimated shifts of the images that are being optimized.

⊕**Show graph:** This will show the default graph with image-quality and the difference between the images and the reference-image.
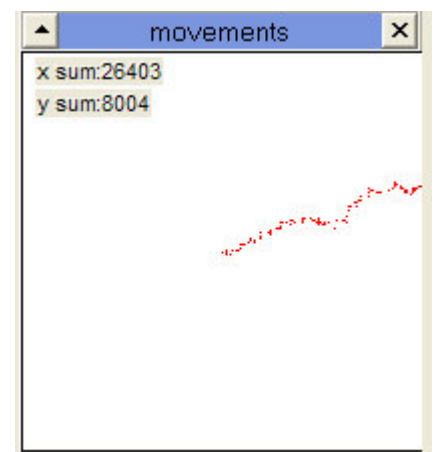
Section Reference Frame
⊕**Create button:** Quite often the raw images of a sequence are not undisturbed. In RegiStax V3 there is a new option to create a good reference-image. When this button is pressed it will start processing a set of frames (number set by the other control in this section) to create a reference image. First the short sequence (10-50 frames) will be optimized (using the optimizer settings) than stacked. At the wavelet page you will be asked to use wavelets to enhance (if desired) the image, after this press the temporarily visible "continue "button and you will be returned to the OPTIMIZE page. Optimizing can now be done using the newly constructed reference-image.

Section Resampling and Drizzling

Re-sampling: When set the images will be optimized/stacked using a resampling method and enlargement factor. Four methods are available (Bell, Bspline, Lanczos, Mitchell) and the enlargement-factor should be between 1.1 and 4.0. This option will slow down processing as every image will be enlarged both during optimisation and stacking. Be aware that the image size (width and height) is not allowed to exceed 4000x4000 pixels.

⊕**Drizzling:** This uses a completely different system to build a larger final image. During optimisation the images will not be enlarged, during stacking the enlargement-factor will be the same as the factor that can be set for re-sampling. The results depend largely on the number of images used (more = better). More information can be found at the STACK tabpage.

SIDEBAR

⊕**Filter:** This opens the filter window associated to the pre-filter option (see above)
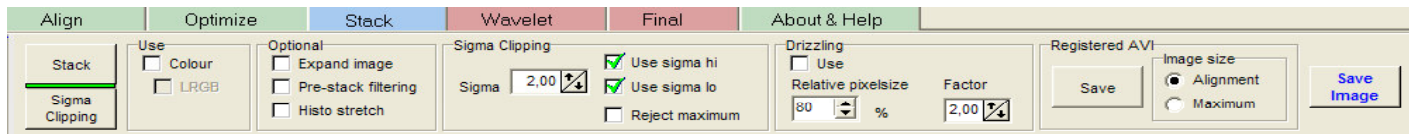
TABPAGE STACK

After the optimizer has finalized optimizing the user can either go manually to the STACK tabpage or use optimize&stack. In the latter case the user will pass the STACK tabpage and move on to the wavelet-page. From that tabpage its also possible to go back to this tabpage to change several settings.

A common processing sequence after entering this tabpage :

- press the stackgraph tab
- use the difference and quality sliders to change the selection of images to be stacked
- press STACK

Control bar:
Buttons:
Stack (DEFAULT): This starts the stacking process. All selected (see stacklist) images will be added to create an average image. This is done at a high-quality resolution of 32bits for every pixel and colour channel.

Sigma Clipping : This button starts an alternative way to create a stacked image. This operation takes two stacking runs. In the first run the program estimates the deviation of the intensity values in the sequence for every pixel. In the second run the actual stacking will be done. After loading a frame every pixel in the frame will be tested against an estimate low-high value for that pixel-position. Pixels with intensities above or below the estimated values will be rejected during stacking. This procedure is effective in removing hot-pixels when no darkframe is available. See more under the section Sigma Clipping (below). This cannot be used together with drizzling/re-sampling.

Section optional:
Expand image: When this option is set the final image will be made as large as possible based upon the estimated shifts.

