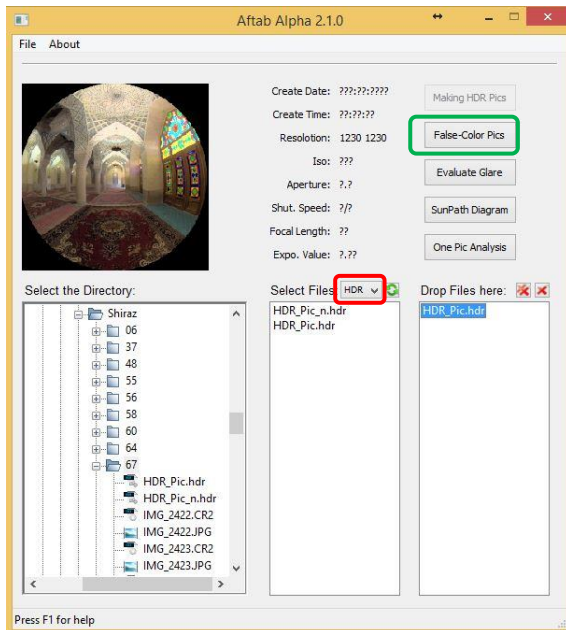
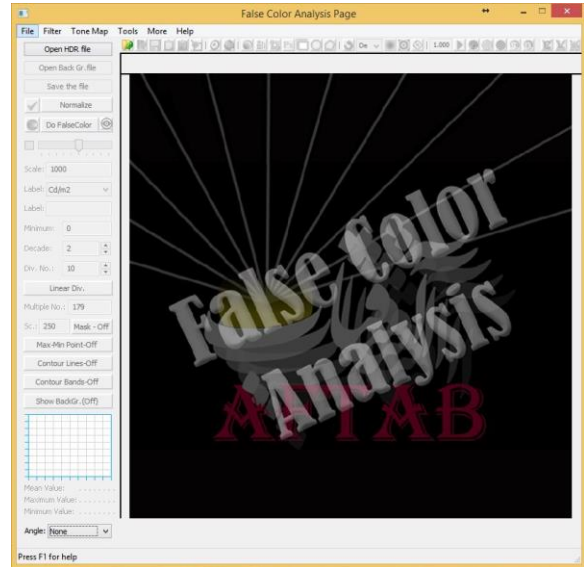


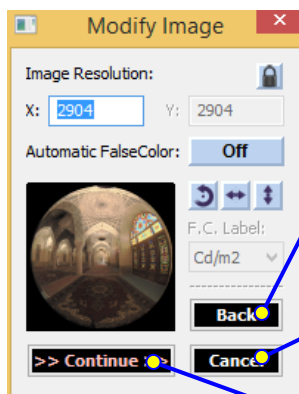
False Color Analysis Page

In this page, we can evaluate a HDR image visually or analytically, with a variety of options. Some of them are related to *falsecolor* and *falsecolor2* options in Radiance, while this page has more tools for analysis. We can export the result in different image types. It works for importing a HDR picture created by merging a few images from a unique scene by different exposure values in the software itself or other HDR creator software, or an image made in Radiance based on luminance (Cd/m^2) - radiance (W/m^2) or illuminance (Lux) – irradiance(W/m^2xsr).



Software Starting:

In the Aftab main page, select Radiance image type (HDR, or PIC) and drag it in the selection panel. Then, click on the 'False-Color Pics' button to enter the false color analysis page.



In this page, we can modify, adjust and also preview the imported HDR image for further analysis in the false color analysis page.



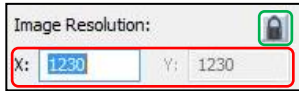
With pressing this button if we open the HDR file from Aftab main page, we return to its main page, while if we open the file directly from the false color analysis page, we go back to the browsing file page.



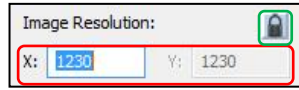
This button close the import modification page, and we return to the false color analysis page.



With pressing this button, we import the selected HDR Image to the falsecolor analysis main page.



Here, we can check and change the image resolution. If the 'Lock' button is available, by changing the X size, the image proportion is kept.



However, if the 'Unlock' button is available, we can change the image proportion based on our needs. So, it is possible to change the image size in both X and Y direction.



If the Automatic FalseColor option is set to Off, the selected HDR image is imported as it is and for each function, the software will calculate based on the input data. While if we set this option to On, the software starts to make nine falsecolor with different scales. So, in the main false color page, we can quickly check those falsecolor images and we can make other analysis based on the chosen scale.



When we set the option to On, the 'F.C Label' text control that is used for labeling the falsecolor image becomes available to change or modify it.



The reddish highlighted area is used to preview the HDR image.



This button rotates the HDR image in a counter clockwise direction.



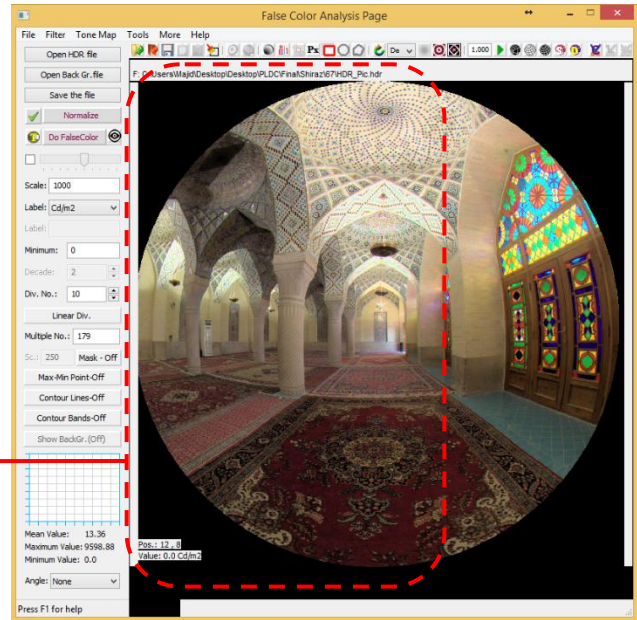
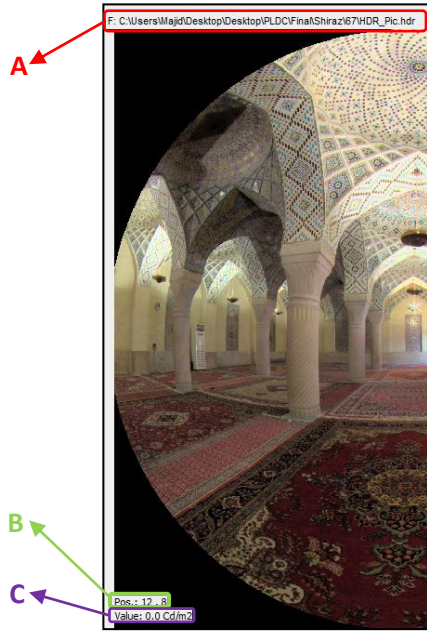
This button flips the HDR image horizontally.



This button flips the HDR image vertically.

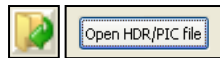
False Color analysis main page:

Here, we can make different types of false color images and some other analysis for HDR images created by merging different pictures of a unique scene with various exposure values or made by Radiance.

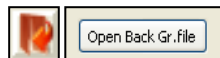


- F:** G:\HDR_Soft\Khodam\2011_07_20\HDR_Pic_hdr
- B:** G:\HDR_Soft\Khodam\2011_07_20\HDR_Pic_hdr

B: F means foreground image used as the source of values and B means background image applied as the picture to overlay with contours.



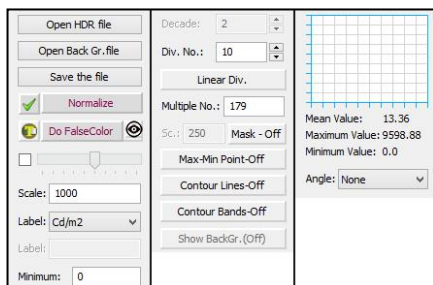
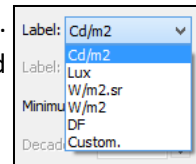
Foreground image is imported by 'Open HDR/Pic file' button.



Background image is imported by 'Open Back Gr.file' button.

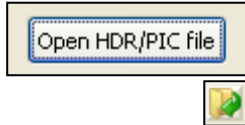
Pos.: 395 , 204 This shows the cursor position in X and Y in the display panel.

Value:50.25 Cd/m2 This shows the image value on the cursor position in the display panel. The value shown here is specifies in the 'label text selection box' and it could be one of these: 'Cd/m²', 'Lux', 'W/m².sr', or 'W/m²'.

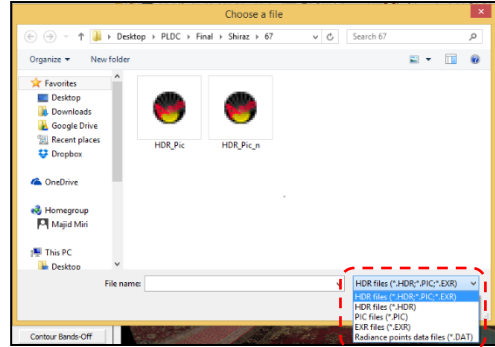


False Color Options part:

In the following all the buttons and text controls plus to the histogram panel will be explained in detail.

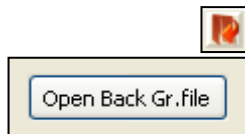


With pressing this button, we can open the browsing file page. In this new page, we can open and import HDR image files. The file imported via this panel used as the source of values for all false-color or other visual analysis.



