



# HDR FINISH V1

D O S C H H D R I

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# Program Function Controls

## Keyboard Function

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(Focus on image window)

<b>Key</b>	<b>Function</b>
Pos1	Size to 100%
End	Fit size to window
Page Up	Zoom out
Page Down	Zoom in
Ins	Zoom interpolation on (normal, fast)
Del	Zoom interpolation off
Num 0	Display colors (normal)
Num 1	Display alpha only
Num 2	Display with alpha pattern
Num 3	Display with alpha pattern inverse
Num 4	Display with red alpha
Num 5	Display with green alpha
Num 6	Display with blue alpha
Num 7	Display red only
Num 8	Display green only
Num 9	Display blue only
Num Add	Increase display Exposure Value (EV) by 1
Num Subtract	Decrease display Exposure Value (EV) by 1
Num Separator	Set display EV to 0
Ctrl + Num Add	Zoom in
Ctrl + Num Subtract	Zoom out
Ctrl + Shift + Num Add	Zoom in by factor 2
Ctrl + Shift + Num Subtract	Zoom out by factor 2
Ctrl + Num Asterisk	Size to 100%
Ctrl + Num Separator	Fit size to window
Shift + Num Add	Increase display EV by 1/10
Shift + Num Subtract	Decrease display EV by 1/10
Cursor keys	Scroll in zoomed image
Shift Cursor keys	Scroll in zoomed image (small steps)

## Mouse Function

---

(Focus on image window)

<b>Key</b>	<b>Function</b>
Left Button	Depends on active tool
Right Button	Depends on active tool
Wheel	Zoom in/out
	Zoom destination is mouse cursor position
Middle Button Drag	Scroll/drag zoomed image
Ctrl Middle Button	Auto scroll zoomed image

# Navigation

## Navigation with Keyboard

Navigation in the active window can also be done by using the keyboard. For all key-combinations mentioned here the Ctrl-key has to be pressed down first.

The '+'-key will result in zooming into the picture, while the '-' will achieve the opposite – zooming out. The computer will automatically use a zoom-factor which produces an optimal picture reproduction. If furthermore the Shift-key is pressed (i.e. Shift+Ctrl+ '+' or '-') only multiples of „2“ are used as zoom-factors.

With '/' from the number-block at the right of keyboard, the picture will be zoomed to 100%. Under that setting, one pixel of the picture will be represent by one pixel on the display. With '\*' from the number-block the picture will be zoomed in such a way that it will fit the display window just right.

By using the arrow-keys, the picture content can be moved around in the display window. If the Shift-key is pressed first, the movement (shifting) will occur in smaller increments.

Also see table “Keyboard Function” on page 4

## Navigation with Mouse

The center mouse-button and the scroll-wheel allow very swift navigation in the active picture (window).

By turning the scroll-wheel one can zoom into the picture, or out (wider view). The center point of the zoom-action is always the current position of the mouse-cursor.

The picture in the active window can be moved (pan any direction) by pressing & holding down the center mouse-button while at the same time moving the mouse in the desired direction. The picture movement directly follows the mouse movement.

By pressing the Ctrl-key as well as pressing and holding down the center mouse-key, the picture can be scrolled in the window automatically. The mouse movement determines the direction and speed of the picture movement.

Also see table „Mouse Function” on page 5

# Tool Bar

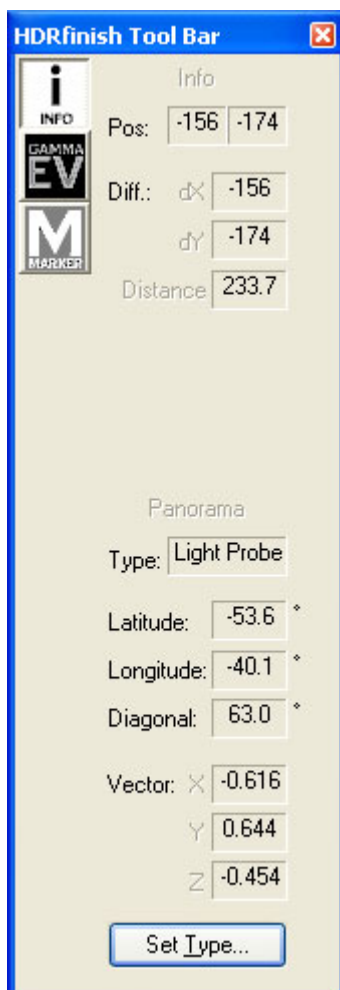
## Measure

This tool allows to display information regarding the current picture, as well as to perform measurements of that picture.

In the fields „Pos“ the current pixel-position of the cursor will be displayed.

In the fields „Diff“ the differential between a marked point and the current pixel-position of the cursor will be displayed. A point can be marked by clicking on it with the left mouse-button.

The panorama-fields display relevant angle and vector information regarding the currently executed mapping. The mapping-type must first be chosen through the function „Set Type“, followed by setting of the camera options.



## Exposure / Gamma

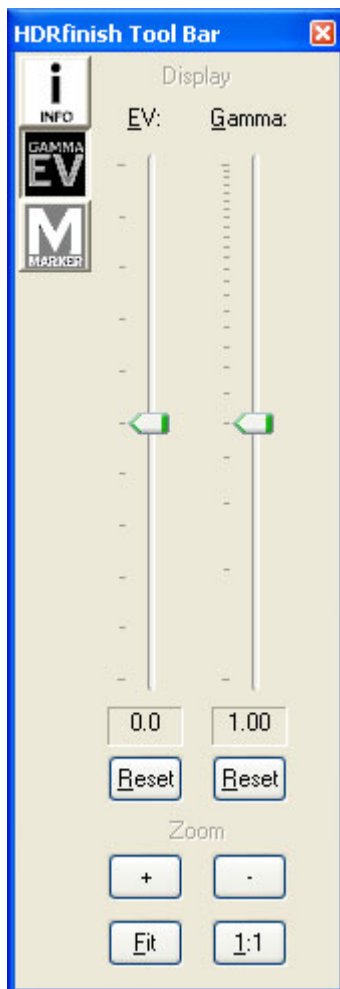
This tool allows to change the depiction of the picture.

The sliding lever „EV“ determines the brightness of the picture. Brightness is stated as aperture distance (EV). A change by one aperture-setting corresponds to a doubling or halving of the brightness level.

Gamma-correction of the picture is performed by adjusting the sliding “Gamma” lever.

The size of the picture detail can be changed by using the Zoom-function. Also see the chapter “Navigation”.

Note: All functions of this tool will only change the depiction of the picture, however not the actual picture content (substance).





# Marker

With this tool markers can be set within the picture. These markers are for filter and editing functions entry data. The placed markers are shown in the list with their respective pixel-positions.

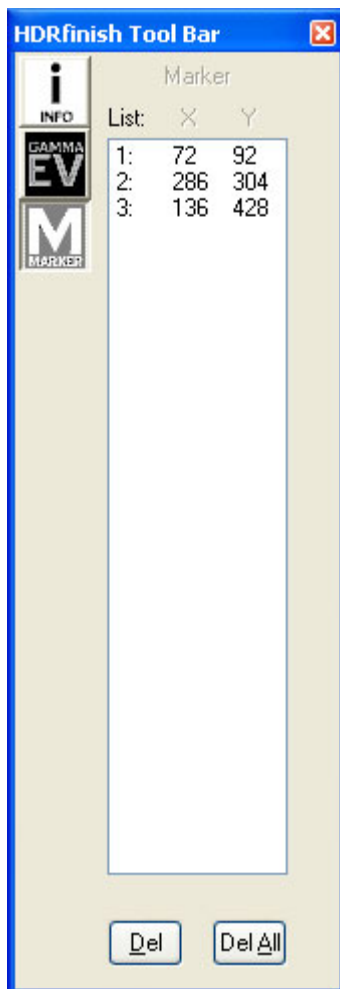
A marker is set by a click with the left mouse-button. If another left mouse-click is done nearby then the marker will be moved from the initial location to the second click position.

A marker will be deleted with a click on the right mouse button.

When the curser is moved near a marker then the respective entry in the list will be selected.

With the function "Del" a marker selected in the list can be deleted.

With the function "Del All" all marker will be deleted



# Menus / File

## File – Open

This function opens a picture file and displays it in a window.

Pictures with low dynamic range (LDR) at 8 and 16 bit per color channel can be loaded just as well as pictures with high dynamic range (HDR). During file-opening LDR-pictures will automatically be converted into HDR-pictures, and can therefore be edited just like any HDR-picture.

If the file contains an alpha-channel, it will be loaded alongside the regular picture, and it becomes part of the picture.

## File – Save / Save As

This function saves the current picture as a picture-file.

Note: If the file-format with low dynamic range (LDR) is chosen, picture content (e.g. brightness values over white and details in dark areas) can be lost.

If the picture contains an alpha-channel then it will also be saved in the picture file as far as the file-format supports an alpha-channel.

## File – Close

This function closes the window containing the current picture. If the picture was modified a security prompt will appear, asking whether the altered picture should be saved first.

## File – Print Preview

This function will produce a print preview on the screen which allows to check and verify alignment as well as overall appearance of the picture.

## File – Print

With this function the current (active) picture will be printed to the selected printer. The picture will be printed in its original size with the current brightness settings and the current gamma-value, as well as with all the markers.

The print-window will allow printer selection and to set the desired Nr. of prints.

The picture picture will always be enlarged to fit the maximum printing area of the printer.

## File – Print Setup

This function allows modification of standard printer settings, paper dimensions and alignment for any following print-outs (until further printer setup changes).

## **File – Preferences**

---

These functions handle important presets and preferences for the program.

The “Status Bar” menu contains settings for the appearance of the program status bar. The brightness values of the color channels can be displayed from 0 to 1 (as in memory), from 0 to 1 with re-calculated gamma-value of 2.2, from 0 to 100 (percent), and from 0 to 255 (as in 8-bit picture). The value of the alpha channels can be displayed from 0 to 1 (as in memory), from 0 to 100 (percent), and from 0 to 255 (as in 8-bit picture). The display “Memory Usage” indicates how much memory the current picture uses in the RAM-memory of the PC.

The interpolation-method is determined in the “Processing” menu. Standard setting is “Bicubic”.

The “Shortcut Keys”-menu determines the keyboard shortcuts.

## **File – Properties**

---

This function will display the properties of the current picture.

## **File – Exit**

---

This command function will close or shut down the program.

# Menus / Edit

## Edit – Undo / Redo

The „Undo“-function will reverse the last change made with a filter. Once un-done, a change can be re-instated with the „Redo“ function.

Every picture stores up to 10 work-steps – and consequently up to 10 most recent changes can be undone or reversed.

## Edit – (Auto) Submit Undo

The menu „Auto Submit Undo“ determines whether an Undo-step should be saved with every filter function.

If the selection menu “Auto Submit Undo” is active (check-mark in menu) every action will result in saving a reversible Undo-step. If the menu is not active then the user can selectively effect saving of an Undo-steps by using the function “Submit Undo”.