Pre-Stack filtering: Just as filtering can be used during optimisation to reduce noise the same option (and functionality) is available during stacking. For more info see the section on the TABPAGE OPTIMIZE. Be aware that using filters at this stage will have effects on the final result.

 Histo Stretch: In RegiStax V2 the final intensity-range of a stacked image was automatically stretched to the 0-255 range (32 bits range !). In RegiStax V3 you can still have this option active, but if you want to keep the original intensity-range uncheck this box.

⊕Section Sigma Clipping :

Sigma: This is a statistical value. After calculating the average and standard-deviation for every pixel based upon all frames a band of "acceptable" pixel values is calculated. The default setting makes the band 2x the standard deviation both above and below the average of every pixel. In "standard" statistics this means it expects that 95% of the frames will have a pixel intensity in this band. Setting this for instance to 1x, the band will contain about 70% of the values. A higher value thus will keep most of the values and only reject a few, a low setting will reject many values. This will also reduce the stack size for individual pixels and that can lead to image-quality degradation.

Use Sigma hi/Use Sigma lo: By default both of these settings are on. When Sigma hi is set the program will only reject pixel values above the expected range. When Sigma lo is selected, the program will reject pixel values below the expected range.

Reject maximum: This can be a helpful way of removing hot-pixels from images as they tend to be (for any pixel in the final image) uniquely high.

⊕Section Drizzling:

Use Drizzling: this can be set by the user and is directly linked to the use drizzling option on the OPTIMIZE TABPAGE.

Relative pixel size: The drizzling technique is very different from "normal" processing. To create the final – and larger – image, pixels are drizzled/sprayed over the final image. The pixels however need not be larger than the size of a standard pixel but can be smaller too. Every image that will be stacked thus will leave empty spaces between the pixels when they are stacked. The space between the pixels can be set by the user with "relative pixel size". Smaller pixel sizes will mean larger spaces between the pixels of the individual images during stacking and will demand more images to have a completely filled image. This technique only uses information from the original images and, unlike re-sampling, does not use interpolation between pixels.

Factor: The setting is related to the value of the re-sampling factor on the OPTIMIZE tabpage. The final image will be enlarged with this factor.

⊕Section Write AVI:

Start Button: This will start the AVI-creation sequence. After first asking the user for a filename, the program will write all the registered images (in the original sequence after loading frames) into a registered AVI-file. When this avi is played the alignment feature will be stabilized in the middle. There are two ways to create this AVI, by default the maximum area (i.e the maximum area available in all the frames) is written to the AVI. Alternatively only the registered area (equal to the size of the alignment box) will be saved.

SAVE button: After pressing this button a dialogue will ask the user to specify the type and name of the image to be saved. When the IMAGE_INFO function (TOPBAR) is used a filename will be generated (user can overwrite this name). Possible types are BMP, JPG, FIT-16, FIT-32, Special FITS, TIFF, and PNG. Only BMP/JPEG are 8bit/channel formats all other formats are 16bit/channel or more. The Special FITS is only used to create calibrated darkframes or flatfields.