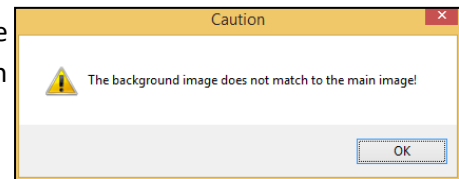
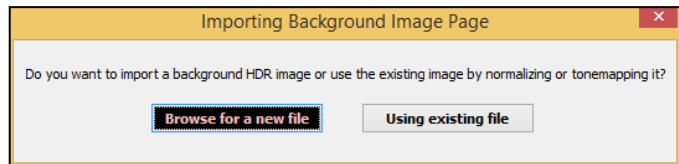
When opening a file here, the file address appears on the display panel as foreground image.

In addition to HDR and PIC extension files that can be imported to the false color analysis page, Radiance points data files with DAT extension can be imported for doing some analysis that will be described later in this section.

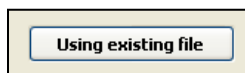
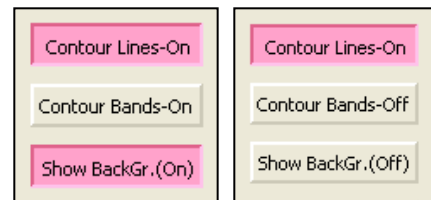


This button opens a panel to define background image applied as the picture to overlay with contours.

Here, we have two options. First is to open the browsing file page. In this browsing page, we can import an HDR image as a background image. The imported background image should have exactly the same as the foreground image. Otherwise the following page as an error page appears on the screen.

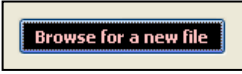


Here, it is worth to say that firstly, the background image is applicable just for *contour-line*. Moreover, it should be mentioned that for making effective the background image when making contour-line images, the 'Show BackGr.' button must be **on**.

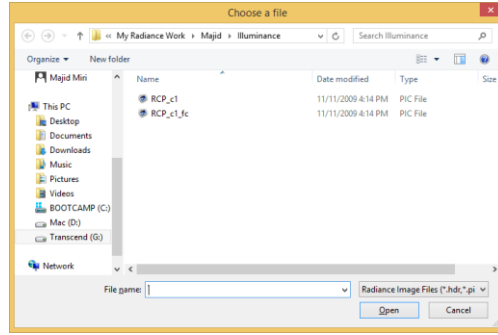


With clicking on this button, the software used a tone-mapped image out of the foreground image as background image. When choosing this option instead of address file of background image, this sentence appears in the front of **B** on the display panel: 'Tone mapping of the foreground image'.

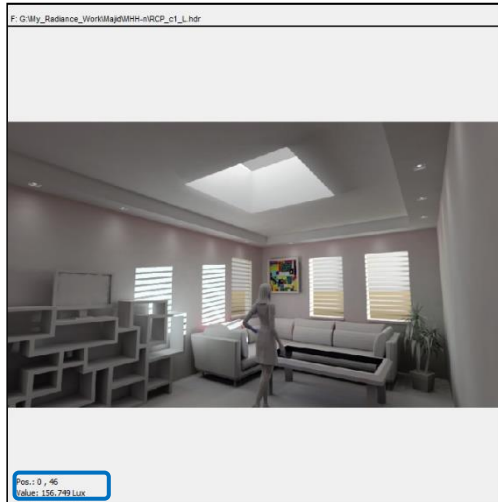




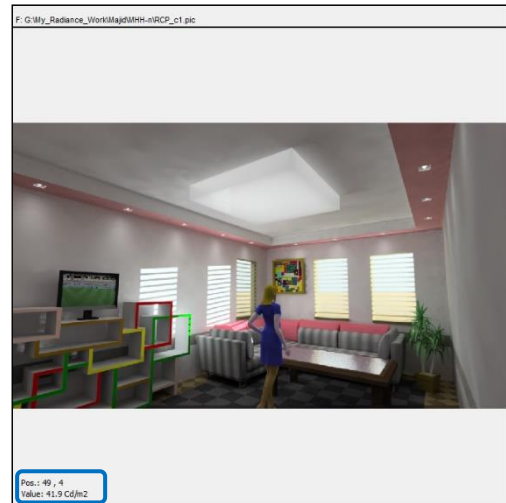
With pressing this button, the browsing file page will be opened.



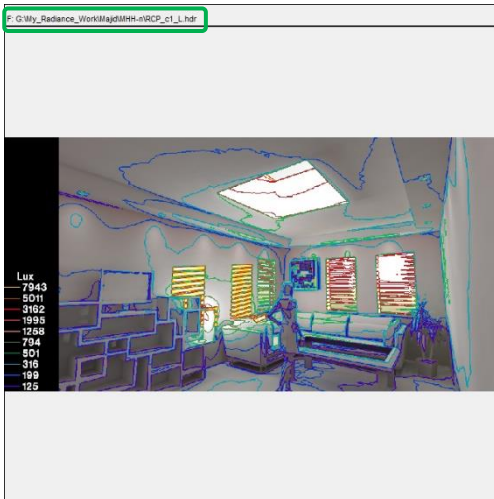
Normally this option is used when the HDR image is created by Radiance based on both Luminance and Illuminance calculation. By importing Illuminance based Radiance file as foreground image and then importing its corresponding luminance based Radiance file as background, the contour-line and false-color analysis seems visually much better.



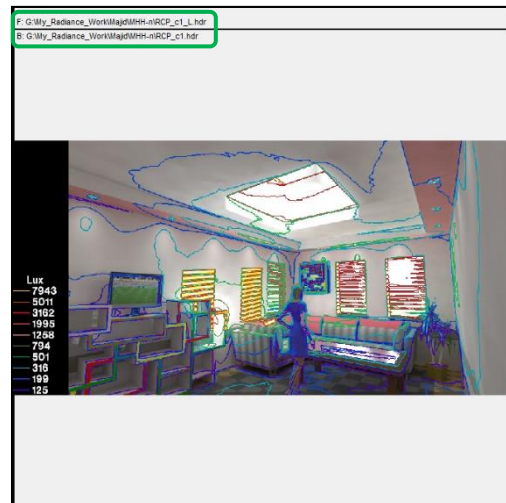
This picture is created based on Illuminance by Radiance. So all values shown in this image is Lux.




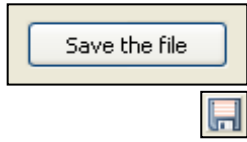
This picture is created based on luminance by Radiance. So all values shown in this image is Cd/m².



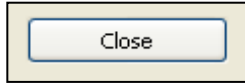
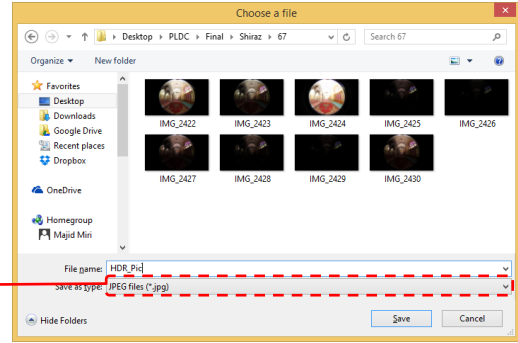
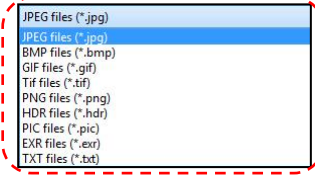
This image is a contour-line analysis image for an illuminance based Radiance image as a foreground image.



With adding a luminance based Radiance image as a background image to an illuminance based one and activate this button (), we can arrive to an image like the front image.



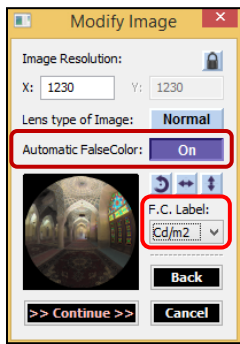
This button open the browsing page to save the image output as different types of picture files like JPG, BMP, GIF, TIF, and PNG or Radiance files like HDR or PIC.



With pressing close button, we will exit the false color analysis page and go back to Aftab main page.



By checking the checkbox, most of the falsecolor options become unavaible while the slider under the button is enable and we can adjust the slider and automatically scale the falsecolor image between minimum to maximum reasonable level. However, The starting point of slider shows the original picture of the image.



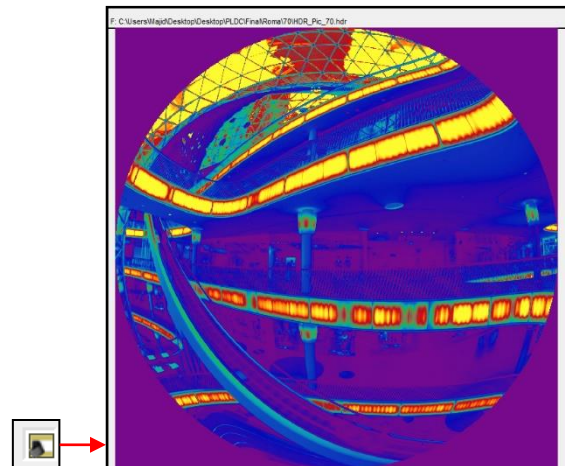
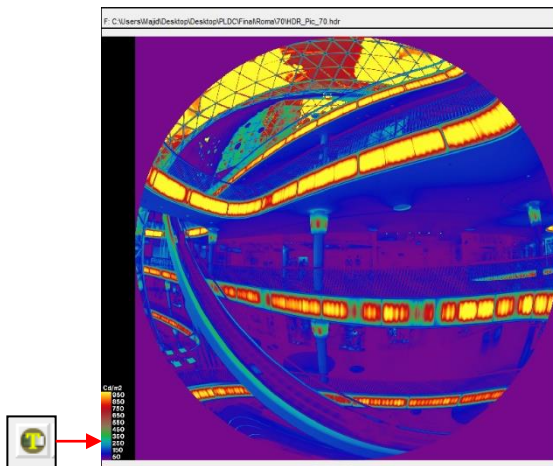
Here, it is worth to say that, if we set the automatic falsecolor 'On' in the import modification page, the software creates the falsecolor when opening the file, so, it does not take time to calculate. Additionally, when the Automatic FalseColor is set to 'On' the 'F.C. Lable' text control box becomes available. Therefore, in that box, we can modify the label in all falsecolor image when we adjust the slider for creating automatically the false-color images.