Note: For very big pictures/files (several hundred MB) it is useful to un-check the menu “Auto Submit Undo”, since every change or file editing (the last 10) results in saving a separate version of the entire picture (e.g. a 200 MB picture changed 5 times will use ca. 1 GB). This can quickly lead to memory bottle-necks and to continuous ex/importing (swapping) of data to/from the hard-drive.

## Edit – Copy View (LDR)

This function copies the depiction of the current picture into the intermediate memory (clipboard). From there the picture can be inserted into other Windows-programs. The picture will be transferred in its original size, with the current brightness values and with the current gamma-value, as well as all markers.

Note: Since the Windows-Clipboard doesn't support pictures with high dynamic range (HDR), the pictures are transferred with low dynamic range (LDR). Some picture information can therefore be lost in the process.

## Edit – Paste To New

This function will insert a picture from the Windows-Clipboard as a new picture.

Note: The transfer of pictures via the Windows-Clipboard can only occur at the low dynamic range level. Any HDR-content on the „copy“-side will be lost once pasted.

## Edit – Duplicate

This function duplicates the current picture in memory. It can now be edited, modified and saved separately from the original picture.

# Menus / View

## View – Tool Bar

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This function turns on/off the Tool Bar menu

## View – Status Bar

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This function turns on/off the Status Bar

Note: Individual elements in the status bar can be selected (added/removed) using the Preferences menu

## View – Zoom ...

---

This menu function permits the enlargement or shrinking of the file display in the window. This will only affect the on-screen display, not the file-content.

Note: For more effective picture editing key-combinations (shortcuts) can be used, as well as elements from the Tool Bar, and the scroll-wheel on the mouse.

## View – Display Exposure ...

---

This menu function allows to change the brightness of the display. This will only change the display on the computer screen, not the picture content however.

Note: For more effective editing keyboard shortcuts as well as elements from the Tool Bar can be used.

## View – Display Gamma ...

---

This menu function lets user modify the gamma value of the display. This will only alter the display, not the actual picture (file) content.

Note: For more effective editing keyboard shortcuts as well as elements from the Tool Bar can be used.

Mit diesen Menüpunkten kann der Gammawert der Anzeige verändert werden. Dabei wird nur die Anzeige jedoch nicht der Bildinhalt verändert.

Hinweis: Für ein effektiveres Arbeiten können auch die Tastenkombinationen als auch die Elemente der ToolBar verwendet werden.

## View – View Mode ...

The View-Mode changes the depiction of the picture, however not the picture itself. Modifiable parameters are the color channels, the alpha-channel, or combinations thereof.

### Menu

Smooth  
Pixel Steps

### Function

While magnifying the image display the pixel are interpolated  
While magnifying the image display the pixel are shown as blocks. Interferences can occur.

### Menu

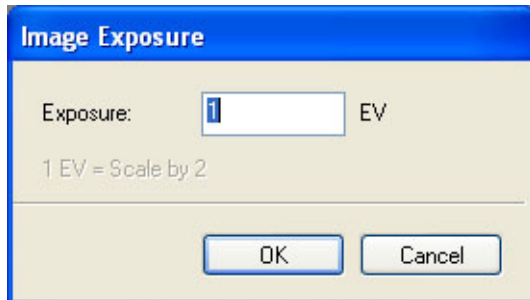
RGB  
Alpha  
RGB Alpha-Mask  
RGB Alpha-Gray  
RGB Alpha-R / G / B  
RGB R / G / B

### Function

Standard View of the Image  
View of the Alpha-Channel in gray scale. White is opaque, black is transparent, gray levels are partial transparent  
View of the Image with checkerboard overlay of the Alpha channel  
View of the Image with overlay of the Alpha channel in light gray  
View of the Image with red / green / blue colored overlay of the Alpha channel. The Alpha channel only colors the image. ?  
Single color channel of the image as gray scale

# Menus / Image

## Image – Exposure – Numeric



This function increases or reduces the brightness of the current image. The value for the brightness change is stated in aperture steps (EV). One aperture step change results in double or half the light exposure (brightness). A positive value brightens up the picture, while a negative value makes the picture darker.

When the aperture number increases (+2; **positive** value) then the lens opening size widens and the picture **brightens**. When the aperture number decreases (e.g. -4; **negative** value) then the lens opening size narrows, **more** light comes in and picture **darkens**.

## Image – Exposure – Scale to Display EV

This function increases or reduces the brightness of the current image. The brightness value used is the value of the display brightness (display EV, see Tools-Exposure/Gamma on page 6)

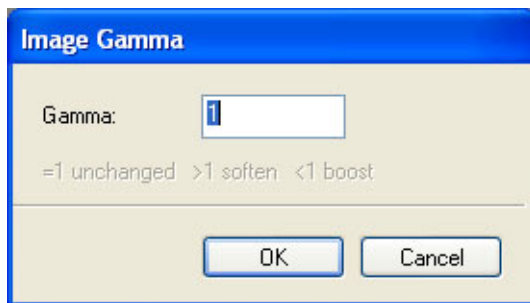
Note: After calculating the picture the display value is reset to „0“. The display (monitor) will therefore show no change.

## Image – Exposure – Clip to Display EV

This function cuts off all the brightness values above white for the current picture. As measure of the white-value the display brightness (display EV, see Tools-Exposure/Gamma on page 6) will be used

Note: After calculating the picture there will be no changes visible on the display (monitor) since the modifications are outside the visible dynamic range.

## Image – Gamma – Numeric



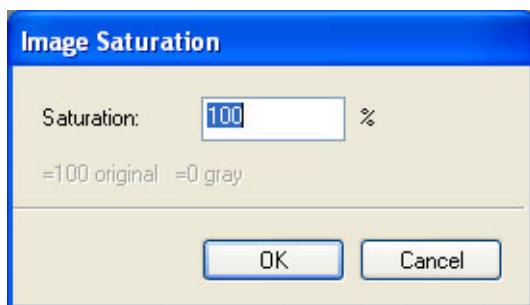
This function increases or reduces the gamma-value of the current picture. A value greater than 1 will result in a softer image. A value smaller than 1 will result in a sharper image.

## Image – Gamma – Scale to Display Gamma

This function increases or reduces the gamma-value of the current picture. Active gamma value will be the value of the display gamma value (display Gamma, see Tools-Exposure/Gamma on page 6) verwendet.

Note: After calculating the picture the display value will be reset to 1. The computer screen will therefore not show any changes.

## Image – Adjust – Saturation



This function increases or reduces the color saturation of the current picture. Color saturation is stated in percent. 100% corresponds to the current value of the picture, while 0% corresponds to a gray-scale picture (also see Image-Adjust-Gray below)

## Image – Adjust – Gray

This function creates a gray-scale image from the current picture. In the process the 3 color channels are balanced for a natural appearance to the human eye.

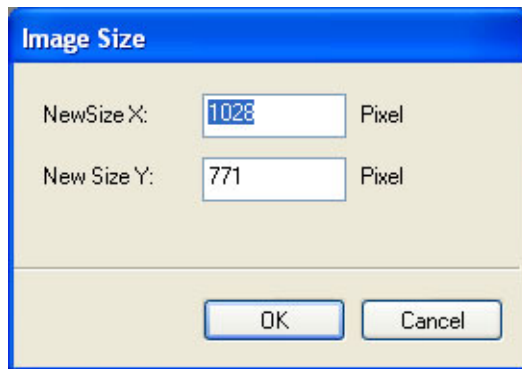


## Image – Adjust – Invert

This function inverts the colors of the current picture (photo negative)

Note: Since high dynamic range images –unlike images with low dynamic (LDR)- can also have brightness values of greater than 1 (white), those values can also become negative (smaller than zero).

## Image – Size – Numeric



This function increases or reduces the current picture by a certain value. The size of the target picture is stated in Pixel.

Unlike with many other programs which use every  $n^{\text{th}}$  pixel in order to reduce the overall picture size, the process here is that pixel-groups are bundled together. This prevents the aliasing effect (interferences) from occurring.

Note: A number of interpolation procedures are being used for this calculation. The type of interpolation can be selected under “Preferences”. The chosen interpolation method will also affect the calculation speed and the quality of the picture.

## Image – Size – Double

This function doubles the picture size (increase by factor 2). The picture content between the „old“ pixel will be interpolated.

## Image – Size – Half

This function reduces the current picture size by a factor of 2. In the process, 4 pixel will be merged into one, which represents an “average optical value” of the original 4.

## Image – Size – Half X

This function reduces the current picture’s horizontal dimensions (X-axis) by a factor of 2. In the process, 2 pixel will be merged into one, which represents an “average optical value” of the original 2.

## Image – Size – Half Y

This function reduces the current picture's vertical dimensions (Y-axis) by a factor of 2. In the process, 2 pixel will be merged into one, which represents an "average optical value" of the original 2.

## Image – Crop – Crop to Marker Rect.

This function will crop the picture to that area which is indicated by the straight lines connecting all markers (2 or more) that have been set. For calculating the new image the smallest rectangular will be used which encompasses all markers.

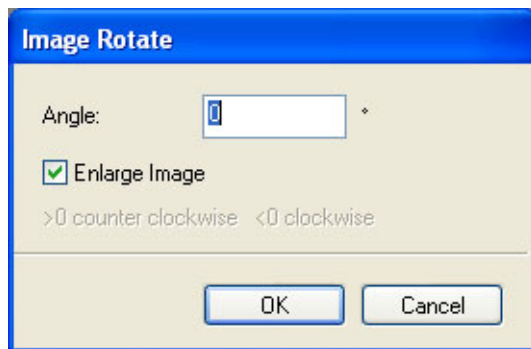
The marker can either mark the corners of the new picture or the center of each side or a combination of it. The latter feature is particularly helpful when cropping rounded picture content.

Now we are actually writing about "rounded picture content" – That's a contradiction to "rectangular" ...

## Image – Flip – Horizontal / Vertical

This function mirrors the current image horizontally or vertically, depending on individual requirement

## Image – Rotate – Numeric



This function rotates the current picture by a specifically determined degree. The rotation is controlled by setting the degree-value (+/- 1-360 degree), with positive degrees rotating the picture counter-clockwise, and negative degrees rotating the picture clockwise.

If the CheckBox "Enlarge Image" is chosen, then the area of the target picture will be enlarged in such a way that no corners will be cut off after rotation is complete. Without this feature being active the overall picture size remains unchanged and rotated picture content can be lost through truncation of corners etc.

Note: Interpolations procedures are used for this calculation. The type of interpolation can be specified under "Preferences". The chosen method will also determine the calculation speed and the quality of the rotated picture.

## Image – Rotate – 90° CW

The function rotates the current picture clockwise (right) by -90 degrees.