SIDE BAR

Interlace tool window: This will allow the user to select a specific de-interlace routine (use in combination with interlace option from ALIGN TABPAGE).
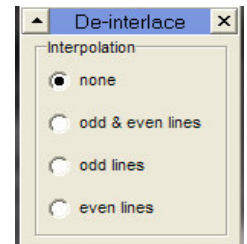
Stack graph Tool Window: This window allows the user to deselect frames based on two factors. The vertical slider on the left will, when lowered, deselect any frame above the horizontal line (blue). The slider on the bottom will deselect any frame to the right of the vertical line (red). The number of selected frames can be read in the status bar. Additionally when moving the lower slider the image at the pointer will be shown together with the estimated position of the alignment feature (a yellow circle).
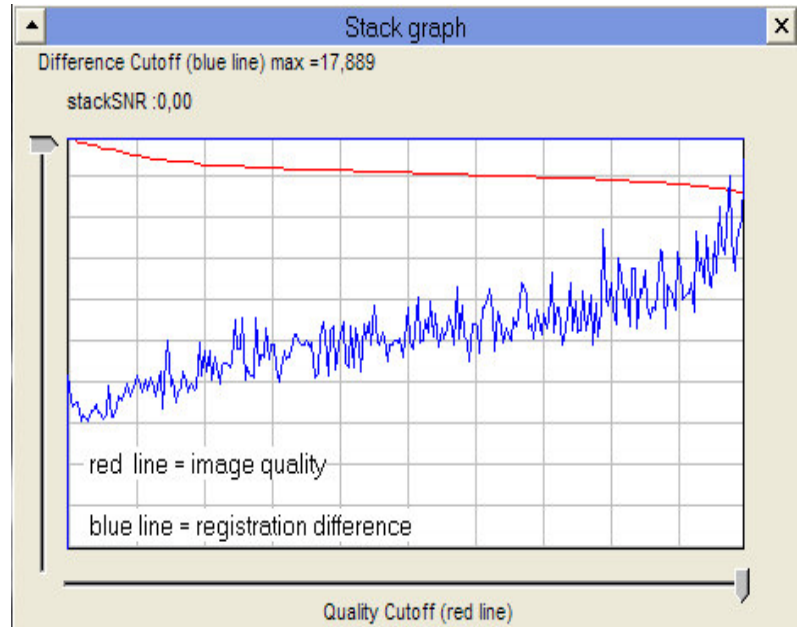
The graph shown is exactly the same as the optimisation graph. In this example the blue-graph slowly moves upwards, indicating more differences between the reference frame and the frame in the graph. At the same time the red-line, indication image quality, goes down. This type of "linkage" between these lines indicates that the image quality estimator seems to have worked well.

Stacklist Toolwindow:
The stacklist toolwindow shows the frames ordered according to quality. The user can select/deselect frames manually (similar to the framelist on the ALIGN tabpage). When browsing through the images make sure that the stackgraph is also visible. The position of the bottom-slider of the stackgraph is connected to the selected image in the stacklist. When finished deselecting frames make sure you set your cursor to the last image in the stacklist that needs to be stacked.
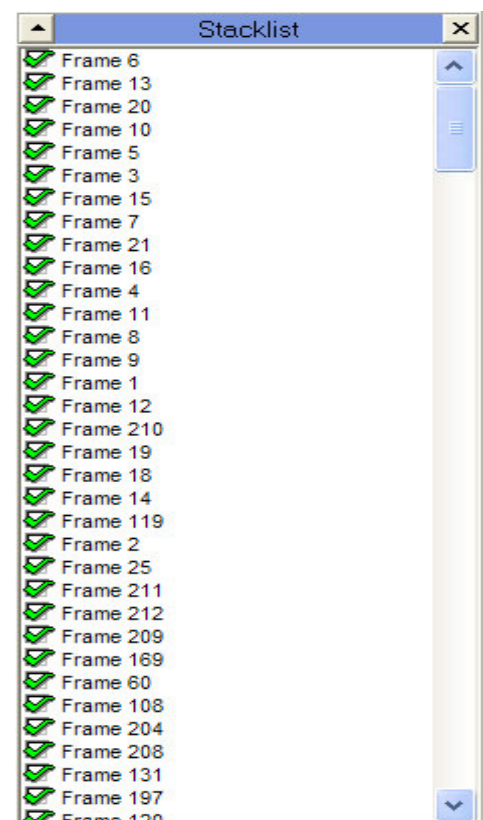
TABPAGE WAVELET
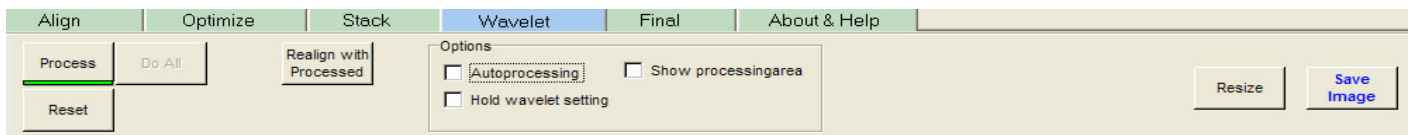
This is the page that allows most of image enhancement power of the wavelets.