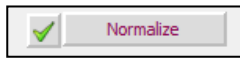
With pressing this button each time, the software create a new false color image based on falsecolor given specifications.



With pressing this button we can hide or show the falsecolor scale legend.



This command will be defined in the next updated tutorial.



With Choosing 'Normalize' and then pressing , the image shown in the display panel will be tone-mapped with histogram adjustment.



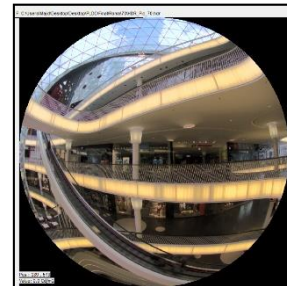
With Choosing 'H.Vision Resp.' and then pressing , the image shown in the display panel will be simulated based on human visual response.



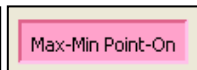
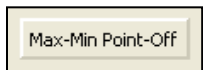
Original Image



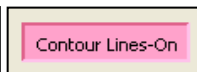
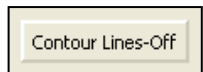
'Normalize'



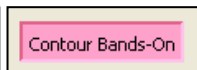
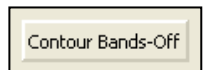
'H.Vision Resp.'



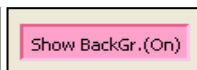
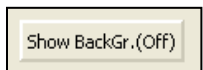
By activating this button, it causes extrema points to be printed on the brightest and darkest pixels of the input picture.



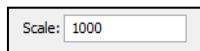
By selecting this option, contour lines are desired rather than just false color images.



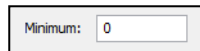
By choosing this option, it produces contour bands instead of lines, where the thickness of the bands is related to the rate of change in the image.



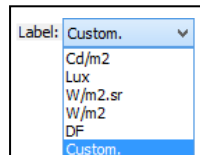
then it will be used both as the source of values and as the picture to overlay with contours



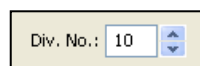
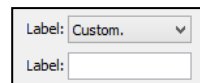
A maximum scale for creating falsecolor image can be given with this text control box.



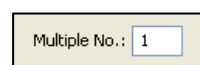
The minimum value when creating falsecolor image can be given in this text box.



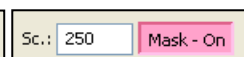
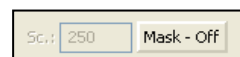
This choice control box is for selecting the legend used when making false color images with a label given by it. It is more useful, when creating HDR image by Radiance software based on Luminance, Illuminance, Radiance, Irradiance, or Daylight Factor that their corresponding units are Cd/m², Lux, W/m².sr, W/m², and DF respectively. Finally its last option is Custom that allow us to have add our cutomize label too. there is custom.



Here, we can change the number of contours (and corresponding legend entries) used for creating false color images.



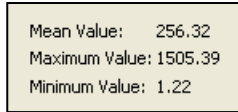
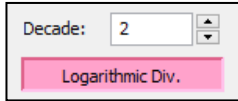
In this text box, a different multiplier can be given to the image that temporarily multiplies all pixel values by this new number when creating false color images.



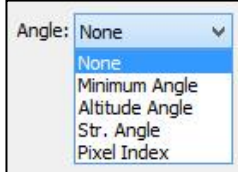
This option masks all values below minimum value defined in this box with the background color (black).



For a logarithmic rather than a linear mapping when creating false color images, the option can be used, where decades is the number of decades below the maximum scale desired.

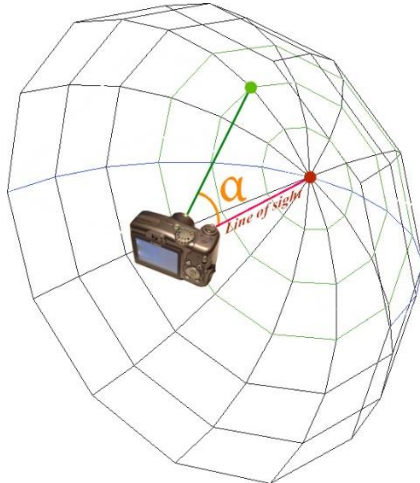


Mean Value: Average pixel values for whole the image.
 Maximum Value: Maximum vlaue in the image.
 Minimum Value: Minimum vlaue in the image.

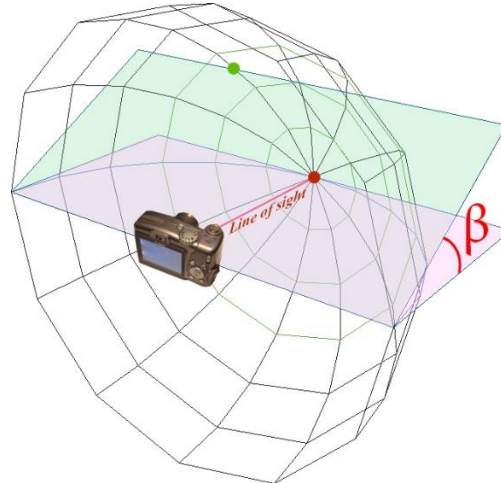


Here we can change the pixel value from luminance / illuminance values to the followings (if the HDR image is not created by a photo realistic rendering software like Raadiance, etc., we need to specify the camera sensor size to define its relevant view):

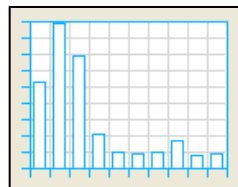
- Minimum Angle: the angle between the selected pixel in the scene and the line of sight.
- Altitude Angle: the angle the selected pixel and the horizontal surface that includes the line of sight.
- Str. Angle: by selecting an area in the scene, it give us the total steradian angle of that area.
- Pixel Index: it shows the position index of each selected pixel.



Minimum angle

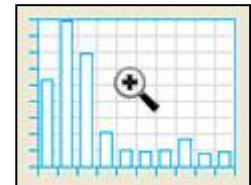


Altitude angle



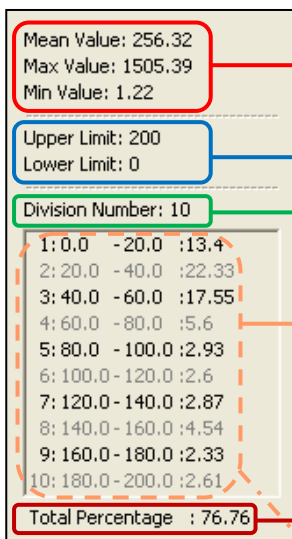
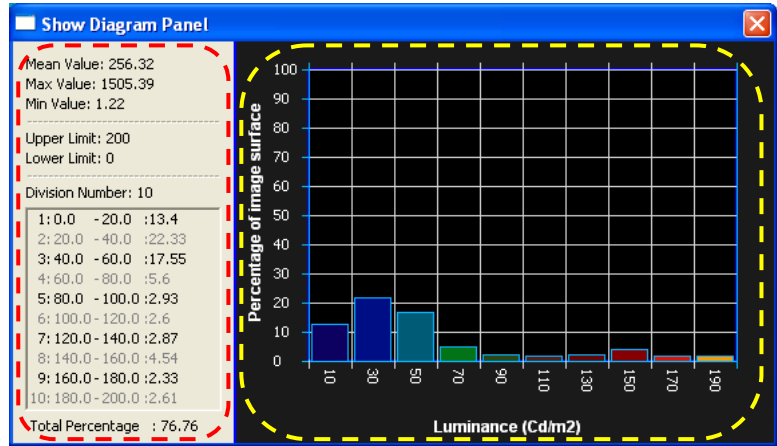
When a false color calculation is finished and its relevant false color image is shown on the display panel, image histogram appears on the histogram panel.

By moving the mouse cursor, its shape changes to a magnifier one. In this case, we can click on the histogram panel to open 'Show Diagram Panel'

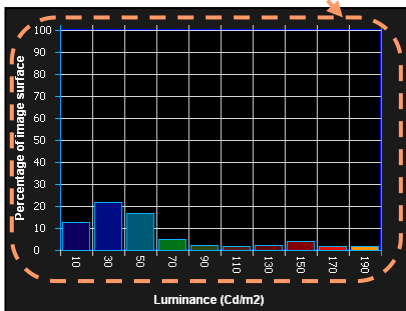


'Show Diagram Panel' page is divided to two sections.

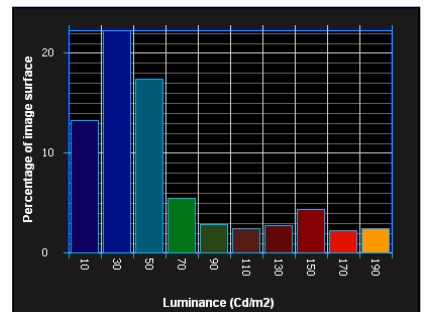
The left part shows some numerical analysis (Highlighted with reddish line). While the right easily distinguished by its black background show the image histogram based on division numbers and colors in the falsecolor image (Highlighted with yellowish line).