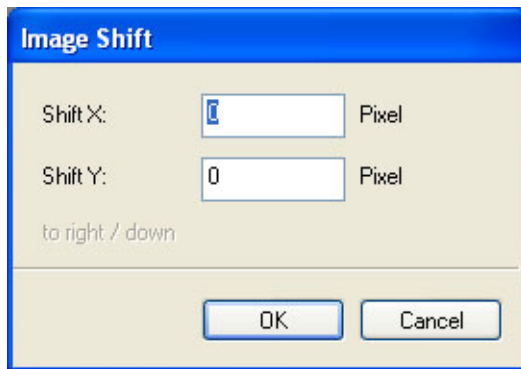
## Image – Rotate – 90° CCW

The function rotates the current picture counter-clockwise (left) by 90 degrees.

## Image – Rotate – 180°

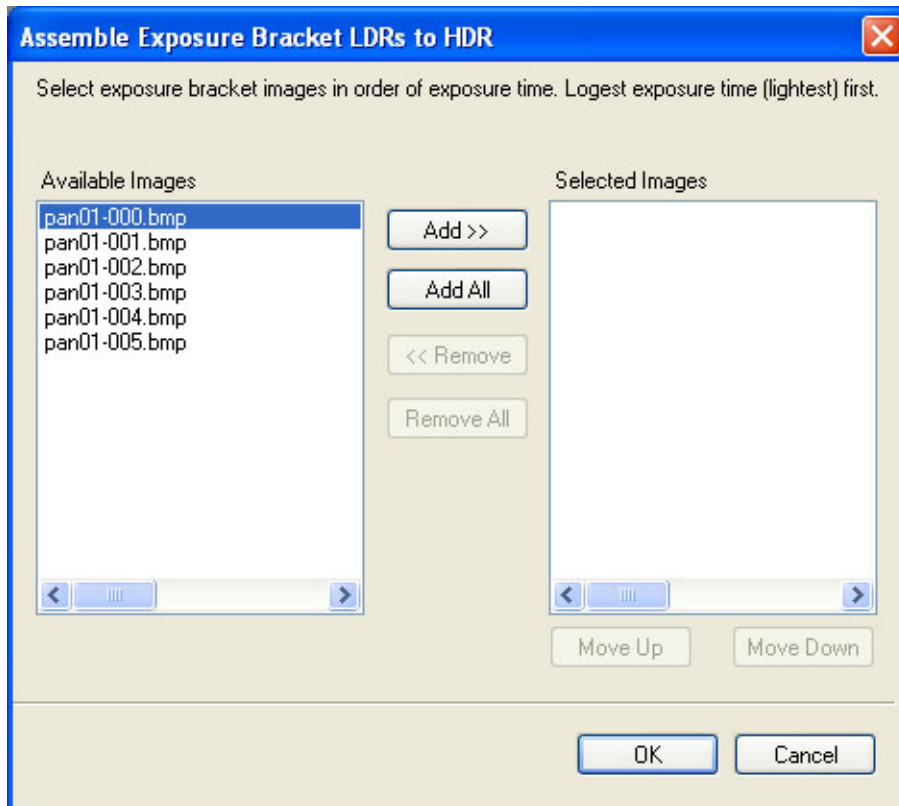
The function rotates the current picture by 180 degrees (i.e. leaving it upside-down)

## Image – Shift – Numeric



This function shifts (rolls) the picture content inside the current picture window. Picture areas which “drop off” one edge of picture (e.g. a tree on the left edge during a left-shift) will “move in” on the opposite side (e.g. tree now appears on right edge of picture). Specifying the value by which picture is shifted is done in pixel. A positive value will move the image towards the right or down. A negative value will move the image left or upwards.

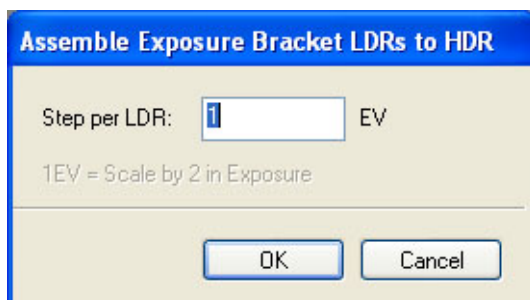
## Image – Assemble – Exposure Bracket LDRs to HDR



This function merges (combines) 2 or more pictures of an exposure series into 1 picture with high dynamic range (HDR).

The pictures are marked in the selection list in the order of their exposure time. The picture with the longest exposure time –i.e. the brightest one- has to be selected first, and the darkest version (shortest exposure) last.

Next, the aperture differential of the exposure series needs to be specified – typically one aperture step (1 EV).



The new target picture will be opened into a new window. The source picture remains unchanged.

Note: For optimal quality of final result it is recommended to set the camera to save the pictures in RAW-format, and to convert that RAW-picture data to a "16-bit per color channel" file-format (e.g. TIFF) after picture is transferred into the computer. Such pictures can directly be opened into this program.

## **Image – Assemble – Insert with Alpha**

This function inserts one more pictures with their respective Alpha-channels as a mask into another picture. All pictures need to have the same size for this operation to work properly.

First, the main-picture, that picture into which another picture (or pictures) are later to be inserted is picked in the selection list. Then the "secondary picture(s)", those picture(s) which are to be inserted into the main-picture are selected. If the Alpha-channel is opaque (white) in an area of a secondary picture, then this area of the secondary picture will be copied (overriding the content of original picture). If the Alpha-channel is transparent (black) in an area of the secondary picture, then this area of the original picture remains intact. Gray-shades in the Alpha-channel will result in a corresponding mixing of the various picture contents.

The new picture (target picture) will be created in a new window. The source pictures will remain unchanged.

# Menus / Alpha

## Alpha – Adjust – Clear

---

This function deletes the Alpha-channel of the picture.

## Alpha – Adjust – Invert

---

This function inverts the Alpha-channel of the picture.

## Alpha – Assemble – Insert from Image

---

This function inserts a picture (gray-scale picture) into the Alpha-channel of another picture. All pictures have to have the same size for this operation to work properly.

First, the picture is chosen from the selection list which is supposed to receive a new Alpha-channel. After that a picture is selected whose gray-value is to be used as Alpha-information.

The new picture (target picture) will be created in a new window. The source pictures will remain unchanged.

## Alpha – Assemble – Extract to Image

---

This function extracts the Alpha-channel of a picture into a new picture (gray-scale image).

This image can be modified using filter and software tools, and then later be re-inserted into the Alpha-channel of the picture using the function “Alpha-Assemble-Insert from Image”.

The new picture (target picture) will be created in a new window. The source pictures will remain unchanged.

# Menus / Filter

## Filter – Sharpen – Sharpen

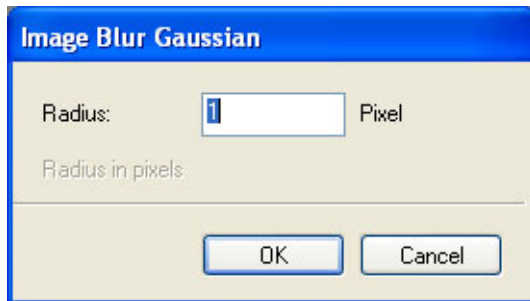
---

This function increases the sharpness of the picture.

The Alpha-channel remains unchanged.

## Filter – Blur – Gaussian Blur

---



This function blurs the picture content within the selected radius. The radius is specified in pixel.

The Alpha-channel remains unchanged.

Note: The filter's calculating time increases with a widening of the blur radius.

## Filter – Math – Add Images

---

This function adds (combines) two or more picture into a new picture.

All pictures which are to be added are chosen from the selection list.

The new picture (target picture) will be created in a new window. The source pictures will remain unchanged.

## Filter – Math – Multiply Images

---

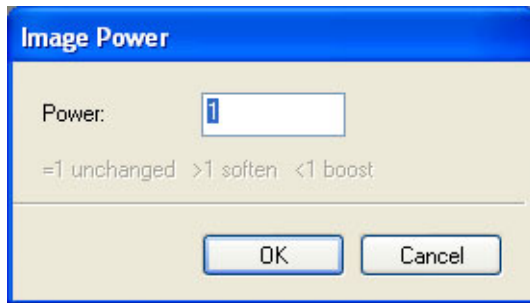
This function multiplies 2 or more pictures into a new picture.

All pictures which are to be multiplied are chosen from the selection list.

The new picture (target picture) will be created in a new window. The source pictures will remain unchanged.

## Filter – Math – Power

---

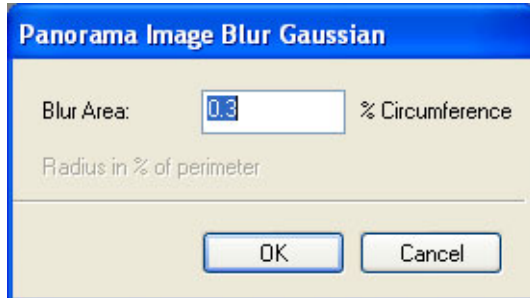


This function exponentiates the current picture by a specified value ( $\text{Picture}^x$ ).



# Menus / Panorama

## Panorama – Panoramic Blur – Gaussian Blur



This function blurs the content of a panorama-image within the specified radius. The radius is stated in percent of the diameter of the “mapped sphere or globe”.

During the sphere mapping (settlement) process, the various picture parts of the mapping represent areas of the globe which are of different sizes. This filter takes into account these distortions, and blurs every point on the sphere to the same degree.