Control bar:
Buttons:
Process (DEFAULT): This button is only available if Auto processing (see options section) is not active. This allows the user to change settings and only see the result after pressing the process-button.

Reset: This button resets the values of several controls (all the wavelet controls, gamma and contrast/brightness).

Do_All: During processing only the processing area (size set at ALIGN tab page) is processed. After changing the waveletsettings and other options use this button to calculate this on the full image.

Realign with processed: This function was introduced in V2 and is in fact much like the "create reference" options in the OPTIMIZE tab page. When pressed, a copy of the current image will be used as a reference and the user will be returned to the OPTIMIZE tab page.

Options section:
Auto processing: when on, most actions will lead directly to a visible change of the processed image.
Hold wavelet settings: if this is checked, the current wavelet settings will not be reset when the user starts processing a new set of images.
Show processingarea: this shows a set of small lines at every corner of the processing-area.

RESIZE button : This will show the Resize Window (see more at XXX)

SAVE button: After pressing this button a dialogue will ask the user to specify the type and name of the image to be saved. When the IMAGE_INFO function (see TOPBAR) is used a filename will be generated (user can still change this name). Possible file types are BMP, JPEG, FIT, TIFF and PNG. BMP/JPEG are 8bit/channel formats but all other formats are 16bit/colourchannel. When processing in colour and saving the output as FIT will result in saving three files with names ending on _R, _G and _B respectively.
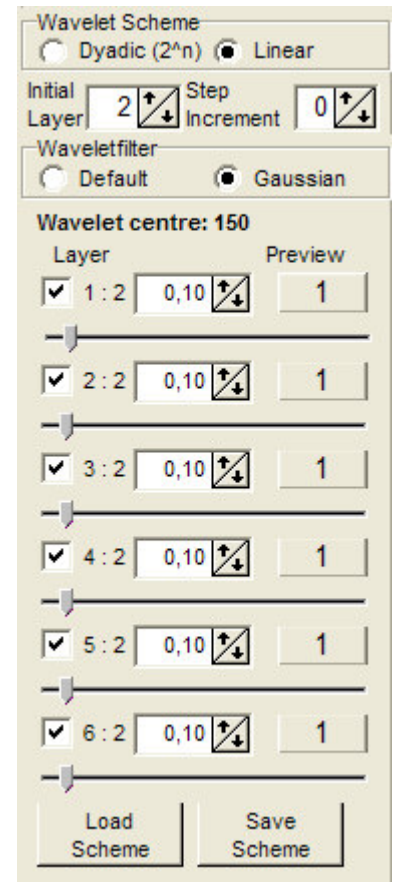
NEW Wavelet controls

This is the section that controls most of the image processing to enhance image-details. The controls are described from top to bottom.

Wavelet-scheme: This allows two options, Dyadic or Linear. The dyadic setup is a default scheme where layer 1 is set to 1, 2=2, 3=4 , 4=8, 5=16 and layer 6=32. The default setup is Linear. When using linear the settings of **Initial layer** and **Step increment** are used to set the layers. The initial layer setting sets layer 1, all successive layers will increase in size according to the step setting.

The layer settings control the size of the area (for every pixel) that is used to calculate the information for every layer. A setting of 1 simply uses the wavelet-filter on a 1:1 basis per pixel. If the wavelet-filter is a 5x5 filter all pixels in this 5x5 area (of the stack) will be used to estimate a pixel in that layer. If the setting is 2, an area of 10x10 pixels will be used to estimate the pixel in the layer.

✛**Wavelet filter:** This control is new due to the introduction of a second system of wavelet-filtering called **Gaussian**. The default setting corresponds to the wavelets as used in V2. When using Gaussian all the wavelet-sliders will show an additional numerical control. The default wavelet is specified using the wavelet-filter tool window(see below). The central value of this filter is also shown labeled as **wavelet centre.**

When using Gaussian wavelets every layer uses a different filter. These filters are user controlled by the numerical controls in the layers. Every filter setting corresponds to a Gaussian blur function with a FWHM (full width half maximum) of that size. Smaller settings (0.08 is the smallest that can be used) will use filters that use smaller surroundings to estimate the layers. Due to the fact that this is fully user-controlable odd schemes can be used. One of the options is to create a larger filtersetting at the 1st layer. This filter can effectively "catch" noise from the image into the 1st layer. After selecting that simply uncheck that layer and use layer 2-6 for further enhancement.