- Mean Value: Average pixel values for whole the image.
- Maximum Value: Maximum value in the image.
- Minimum Value: Minimum value in the image.
- Upper Limit: 200
Lower Limit: 0
The upper limit shows the maximum values when creating false color images. The lower limit is always zero.
- Division Number: 10
The number of contours (and corresponding legend entries) used for creating false color images.
- Each number, with the same interval, specifies the lower level and upper level defined in the false color image and then percentage area being in this range in the image.
- If this number is not 100, the remaining shows the percentage area between upper level of last number and pixel peak value. For example, in this picture, as 76.76 is less than 100, $(100-76.76)=23.24\%$ of image area is in the range between 200 [10: 180.0 : 2.61] and 1505.39 [Max Value: 1505.39].




Here, this histogram diagram shows a summary graph counting data points falling in the falsecolor division ranges. The horizontal numerical text is the mean value for each range. At first, the maximum value in the vertical axis is 100, while with mouse right click the vertical axis is zoomed to fit.




Histogram diagram after being zoomed to fit by mouse right click




- The same as . With pressing these buttons, we can open a new HDR file.
- The same as . With pressing these buttons, we can open import a background HDR image applied as the picture to overlay with contours.


 The same as . With pressing this button, we can save the file with different extensions.

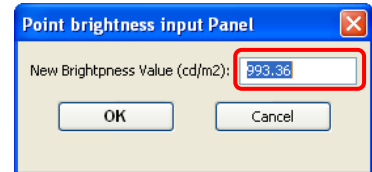
 With pressing this button, we can copy the image on display panel to the computer's clipboard.


 However all the pixel values will not copied together with the image to the clipboard. **(Unfortunately, this option is not available in this version)**



 With pressing this button, we can copy the image on display panel together with pixel values on the display panel to the clipboard. **(Unfortunately, this option is not available in this version)**

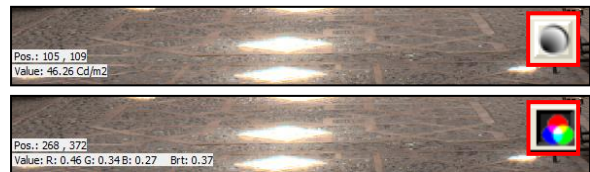
 With pressing this button, the display panel will be cleaned.

 As soon as clicking on a point on the image in the display panel, pixel value appears on the screen and also this button becomes available. Then by pressing the button, the 'Point brightness input panel' will be opened. In the text box, the pixel value is shown. So, with giving a new value to this number, all the image values proportionally changes. For example, if the existed value is 993.36 and we give a new value of 1200 in the text box, all the pixel values on the image multiplies by $(1200/993.36 = 1.2080)$




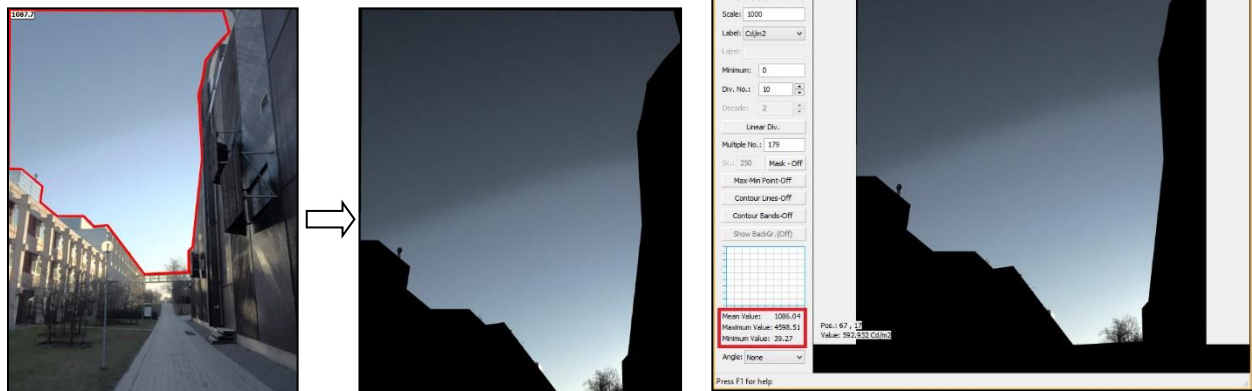
 With pressing this button, all the change on the image values done in 'Point brightness input panel' we be restored to its origin.

 ↔  With clicking on this button, we can change displaying value from brightness values to RGB or vice versa.





 Cropping the selected area in the image

 Bring the original size of the image (before cropping)



When we crop the image by pressing this button ( ) we can exclude all black points from measuring the average and minimum value.

 Bring the original size of the image (before cropping)

 Select a rectangular area



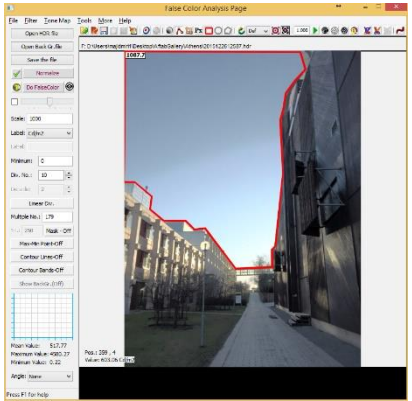
Select a circular area



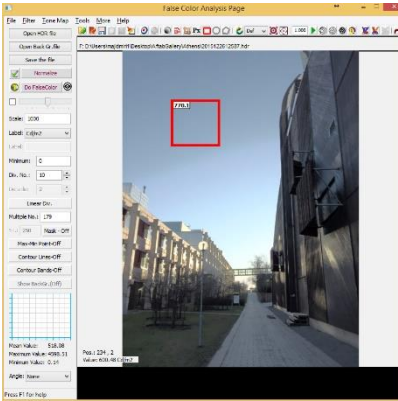
Select a polygonal area,



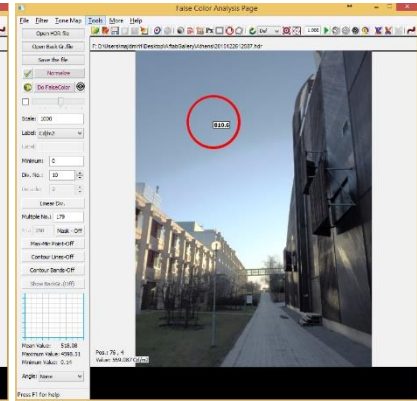
Starting and finishing the polygon drawing.



Polygon selection



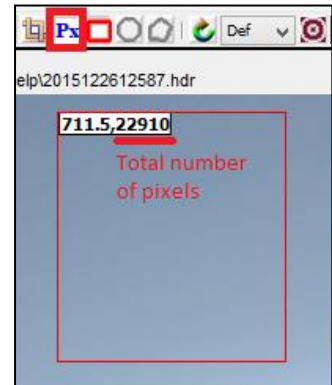
Rectangular selection



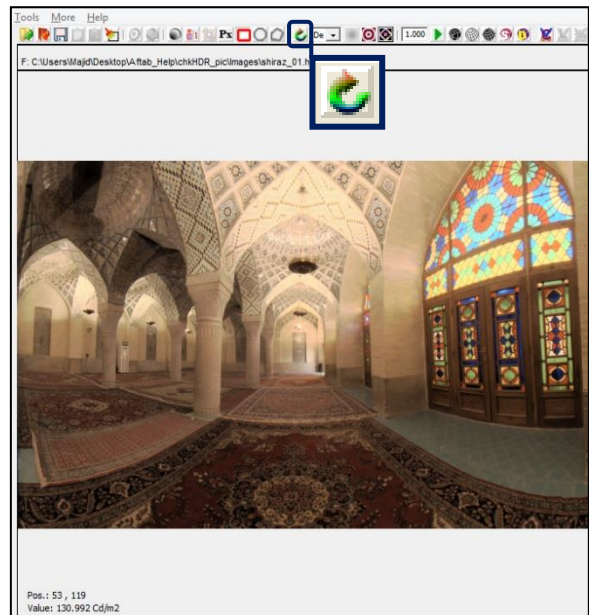
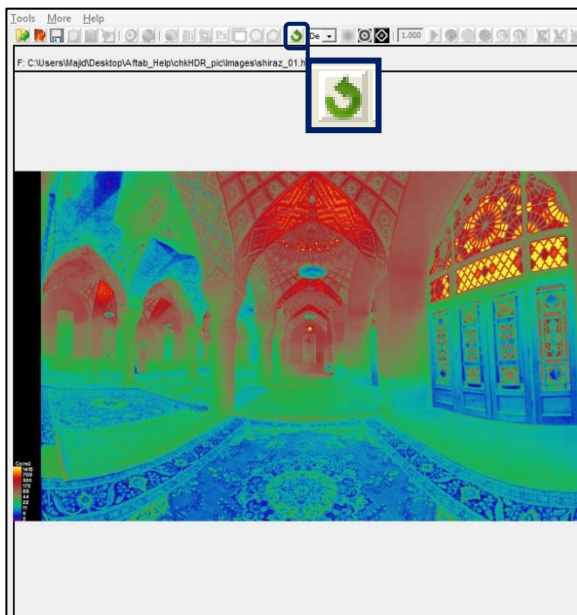
Circular selection



Showing the total area of the selected region by calculating the number pixels kept in the select region.