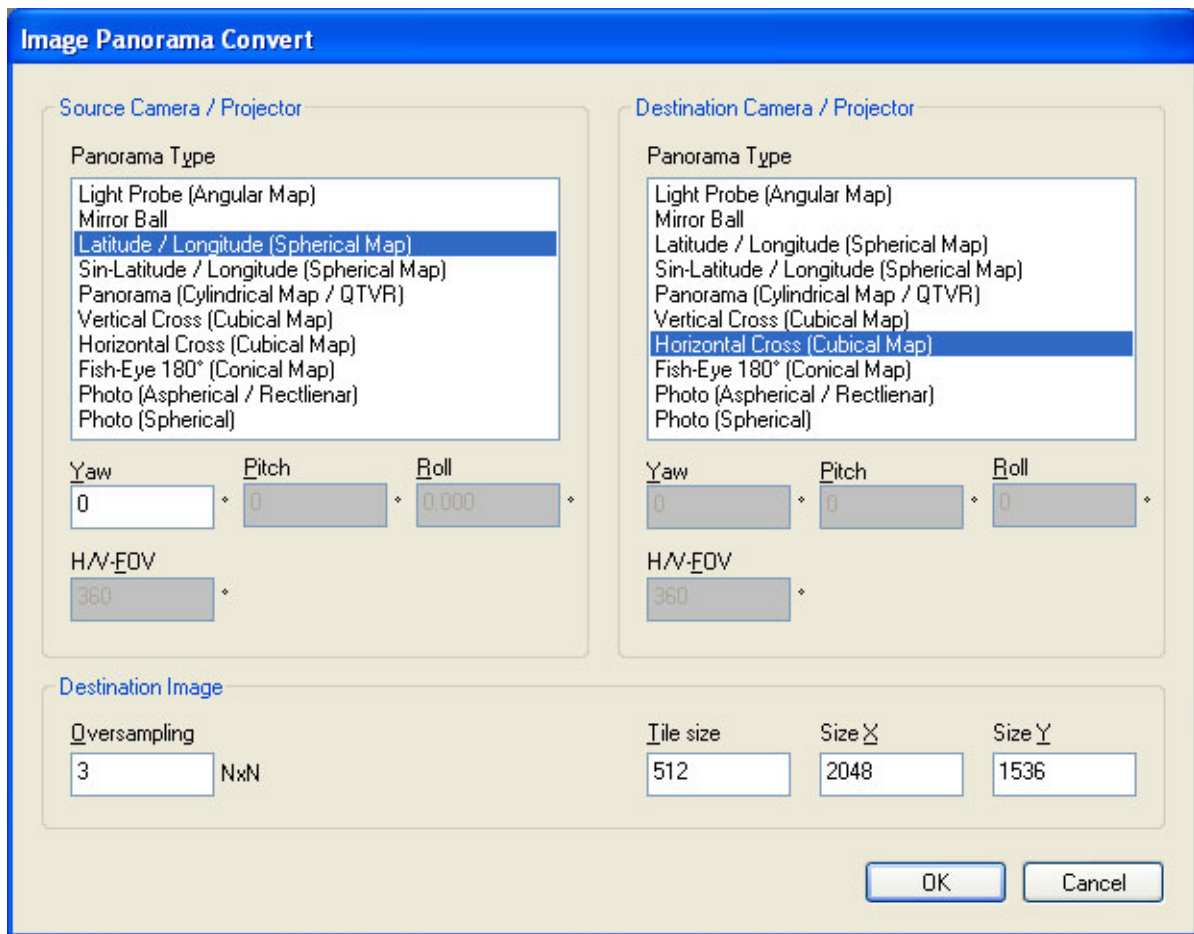
A picture with a side-ratio of 2:1 a lat/long-mapping is assumed. If the side-ratio is 4:3 or 3:4 then a H/V-Cross-mapping is assumed

For other mapping methods, the type needs to be specified in the Info-ToolBar.

The Alpha-channel is not being altered in the process.

Note: With increasing radius the processing time of the filter will increase as well.

## Panorama – Convert – Transform Any to Any



This function transforms the content of a panorama-picture into another mapping method. In the lists "Panorama Type" the mapping method for the source and target camera is selected. The angle "Yaw", "Pitch" and "Roll" indicate the perspective and rotation of the camera in a standard sphere. The value "H/V-FOV" (Field of View) states for some mapping methods the openings-angle of the camera lens (focal length) in degrees. The greater of the horizontal and vertical dimensions of the picture is the relevant one.

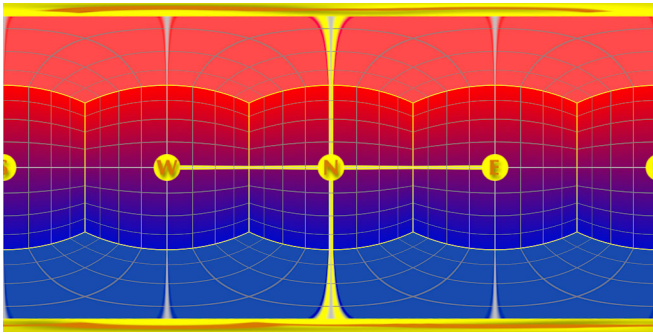
The value for „oversampling“ provides a measure for the quality of the final picture. With rising value more pixel of the source picture are taken into account in order to calculate one pixel of the target picture. This minimizes the Aliasing-problem. A typical value would be between 3 and 5.

Note: With increasing oversampling the processing time of the filter will increase exponential.

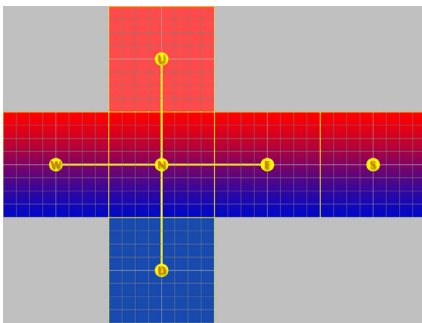
The values for „Size“ set the size of the target picture. For some mapping methods a fix side-ratio is necessary, and only one tile size can be specified from which the picture size will be calculated.

Note: Interpolation processes will be used for this calculation. The type of interpolation can be specified in "Preferences". Calculation speed and the quality of the picture also depend on the process chosen.

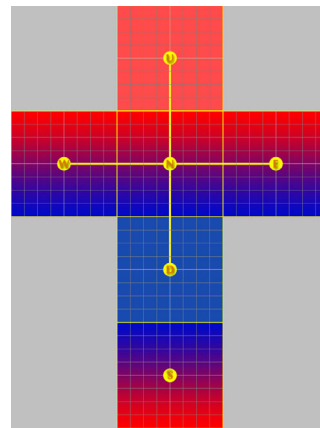
The new picture (target picture) will be created in a new window. The source pictures will remain unchanged.



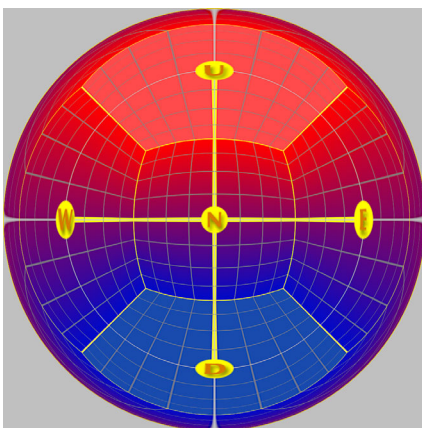
*Latitude/Longitude-format.*



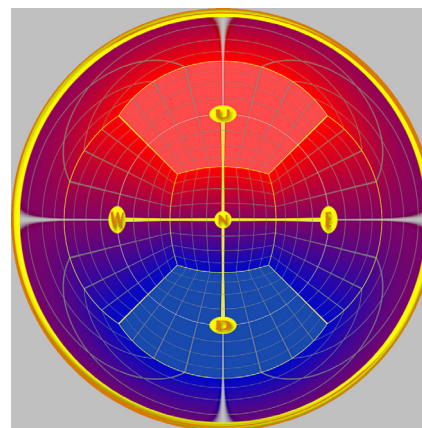
*H-Cross-format.*



*V-Cross-format.*

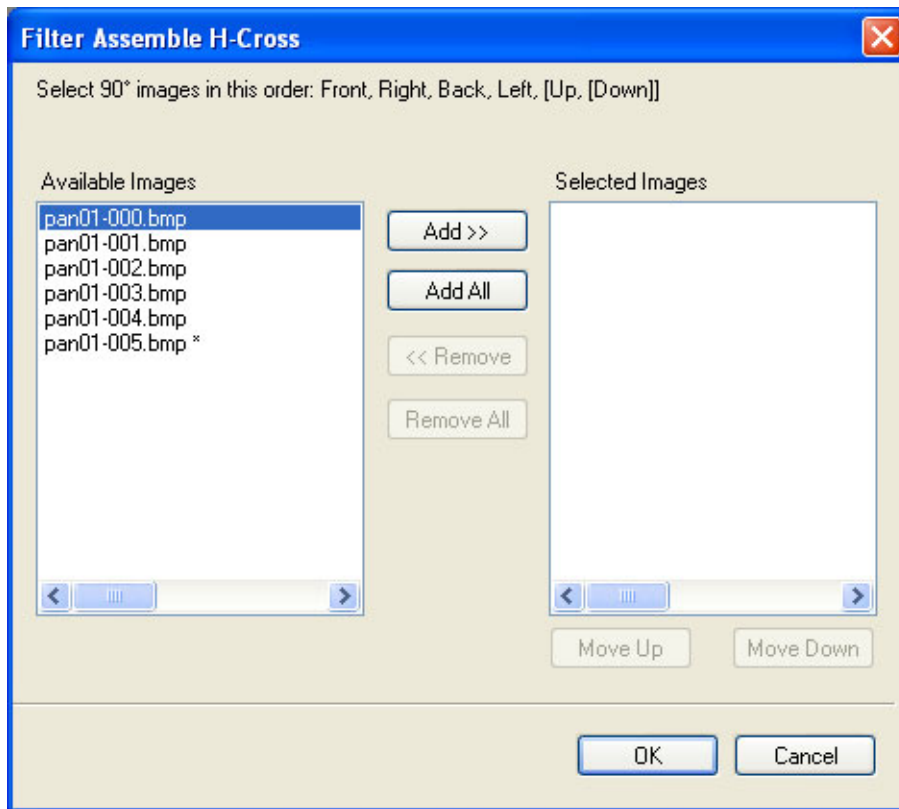


*Mirror-Ball-Format.*



*LightProbe-format.*

## Panorama – Convert – Combine 6 Cubic Environment Maps to H-Cross



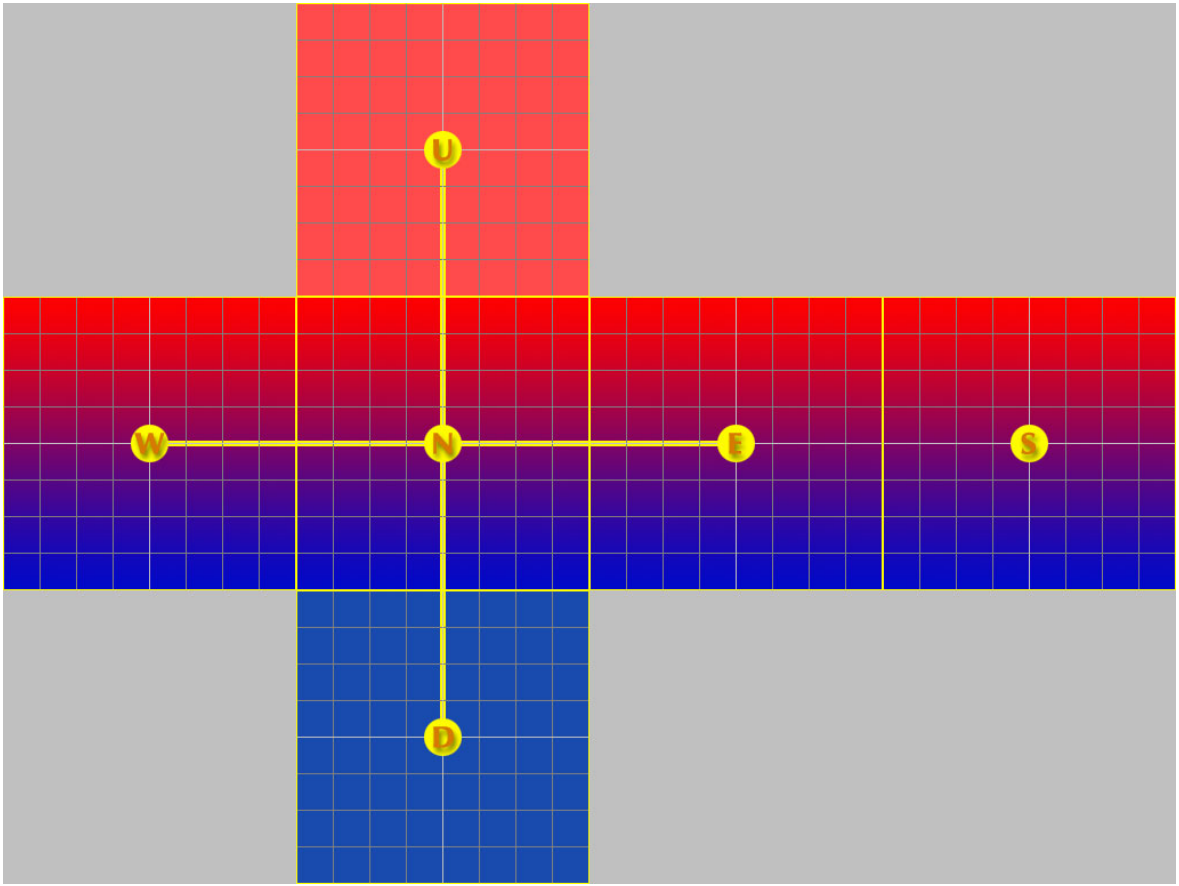
This function merges 4 to 6 aspheric pictures (photos) into one panorama image with the mapping method “H-Cross”. Prerequisite is that all pictures are square, and that the all have the same size.