✛The LOAD and SAVE scheme buttons allow the user to load/save all wavelet-settings into a file for later usage or to share with others.

LRGB
When, either at the alignment or stacking page, the LRGB setting is checked, a special LRGB-mixer will appear under the Wavelet controls. This will maintain the colours after the stacking for every pixel and only the luminosity will be used in the wavelets. The LRGB mixer allows the user to control the way the luminosity is calculated. If the "red" layer is for instance showing more details the slider can be moved to the right to improve the influence of the red-channel on the luminosity.

LAYERS

Every layer consists of a checkbox, a slider, a numerical value (as explained above) and a button. The checkbox can be used to unselect the layer (equal to setting the slider to value 0). The button will normally show the value of the sliderposition and when pressed shows a special red/green image. This is the "information" stored in the layer. All areas that are red will lead to a lower intensity of the final image (at the position) when this layer is enhanced (value>1) and all areas that are green will lead to a higher intensity. Brighter red and brighter green are associated with larger changes. The values HI and LO tell how high the intensities in the layer are. In the example Hi is 1.19, when the slider is set at position 10 the largest brightening due to this layer will lead to pixels to be 11.9 values higher on a scale from 0-255.
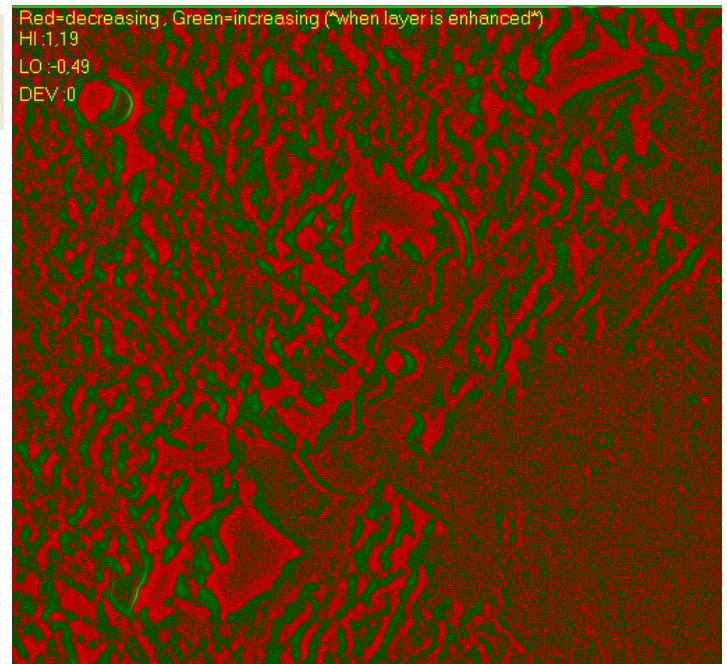
Wavelet Filter Window

This is the control centre of the wavelets. The numerical control-matrix is a representation of the default waveletfilter. The central value is shown with a different colour. The values can be manually changed by the user. You can save filters using the SAVE button or LOAD previously saved filters. SET/RESET are used to set the filtersettings (after manual changing) or resetting to the default values.

⊕The second area (below the line) is a fast control of the gaussian wavelet-filters. Every gaussian layer will be assigned a value based on initial and step (every layer is "step" higher than the previous layer). Pressing set layers will set the Gaussian layers. Pressing set Gaussian will make the Gaussian layers active (much like changing the wavelet filter setting).