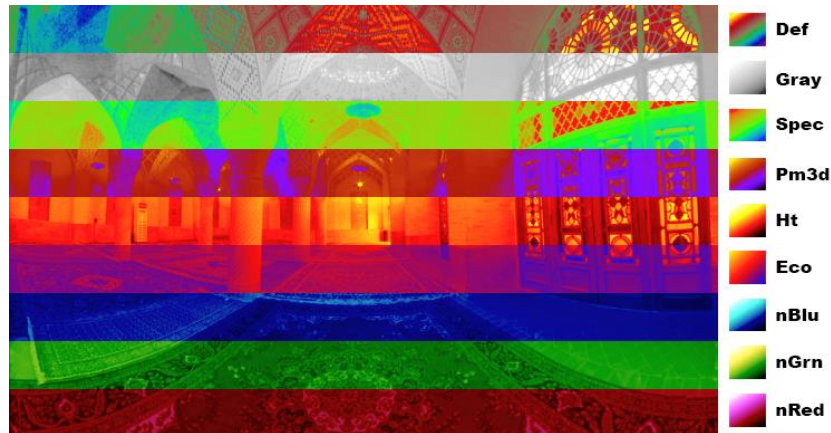


When this button () is available, it works the same as **Do FalseColor** . However, when any kinds of false color image is on the display panel, the button changes to . So, with clicking on the button (), the image on the display panels restore to its origin.





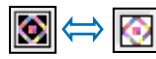


Here we can choose different color palletes for the false color image.

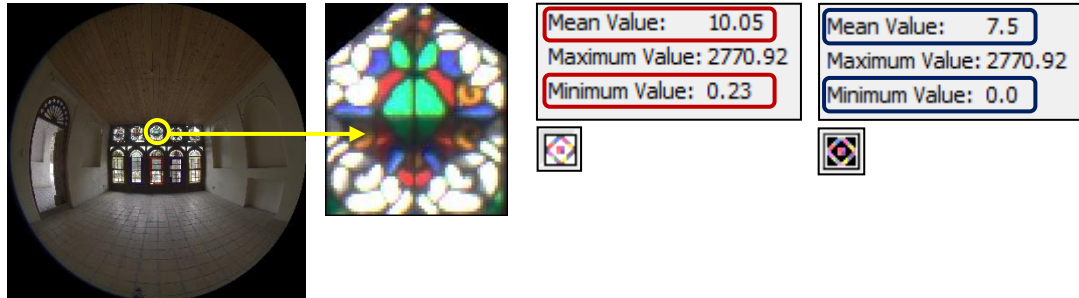




This option works well when we have 180° fisheye lens. By pressing this button, at first, we go to "Camera sensor size page". Then, we have three options. The first one (Field of view: None) is about cropping the image based on conical angle ("Angle list"). One of the most useful function of this choice is to use when we want to measure the access zone luminance (L20) that is recommended by the guide for the lighting of road tunnels and underpasses CIE 88:2004. However the second and third options are Cut-Out field of view that are according to Guth¹ (total field of view and field of view seen by both eyes respectively)

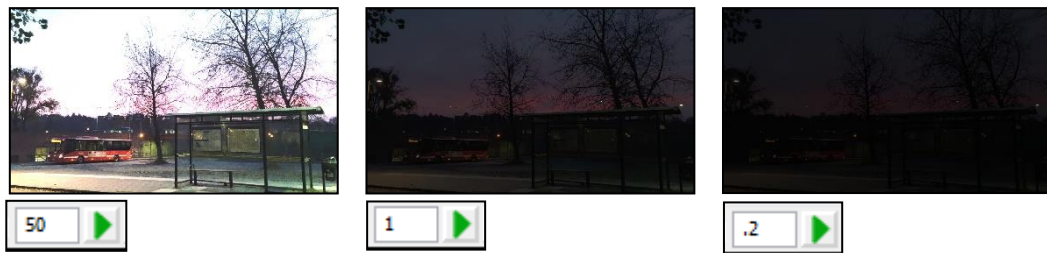



¹ Guth, Light and Comfort, Industrial Medicine and Surgery, November 1958

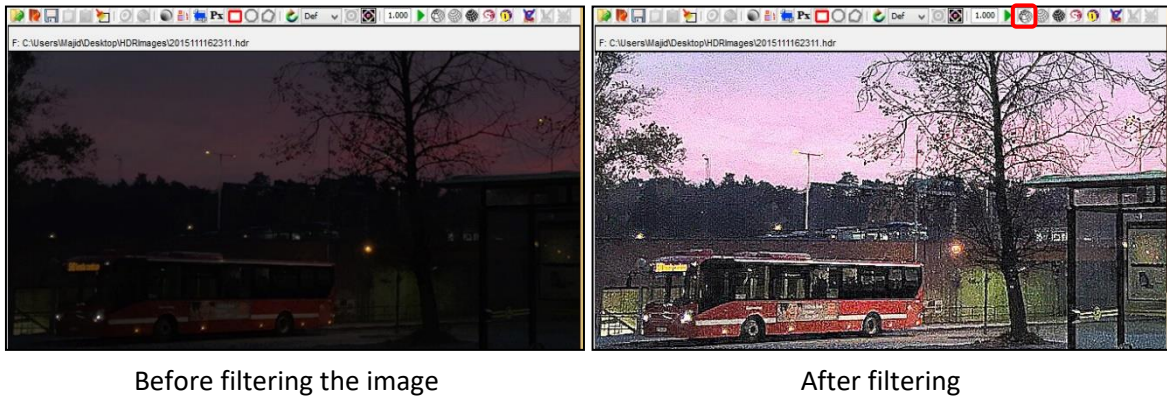
 When measuring the mean and minimum values, this button () means that the software consider the whole image, while this button () means that calculating the mean and minimum values are based on excluding all pixels with zero value. For example we can use this option when importing an 180° fisheye image or for the cropped images.




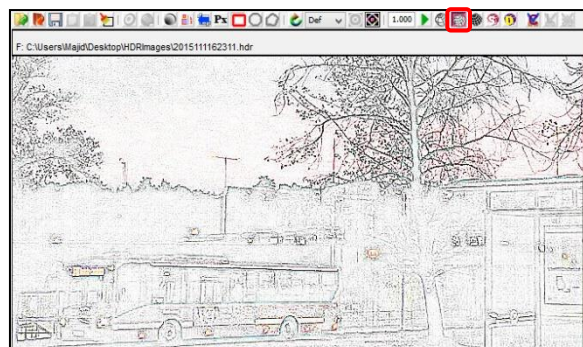
In the text box (), we can set the exposure adjustment for the picture. All the pixel values in the picture is multiplied by this new number. By pressing the green triangle button (), we can affect the image by this new exposure value.





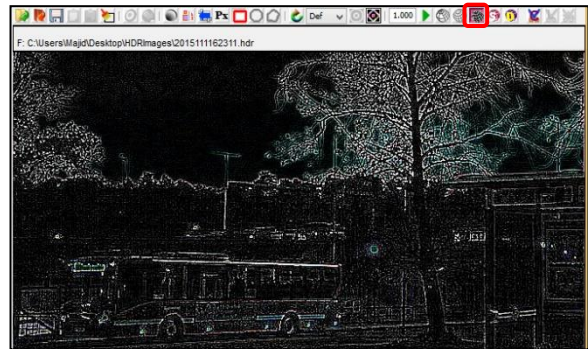
 By clicking on this button, we filter the image with more sharpness and contrast.





 With pressing this button, we change the image to a wireframe image with white color in the background and black color in the foreground.



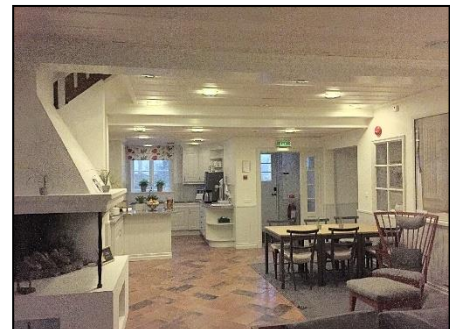
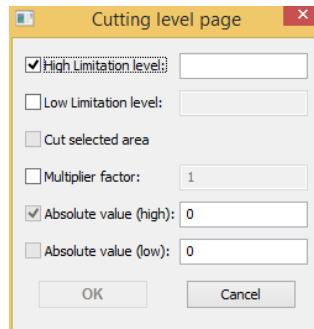
  With pressing this button, we change the image to a wireframe image with black color in the background and black color in the foreground.



  By clicking on this button, we filter the image with more detail.

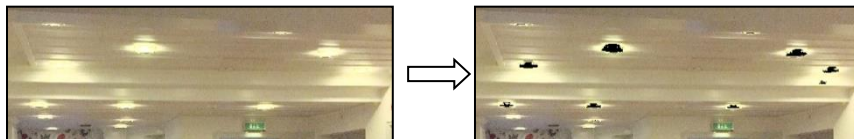


Give the selected area new values.



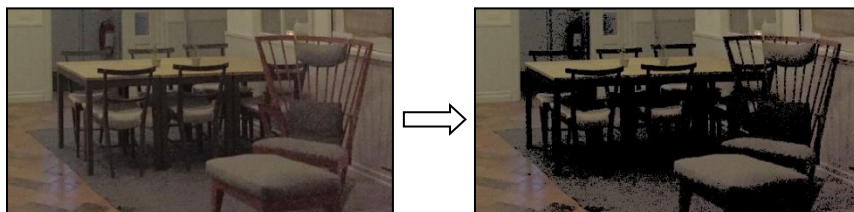
High Limitation level: 100 + Absolute value (high): 0

Select all pixels greater than this specified value, and change them to the new absolute value.