In the selection listing the pictures should be chosen in the following order/perspective: (compass point equivalent is provided to the right)

- Frontal view ⇒ North
- Side-view (right) ⇒ East
- Rear view ⇒ South
- Side-view (left) ⇒ West
- Up (panning upwards from frontal view; optional)
- Down (panning downwards from frontal view; optional)

The new picture (target picture) will be created in a new window. The source pictures will remain unchanged.

Note: Many rendering programs cannot directly calculate a panorama picture. In order to get around that problem one can set the virtual camera to an opening angle of 90 degrees with square side-proportions, and then calculate 6 separate pictures alongside the main axis. This filter merges these pictures into an H-Cross, which can be converted into any other mapping method by using the filter “Panorama-Convert-Transform Any to Any”.



*H-Cross-format.*

*W=West; N=North; E=East; S=South; U=Up; D=Down*

# Menus / Tools

## Tools – Measure

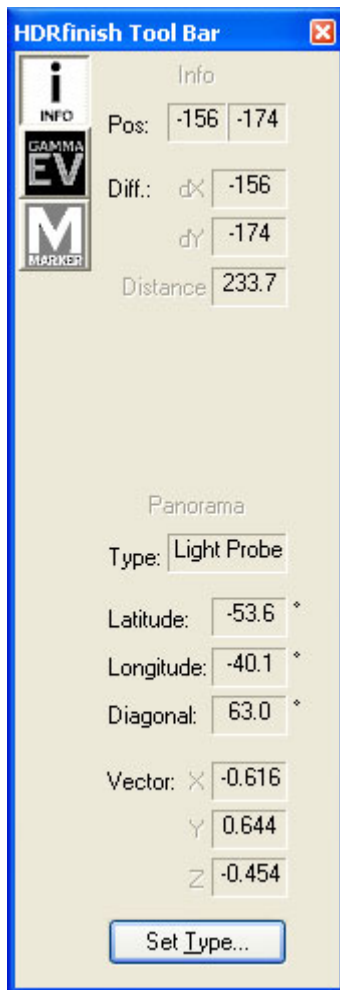
This function activates the ToolBar and switches to the tool „Measure“.

## Tools – Exposure / Gamma

This function activates the ToolBar and switches to the tool „Exposure/Gamma“.

## Tools – Marker

This function activates the ToolBar and switches to the tool „Marker“.



# Menus / Window

## **Window – Cascade / Tile / Arrange Icons**

---

These functions sort the picture windows within the program. It's the equivalent to the usual process in all Windows-programs.

## **Window – Close All**

---

This function closes all windows. If changes were made to a picture a security question will prompt the user to save the altered file or to discard any changes made.

# Menus / Help

## Help – Help

---

This function opens the PDF-file with the information to this program

Note: Prerequisite for viewing the PDF-file is the installation of the Acrobat -Readers by Adobe.

## Help – About

---

This function shows information regarding the program, as well as for individual modules thereof. By means of a double-click on a specific module, additional information can be displayed for that module



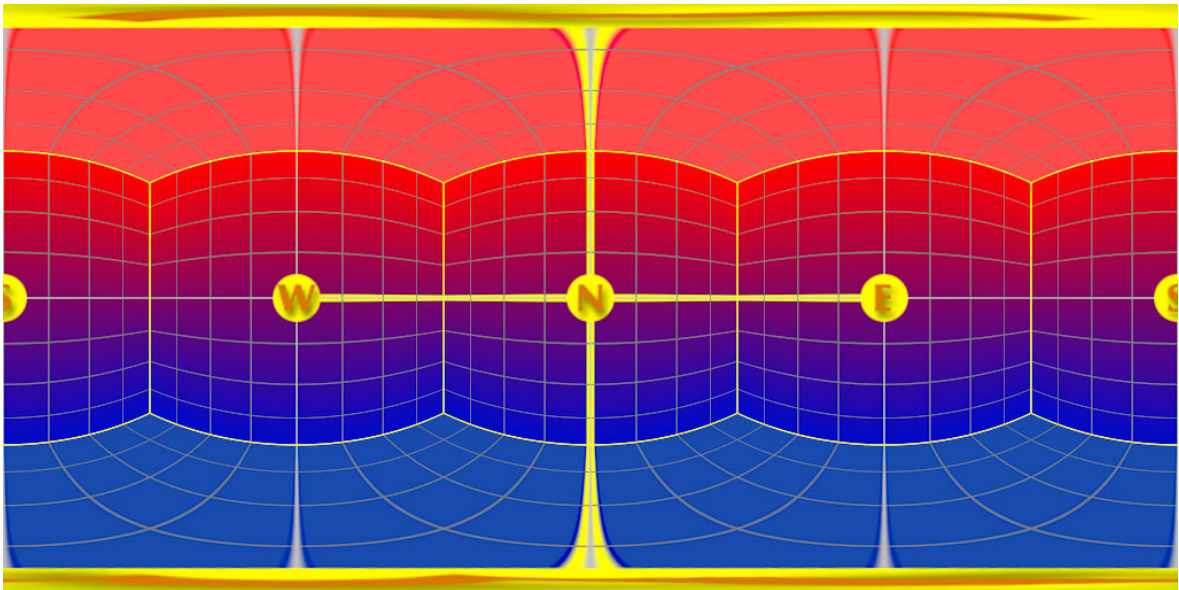
# Appendix

## Sphere Settlement

For the use of HDRIs as an lighting (illumination) technology there are not many, and sometimes no standards at all in the various rendering programs. Also can the mapping format for textures be different from the one for lighting. Lightwave3D for instance uses for textures latitude/longitude-depictions, and for ImageWorld (environments) a picture exclusively in the LightProbe-format. That's why this appendix tries to explain these mapping formats or panorama formats in a bit more detail:

### Latitude/Longitude

The best known spherical mapping method is the latitude/longitude-format. The depiction is twice as wide as high. The X-axis of the depiction directly corresponds to the Heading/Yaw-angle (0...360) and the Y-axis corresponds to the Pitch-angle (-90...0...90 degrees). The horizontal center line represents the equator of the sphere, and the top & bottom lines will translate into the poles. Due to distortions, and the concentration of pixel near the poles, a re-editing of the picture is possible only to a limited extent.