TABPAGE WAVELET
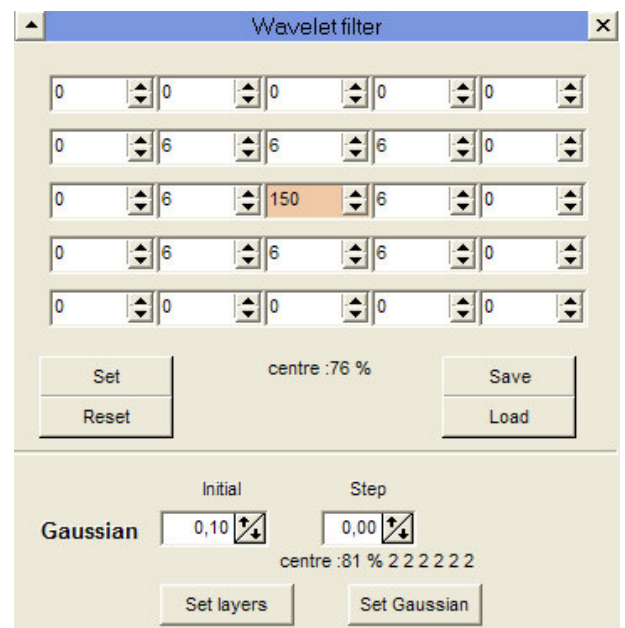
RGB-Shift Window

This control is used to estimate the chromatic shift in the image. Sometimes the R/G/B channels are not aligned optimally and this tool can help improve that alignment. Initially the control will use the alignment area to work with. Press ESTIMATE to start estimating the shift.   After estimation the shifts in X and Y for the Red and Blue channel (compared to green) will be shown in the numerical controls. You can still optimize this by hand by pressing the Up/Down/Left/Right buttons for the two channels. The Showred/Showgreen/Showblue options allow the user to remove temporarily one or more colours from the image. Set RGB align area should be set when the user wants to point (using the mouse) to a different area to use to estimate the shift in RGB.
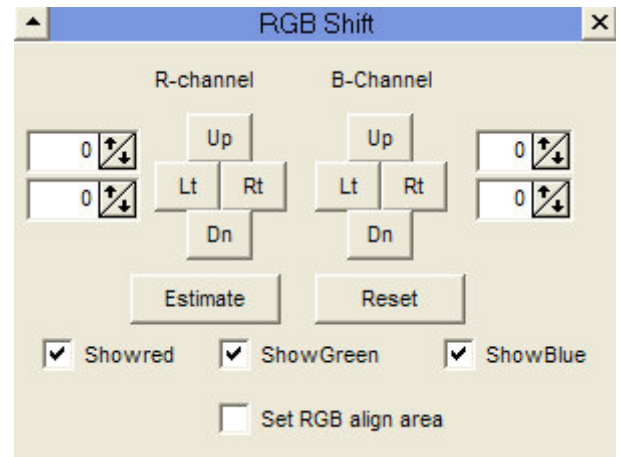
HISTOGRAM WINDOW

The histogram window can be used to control the display of intensities and colours. The imagepart with controls shows the histogram graphs for the different active colourchannels. The colours in the graph are directly related to the colourchannels. The STRETCH button will "stretch" the pixelsvalues between the highest (red triangle) and lowest (green) triangles into the normal 0-255 range. The user first moves the triangles and then presses "STRETCH". The reset button allows the original situation to be returned. The second part (rightside) has two controls that are checked by default, "Show peak and Smooth". These control the appearance of the graph. The Red/Green/Blue channel is represented with a checkbox, a slider and a numerical weight. The checkboxes show the colours that are actively shown on the image. The slider controls the X-axis position of the histograms for every channel (equal to a brightness setting). The weight shows if any of the colours need to be balanced. When for instance green is too prominent in the image its weight should be lowered.