Low Limitation level: 2 + Absolute value (low): 0



Select all pixels lower than this specified value, and change them to the new absolute value.



Low Limitation level: + Multiplier factor:

Select all pixels lower than this specified value, and then multiplying each pixel value by this new value.



 Activating orthogonal selection in polygonal selection () tool.

Camera sensor size page:

Here in this page, we can define the type of view needed by other functions of the software.

Define that your picture is taken:
 With a Fish Eye Lens
 Without a Fish Eye Lens

Here we can define if the lens that the image is taken by is a 180° fisheye lens or not.

Define that your picture is taken:
 With a Fish Eye Lens
 Without a Fish Eye Lens
 Camera sensor size data
 Camera Type:
 Sensor Size X:
 Sensor Size Y:
[Find Sensor Size in dpreview.com](#)

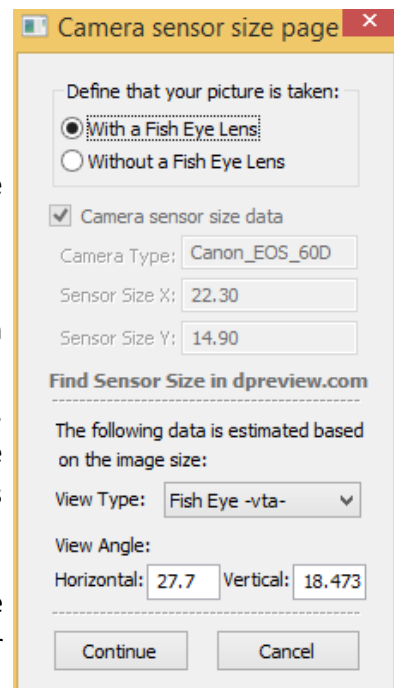
If we select “Without a Fish Eye Lens”, then it asked us to fill the “Sensor Size X” and “Sensor Size Y”. If we do not know the sizes, we can click the link (highlighted with blue color) and find the camera and then find its relevant sensor size.

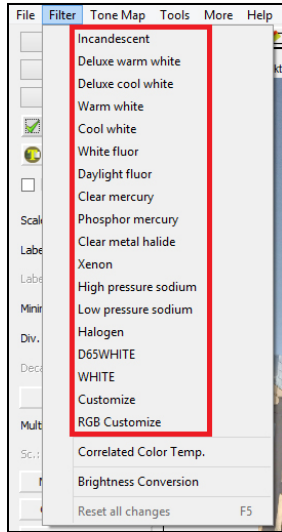
The following data is estimated based on the image size:
 View Type:

Here we can define the view type (Perspective, Hemispheric, or angular fisheye). Generally the most of the comon lenses used for photography are belonged to Perspective (vtv). While for the 180° degree fisheye lens, lenses like “Sigma 4.5mm f/2.8 EX DC” are belonged to angular (vta).

View Angle:
 Horizontal: Vertical:

Here we define the horizontal and vertical angle of the view. However, if you do not crop or unproportionally resize the image, usually the software itself calculates it based on the camera sensor size.



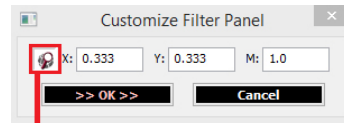


Color-balance the image as if it were illuminated by fixtures of the given type. For more information please check **pfilt -> -t lamp**, and **-f lampdat** from these links:

http://radsite.lbl.gov/radiance/man_html/pfilt.1.html

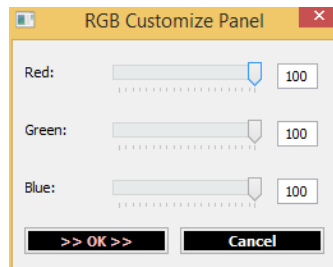
http://radsite.lbl.gov/radiance/man_html/lampcolor.1.html

White: If "white" is specified, the lamp will be uncolored. This is probably preferable for scenes with only a single variety of lamp in order to produce color-balanced images.

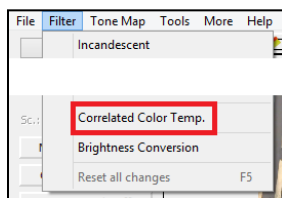
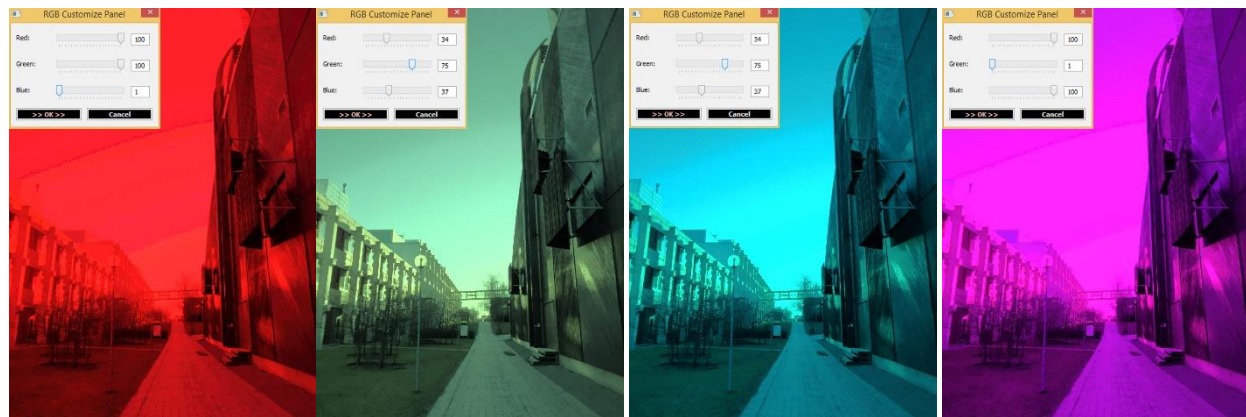


Lamp Type	X	Y	M
/incandescent/	0.453	0.405	0.95
/incand/	0.453	0.405	0.95
/spot/	0.453	0.405	0.95
/flood/	0.453	0.405	0.95
/headlamp/	0.453	0.405	0.95
/headlight/	0.453	0.405	0.95
/EPJAR/	0.453	0.405	0.95
/ER30/	0.453	0.405	0.95
/deluxe warm white/	0.440	0.403	0.85
/warm white deluxe/	0.440	0.403	0.85
/deluxe cool white/	0.453	0.405	0.95
/cool white deluxe/	0.453	0.405	0.95
/warm white/	0.436	0.406	0.85
/cool white/	0.373	0.385	0.85
/fluorescent/	0.373	0.385	0.85
/fluor/	0.373	0.385	0.85
/daylight fluor/	0.453	0.405	0.85

Customize: Here we can specify a customized lamp specification with three real numbers between 0 and 1: x y and m, where x and y are the CIE chromaticity coordinates and m is the lumen depreciation factor (multiplier to get mean lumen output from initial lumens).

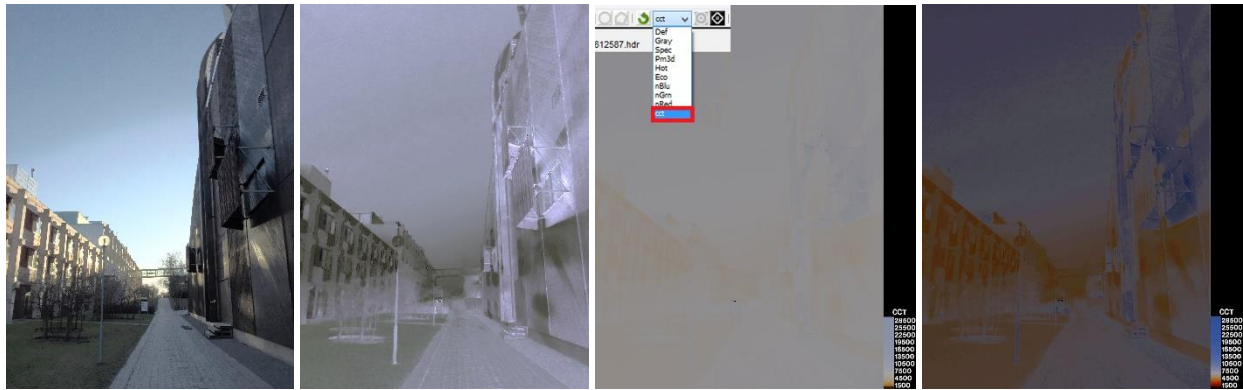


RGB Customize: Here we can filter Red, Green and Blue color of the image by changing the relevant slider between 0 for zero percent and 100 when we want to keep that channel as its original value.