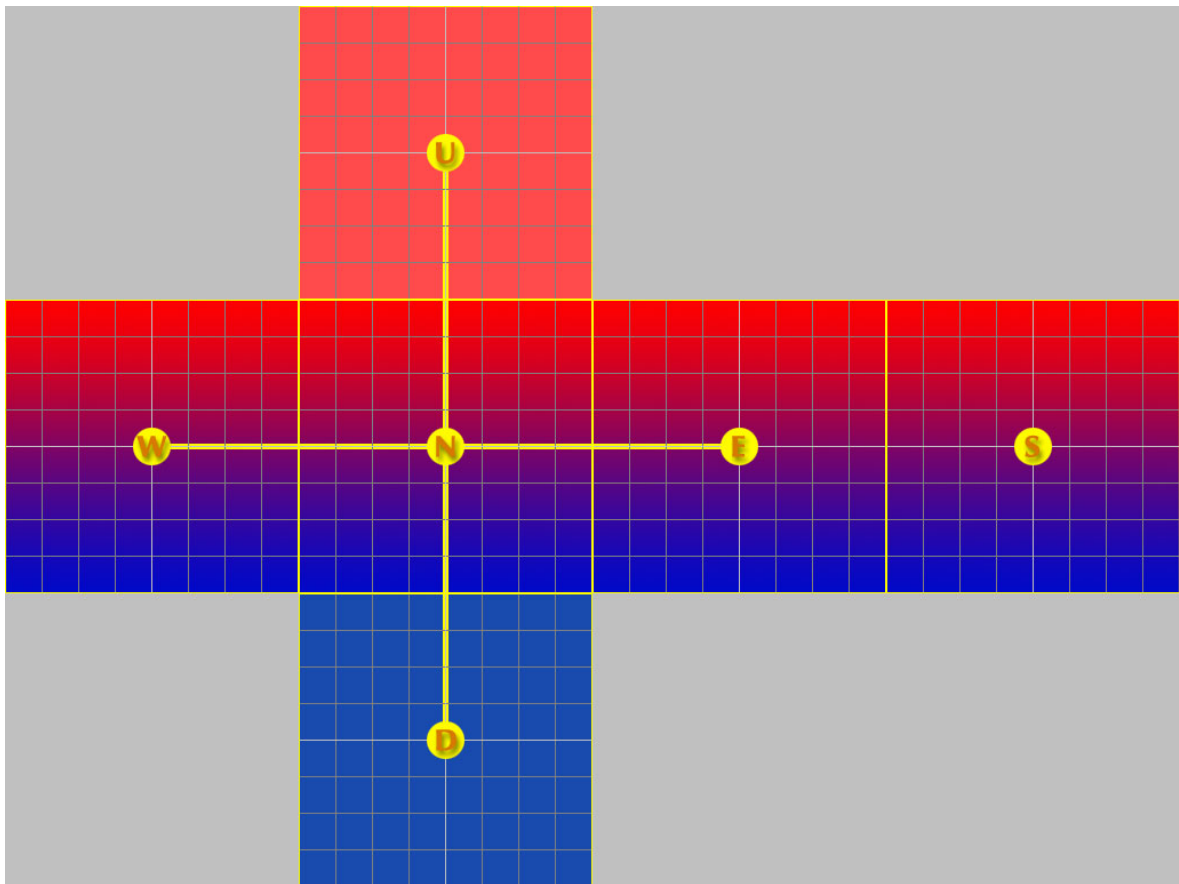
*Latitude/Longitude-format.*

*W=West; N=North; E=East; S=South*

*Up is the top line; Down is the bottom line*

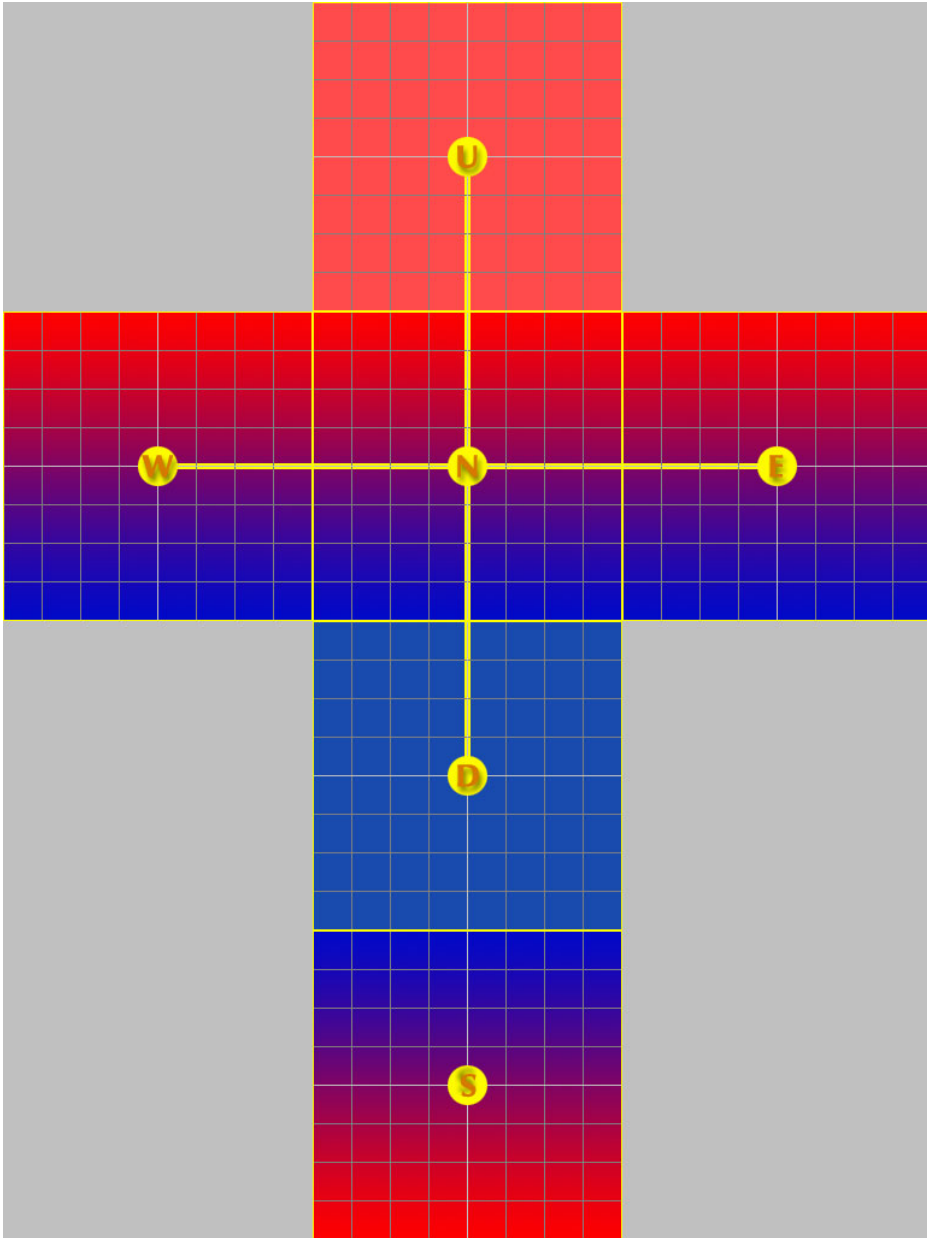
## Horizontal-Cross, Vertical-Cross

These two mapping methods represent cubic mapping procedures. The six sides of a cube are seen as six aspheric quadratic photos which are taken with a 90-degree photo lens. They show the 4 points of the compass, as well as vertical views from the top and the bottom. The individual photos are arranged in such a way that –once cut out- they can be folded back into a cube-shape. The combination of individual photos looks like a cross which lies either horizontally (H-Cross) or vertically (V-Cross) in the picture. This type of mapping is particularly useful for assessment of the spatial geometry and for retouching, since straight lines in the environment (inside the photo) can again be represented as straight lines, and also because floor (bottom) and ceiling (top) remain distortion free.



*H-Cross-format.*

*W=West; N=North; E=East; S=South; U=Up; D=Down*

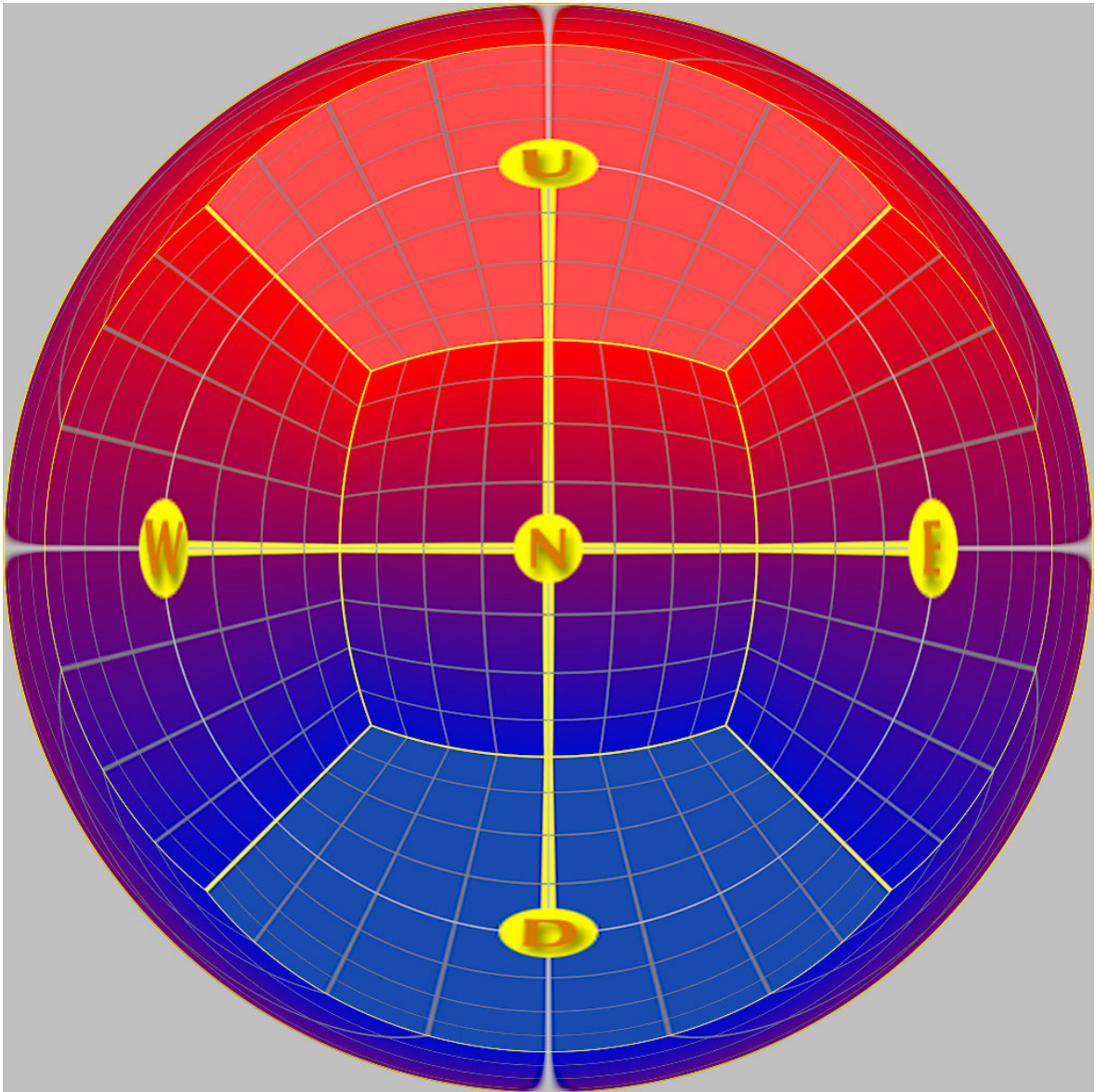


V-Cross-format.

W=West; N=North; E=East; S=South; U=Up; D=Down

## Mirror-Ball

This depiction is not used by rendering programs, but instead is created when photographing a mirror ball. For this the mirror ball is set in the center of a space, and the tele-lens equipped camera positioned at some distance ... pointing at the sphere. From the full-frame sphere image or its mirror image all other mapping formats can be calculated. The picture shows almost 360 degrees of the environment in a heavily distorted form. What will be depicted here at the highest pixel resolution, is the camera man!