The RESET button sets all the weights and sliders back to their default position. The ⊕AUTOBALANCE button will try (see example) to make the X-positions of the Red and Blue be the same as green. This should prove helpfull in creating a good colour balance.
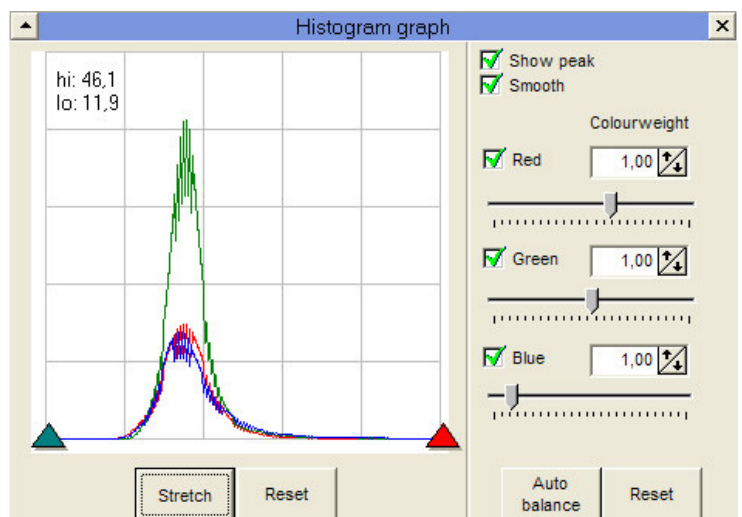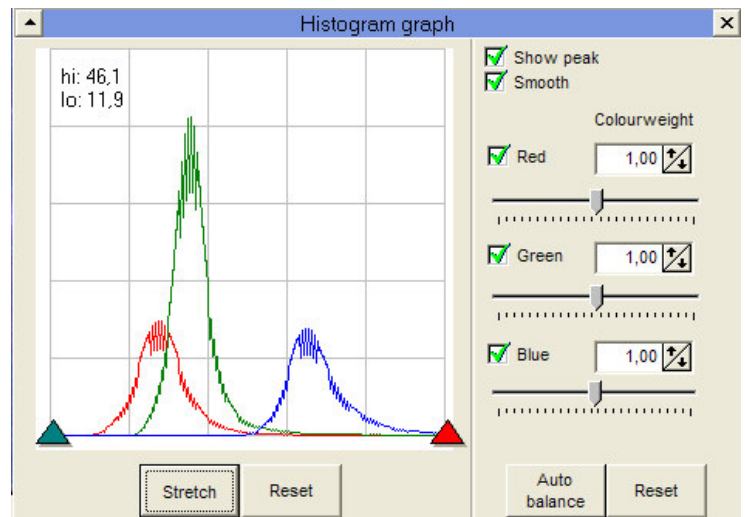
Contrast/Brightness Tool
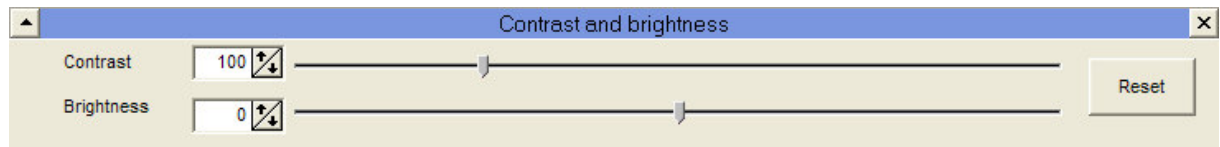
This controls the contrast and brightness settings of the current image. The user can change this in two ways, primarily the sliders can be used. The value of the slider will appear on the numerical controls. Be aware that the sliders are more sensitive (they move in fractions) than the numerical controls. ⊕The numerical controls can be changed by hand. The RESET button will reset these controls.

GAMMA WINDOW

The gamma window allows the user to control the way intensities are displayed. The X-axis equals the input intensities from 0 – 255 and the Y-axis the output between 0-255. By default (Gamma=1) a straight line is used. Input and output are then equal. The user can change the response by adding points to a graph and dragging these. To add a point to the graph right-click with the mouse on the graph. A red circle will appear showing the "anchor" of this point. A smooth graph will run through the points the user specifies. Points can be dragged by pressing (and holding) the left-mouse button over a point. Points can be deleted by holding the ctrl-key and pressing the left mouse button. Any change will be shown in the processing area directly.

Alternatively the gamma-setting can be used, this will clear and override any previously created user-specified points. In V3 the user can ⊕load/save gamma-graphs (only when user-specified points are used).