Correlated Color Temperature: Based on a formula that can be found from the below link, it converts the image to a CCT based image to measure the CCT value of each pixel. (Its accuracy has not evaluated yet.)

http://www.bruceindbloom.com/index.html?Eqn_XYZ_to_T.html



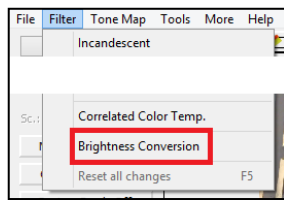
Original image

CCT based image

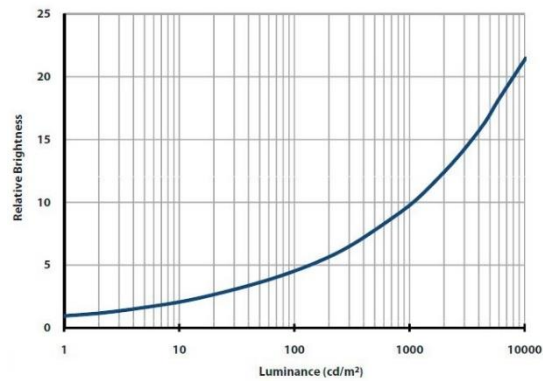
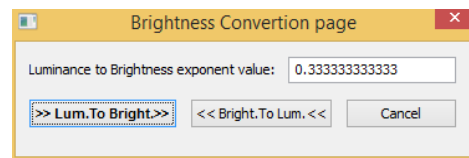
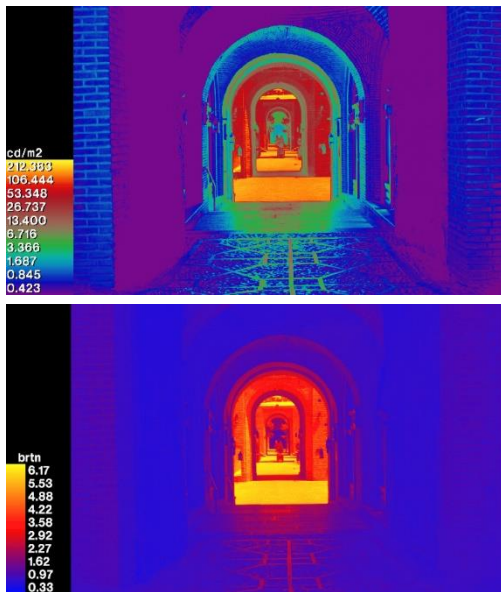
CCT based Falsecolor image

Modify the CCT based Falsecolor image in Photoshop

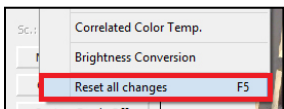
To make a CCT based falsecolor image, first we need to convert the image to CCT through **Menu -> Filter -> Correlated Color Temp.**, then in the palletes dropdown menu, CCT will be added and can be selected to make a falsecolor image. The scale in CCT based Falsecolor image is fixed between 1500k and 28500k and can be changed.



Here we can convert the the luminance values every pixels in the image to a brightness value by specifying a exponent value. The default exponent value is $1.0/3.0$ or 0.3333333333 (For more infomation, please check the following diagram)



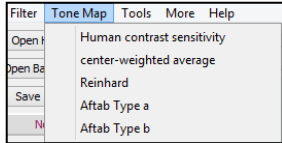
luminance-brightness power relationship based on an exponent of $1/3^2$



Here we can reset all the changes on the image.

² DiLaura D L, Houser K W, Mistrick R G, Steffy G R, Illuminating Engineering Society, The Lighting Handbook, Tenth Edition, New York, Illuminating Engineering Society of North America, 2011, page 4.10

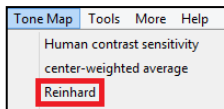
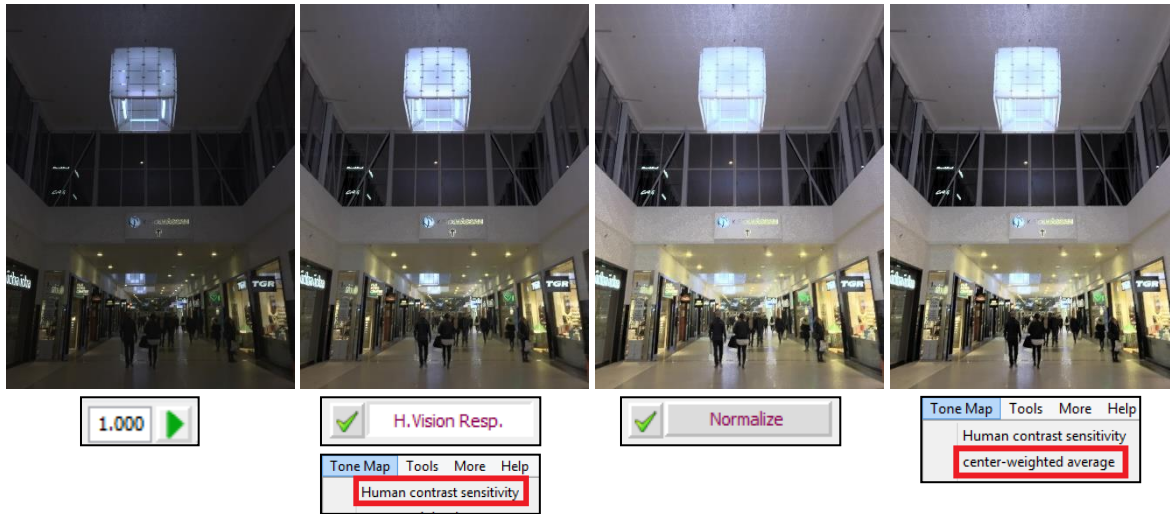
³ Peter Robert Boyce, Human Factors in Lighting, Third Edition, CRC Press, Boca Raton FL, 2014, page 198



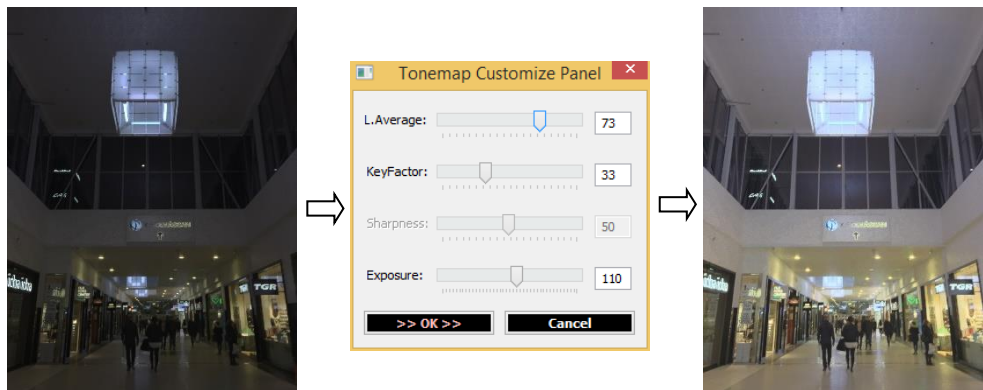
To approximate the appearance of a high dynamic range image in a low dynamic range image, here these 5 tone-mapping operators can be applied.

Human contrast sensitivity: Here the image will be tone-mapped with human vision simulation.

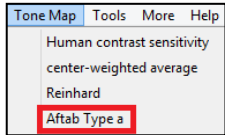
Center-weighted average: Here the image will be tone-mapped with using a center-weighted average for the exposure rather than the uniform average. This may improve the exposure for scenes with high or low peripheral brightness.



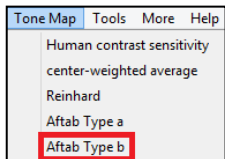
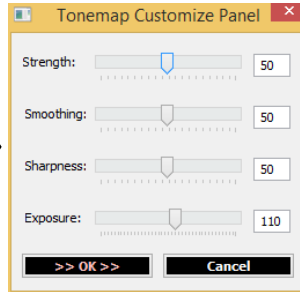
Tone-mapping the image based on the Erik Reinhard's simple global tone-operator.



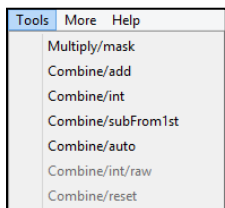
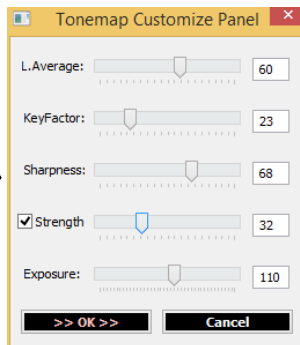
<https://radiance-online.lbl.gov/cgi-bin/viewcvs.cgi/ray/src/cal/cal/reinhard.cal?revision=1.1&view=markup&sortby=log>



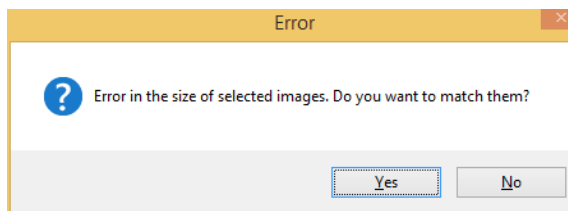
“Aftab Type a” tone-mapping.

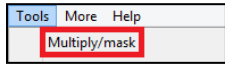


“Aftab Type b” tone-mapping.

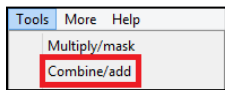
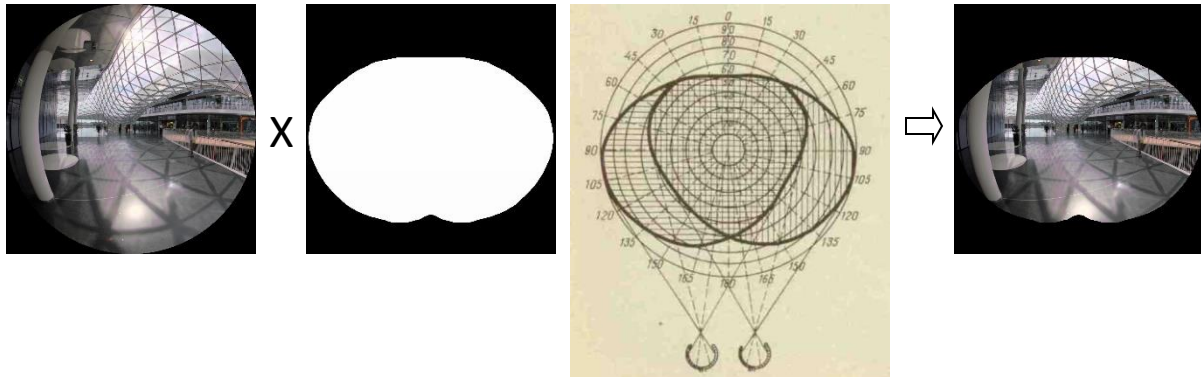


All tools that here are about filtering the image by combining, multiplying, or subtracting with one or more HDR images. If their resolution are not matched it asks you to match them, then a new image will be created by multiplying them by each other.