*Mirror-Ball-Format.*

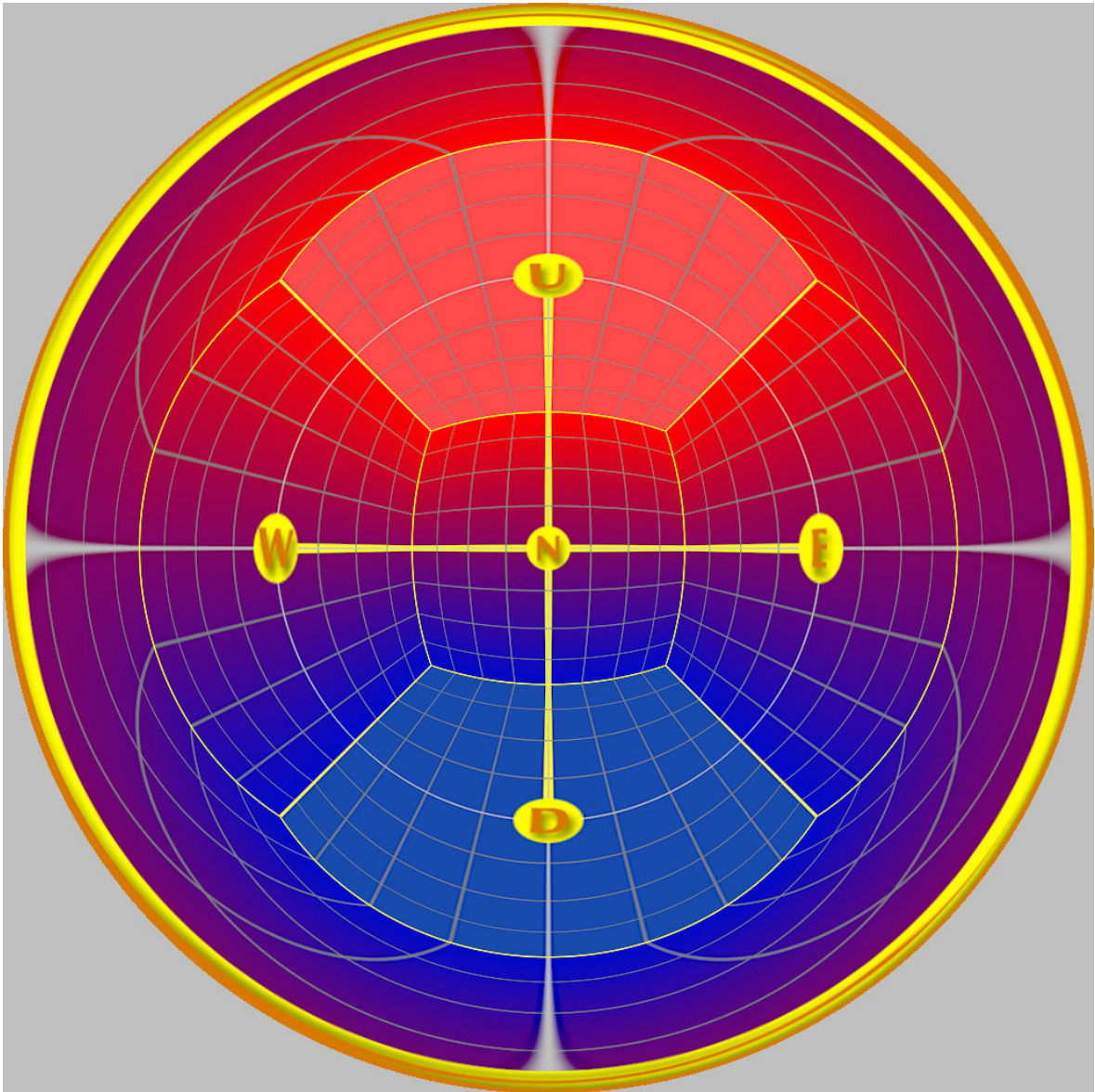
*W=West; N=North; E=East; U=Up; D=Down;*

*South is the circular edge around grid area*



## LightProbe

A LightProbe is a 360-degree fish-eye image (angular map). The square picture contains a circular image which represents the actual mapping. The area outside the indicated circle does not contain any information. The center point of the picture shows the view forward, and the edge of the circle represents the view backwards. Right, left, top (up) and bottom (down) are points at half-radius of circle. Retouching is very difficult due to the strong distortions, and the hard-to-figure out geometry.



*LightProbe-format.*

*W=West; N=North; E=East; U=Up; D=Down;*

*South is the circular edge around grid area*

## Dynamic of the Image

---

When we review an image on a computer screen or from a print-out it will only show a small portion of the brightness range in the environment. By the skills of the photographer, or through the automatic exposure controls of the camera, only that brightness range will be recorded which sets the motive „in the right light“. This is normally sufficient since the human eye can readily process only double the dynamic range (as compared to a digital picture). With a printed picture that range is even lower for many colors.

In order to demonstrate the term and concept of „dynamic range“ let’s take a look at an HDRI of a cluster of trees. As already mentioned we can only print a small portion of the picture’s dynamic range here; it is therefore necessary to examine the HDR-image in several individual steps (i.e. images with various exposure settings).

When we load an HDRI in a proper viewer we first see what we would expect to see in a „normal“ picture (Image 1). The tree leaves are illuminated correctly, the sky is brimming with light, and the details in the underbrush are hard to distinguish in the low light/low contrast at ground-level.

When we decrease (dim) the brightness (luminosity) of the photo (Image 2) then the bright, white sky in a normal picture (24 bit, 8 bit for each color channel) will turn into a grayish area. No information is stored in the picture which transcends white (color hue, saturation, contrast). In the HDRI however the sun will clearly be distinguishable from the surrounding clouds.

When increasing the pictures exposure (Image 3) the bit resolution of the normal depiction is not sufficient in order to show the details in dark areas to any realistic degree. Color transitions are not smooth, but display noticeable „steps“ (Quantization noise) and when using a digital camera one would see the “noise” of the CCD-picture sensor. The uniqueness of HDR-images is that they distinguish not only dark and black, but many nuances in between. As far as the real environment (e.g. dust, haze, diffuse light) provides it, and the quality of HDR-image photography (aperture, lens-reflex etc.) is sufficient, one can brighten the image at will and still recognize details in the dark shadows.





*Image 1: Photo just like from an automatic camera. The sky is full of light and dark areas are shown as black. This is also the normal appearance of an HDR-image.*





*Image 2: Lower-exposure photo. Information beyond white are lost in a 24-bit image (left). The HDRI (right) however still shows distinct sky features.*



*Image 3: Higher-exposure photo. The 24-bit image (left) reveals quantization problems (grainy; low detail). The HDRI (right) successfully depicts details in the dark areas.*



## File formats

Processing HDRIs requires arithmetic which allows representing values “above & beyond white” as well as the precision to distinguish subtle nuances in the dark/black color range. What better to choose for this purpose than floating point representation. Indeed many rendering programs already calculate pictures alternatively in the IEEE-Floating-Point-format (32 bit per number; 12 byte per pixel). The following formats are common for saving the HDRIs in a file:

### PFM

The simplest file format is the Portable-Float-Map (PFM). After a simple ASCII-header follow the 3 color values for each pixel directly as IEEE-Floating-Point values. Because of it’s simplicity it is well suited for programming small filters and converter, however it offers no compression, and will consequently occupy 12 bytes on the hard-drive for each & every pixel in the picture. A PFM-picture file is therefore 4 times larger than an uncompressed 24-bit picture.

### TIFF - Float

The TIFF-format definition doesn’t only contain 8-bit and 16-bit color channels, but also stores picture info as 32-bit floating point numbers (IEEE). Data compressions is not a feature in this file format, which results in significant use of hard-drive capacity (factor 4).

### TIFF – Pixar Log

This format which was developed by PIXAR allows storing of the 3 color channels as 11-bit values. Every value is stored as a logarithmic value, and can therefore cover a very large dynamic range. Logarithmic storage offers the benefit of a constant signal/noise-ratio across the entire brightness/luminosity range. Finally, the picture data is compressed without data-loss by using a ZIP-algorithm.

### TIFF – SGI 24/32 Bit LogLuv

This format was developed by SGI, and it stores the brightness (luminosity) as a logarithmic 10/16-bit value. The color information is converted into a u-v-color range, and stored with 7/8-bit each. This results in memory requirements of 24/32-bit per pixel, which is therefore smaller than the raw-data (floating point) by a factor of 1.333 (i.e. 4/3)

### SOFTIMAGE|XSI Map

The 3D-program SOFTIMAGE|XSI provides its own data format for storing HDRIs. Those files are called “Memory-Mapped-Image”, and they have the file-extension **.MAP**. Picture in the **.HDR**-format can be converted into a MAP-file by using the program HDRITOXSI.EXE (<http://www.xsiturkiye.com/temp/hdrtoksi.exe>).

## HDR

This format was first published in 1987, and also known as the „Radiance-format“.

Having been developed for the „Radiance“-program by GREG WARD, the pictures were stored with the **.PIC** file-extension. The pictures which we find today have the file-extension **.HDR** in order to prevent confusion with other PIC-formats. After a simple, but expandable ASCII-Header follows the picture data. The color is stored as a 24-bit RGB-value that is independent from brightness levels. On top of this there is an 8-bit exponent which returns the standardized color to the correct brightness. The thereby derived 32-bit are compressed line-by-line using a Run Length Encoding (RLE) process. The picture is ca. half the size of an uncompressed 24-bit picture.

## OpenEXR

The most recent file format was created by a company called ILM for editing their large cinematic movies. The file-header also can contain additional information like camera position and –settings, color corrections and parameters for editing programs. Besides the picture data storing as 32-bit floating point numbers (**float**) there is also a memory-saving 16-bit floating point number (**half**) variation. Although the dynamic range of **half** (as compared to **float**) is reduced, it is quite sufficient for editing and storing HDRIs, and it does not result in significant limitations for practical use. Besides the color channels (RGB or YUV) there are also further channels like Alpha, depth and surface vectors which can be added. For compression of the channels there are 3 methods available – all without data-loss – which (according to ILM) can reduce the memory requirements (disk space needed) by 50%. Further information and free C++ sources can be found at

<http://www.openexr.net>.

## HDRI in use

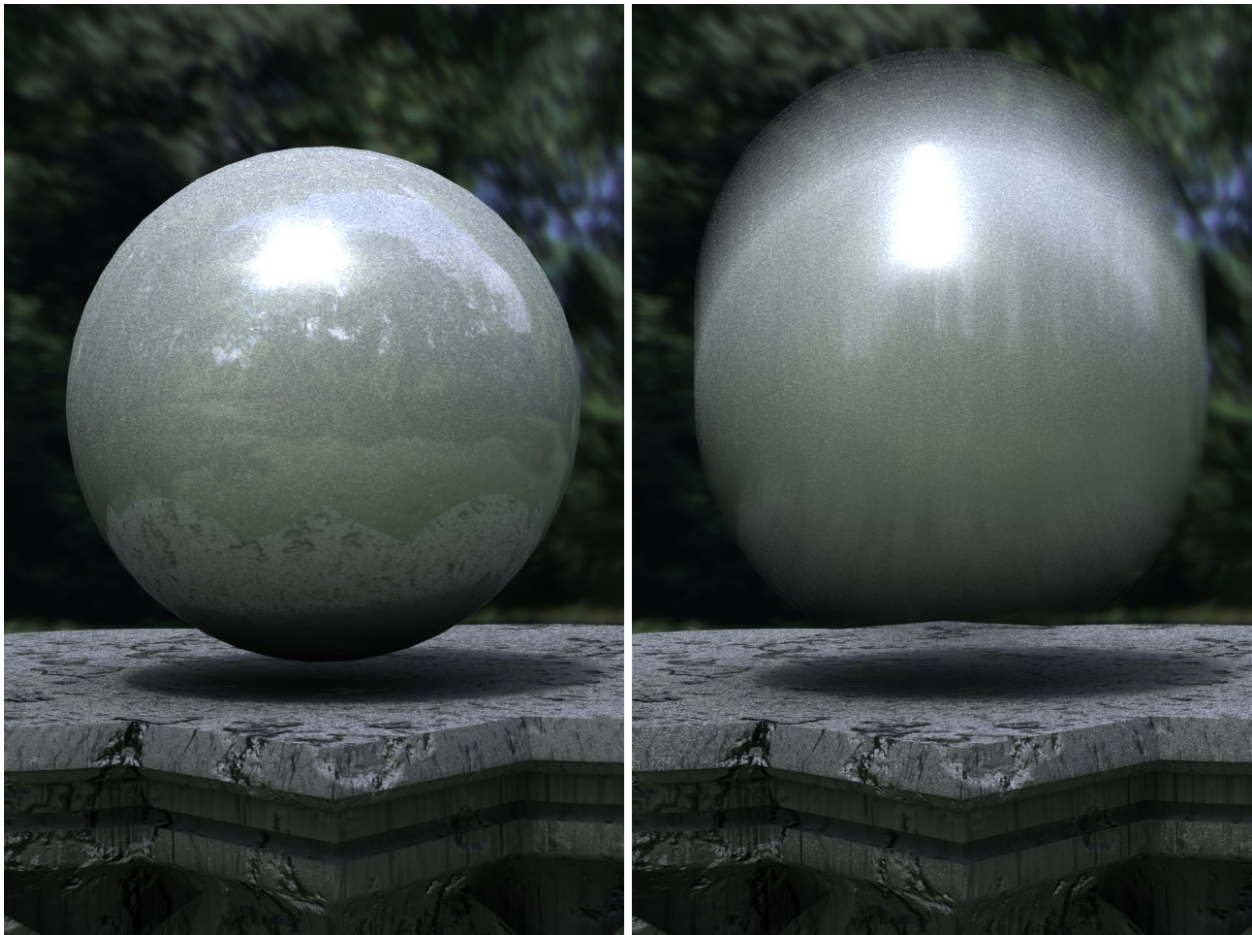
When a 24-bit picture is put out by a rendering program then the result is mostly final in terms of brightness. Editing the picture beyond this point is possible only to a quite limited extent. Many rendering programs by now support saving the HDR-image as an actual HDRI-file, and that's how many of the amazing effects and possibilities only become possible, using the HDRI-technology to its maximum. Here are some samples:

A general advantage of pixel values with a higher bit-resolution is that multiple filters can be use simultaneously (back-to-back; e.g. brightness, contrast, gamma-value, color balance), without quantization effects (abrupt, visible transitions) of the color value. If filters are applied to a 24-bit picture then a noticeable deterioration of the picture will occur after only a few modification runs.

Anybody who starts playing around with the spot-light feature of the rendering program, will quickly end up with an over or under exposed picture. When the test rendering is saved as HDRI it is rather easy to assess the lighting-effects by the brightness changes in the viewer without having to alter the intensity of all light sources. There are also Plugins available which will facilitate an automatic brightness correction – similar to the light meter of a photographic camera.



Image 4: Various mirror balls show the dynamic of their environment or surroundings. They reflect at 100%, 30% und 10%.



*Image 5: A moved object blurs the highlights. With HDRIs the glow (effect) remains white and therefore correct.*

If -for instance- a chrome sphere is placed into the rendering program then the brightness of the environment will be represented 1:1 ; i.e. the very bright sky will again appear as a white area (reflection) on the chrome sphere. Darker reflection materials however (e.g. a black billiard ball) will only reflect part of the light, and the mirrored image of the surroundings is therefore darkened, allowing more environmental features to become visible. As can be seen in Image 4, clouds and the outline of the sun is visible rather than a merely gray, undistinguishable sky area.

When an object is moved quickly within a scene then this will be accentuated in most rendering programs due to the „motion blurring“-effect. This effect results from the many individual pictures of the moved object being later superimposed (centered). If the moved object has a light reflex (specularity, reflectivity) or its own, texture-based light source, then the center alignment of the motion blurring will turn a white dot into a gray stripe. If the white dot is directly or indirectly based on a light in the HDRI then the actual brightness (brighter than white) is taken into account during center alignment, as demonstrated in Image 5.

A subsequent adding of a glow-effect (for reflexes and light sources) only becomes realistically feasible through the use of HDRIs. While 24-bit pictures only provide information like „white“ or „dark“ (for glow-effect), the HDRI also provides quantitative brightness information (e.g. how much brighter than „white“ ...) regarding each pixel.



The glow-radius can be calculated using that specific information.

Similar to the glow-effect, brightness information can also be used for effect intensity when adding or editing lens-flares. A light source in the picture is brighter than white by multiples, and is therefore easy to distinguish for a filter in post production.

A very good example for all the previously mentioned HDRI-advantages are the animations „Rendering with Natural Lights“ (<http://athens.ict.usc.edu/RNL>.) and „Fiat Lux“ (<http://www.debevec.org/FiatLux>) von PAUL DEBEVEC (et al).

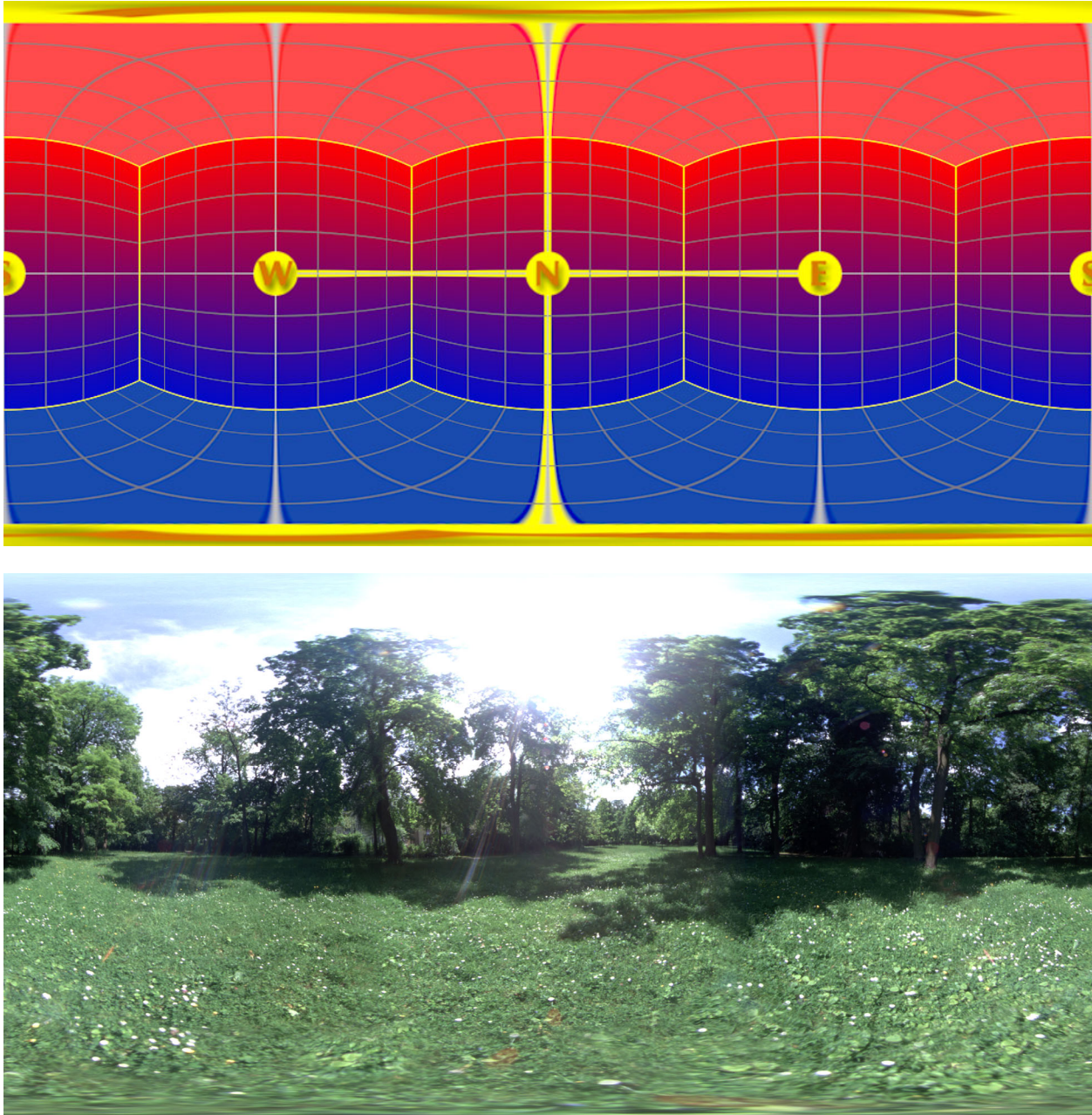


Image 6: Latitude/Longitude-mapping of the HDRI surrounding for the cover image and samples in Image 7.

## Spot out – Lights on!

The most amazing, yet also simplest use of HDRIs is that as a light source (Image Based Lighting). This makes all other light sources (spots, distant lights, area lights etc.) unnecessary or certainly redundant.

Many rendering programs offer the possibility to load a picture as an „image world“ (surroundings/ambient information). That way the picture is not only a spherical background, but also provides the illumination information during the use of the „Radiosity“ feature. One can think of this concept as follows: every pixel on the surrounding Image-World sphere functions as a small spot-light which glows with the respective color and brightness of that pixel. Because of the distribution of the spot-lights (pixel) all over the sphere's surface the object is being illuminated from all sides.

Let's look again at the sample picture of our tree group, and expand it to a 360-degree view of its surroundings (Image 6 shows the sphere mapping (latitude/longitude), which was used for the renderings as Image-World). The greatest influence on the illumination have the pixel of the sun which are 100-1000 times brighter than the other pixel of the HDRI. Due to their large area, the sky-pixels, too contribute significantly to the overall light-quantity, and thereby to the existence and appearance of shadows. On the object side which predominantly faces the trees and the meadow (rather than the sky), various green tones will have the prevailing impact on color reflection and overall mood of the rendered image. Also will those somewhat darker areas of the HDRI be the basis for the diffuse ambient light, and therefore for the softness of the shadows.

A natural surrounding which was captured with an HDRI-camera can be projected –as Image-World- onto the 3D-object which is being rendered. The object will be illuminated exactly in that way as if it had stood in the very location where the camera was positioned when the HDR-image was taken. The result is a photo-realism which was pretty much impossible to achieve with pre-HDR photo-technology. What previously (in the „old days“) required a time-consuming and often elaborate setting (and re-setting) of individual light sources is now as simple as loading a new HDRI ... with all the technical and easy-of-use HDR-advantages.

One source of a variety of surroundings and light-moods is the HDRI-product line by **DOSCH DESIGN** (<http://www.doschdesign.com>).

In order to demonstrate how powerful this lighting technology is we have placed the same 3D-object in various HDRIs, thereby giving it the HDRI's distinct surroundings and illuminations. Nothing was changed, except for switching from one HDRI to another ...

The results can be seen in Image 7.





Image 7: Examples for various HDRI-illuminations of the same scene with the matching LightProbe-picture. The first picture was calculated with a standard illumination.

The white and gray china (porcelain) texture of the dragon reflects the light and picture information of its surroundings very well. Meanwhile, the weathered pedestal nicely displays the interchanging light and shadow features. Lastly, the mirror ball permits an untainted –albeit distorted- look at the surroundings.

## Glossar

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HDR	High Dynamic Range
LDR	Low Dynamic Range
EV	Exposure Value
Rect.	Rectangular
CW	Clock-wise
CCW	Counter clock-wise

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