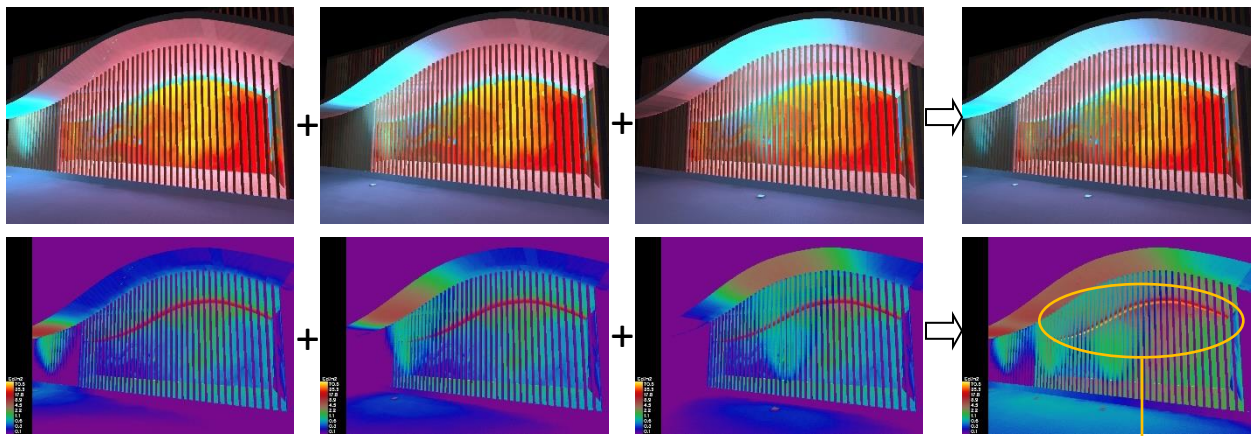




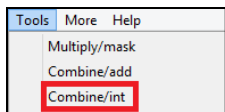
Multiply/mask: It is about filtering the original HDR images by a binary image that has the same resolution.



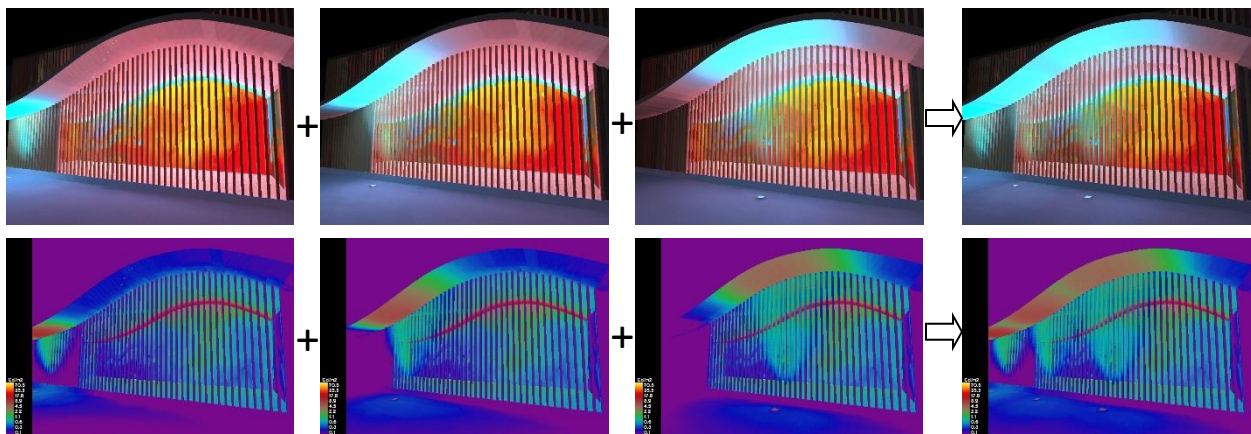
Combine/add: It is about creating an image in which each pixel value is produced by *adding* the pixel values of all the selected HDR images.

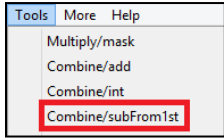


In this command, we should be aware if some lights are existed in every images, because they are cumulated in the final images.

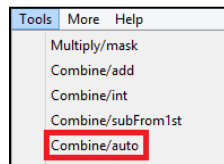
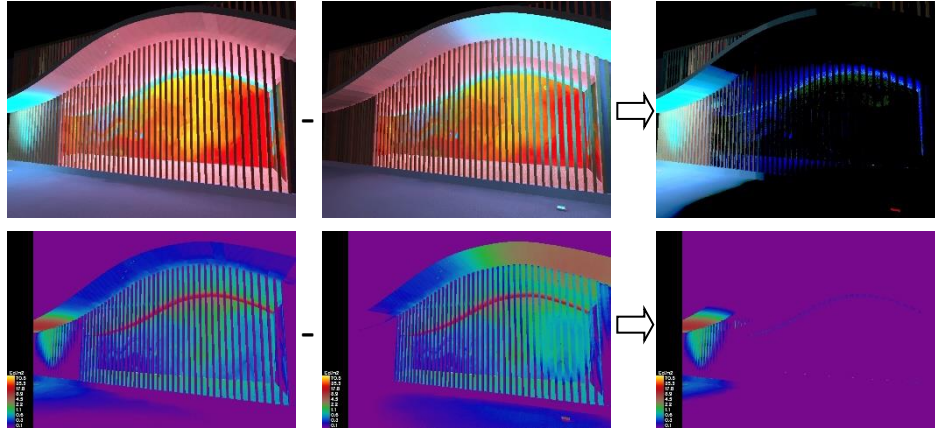


Combine/int: It is about creating an image in which each pixel value is produced by finding the *maximum* pixel values between every selected HDR images.





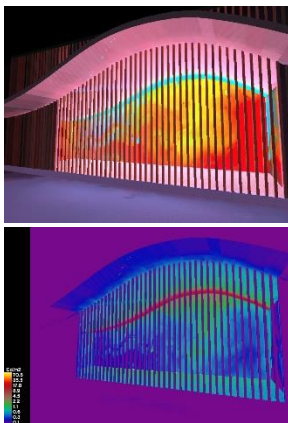
Combine/subFrom1st: It is about creating an image in which each pixel value is produced by subtracting the pixel values of the first (primary) image from the other HDR images.



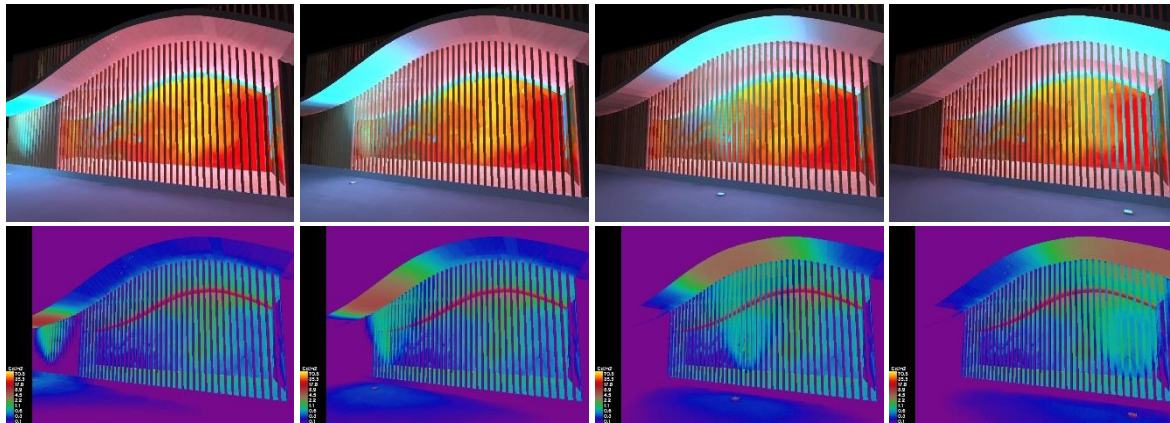
Combine/auto: In work properly with this option, at first, we need to open the image that took before adding any new fixture (an image with an existing lighting condition), then add other images with new fixtures and positions (it is very useful when we do not have enough luminaires to test in a real scene, so we need to take photos for each position and then move around the scene and take more photos).

So in the end we create an image showing the scene when we have all the fixtures in their right position. For example in the example in the below, we have only one inground uplight fixtures, then we move the luminaire in 4 4 different positions and took photos for each position. However the first image that should be opened is the image showing the scene with the existing light conditions.

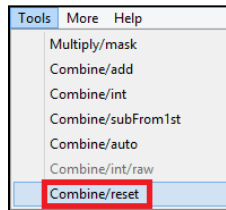
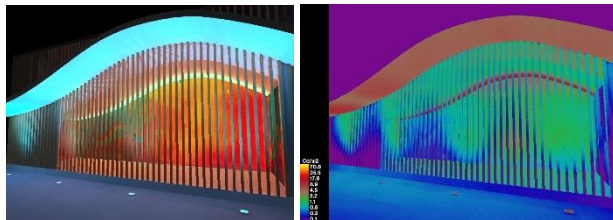
Existing condition: (we need to open this file at first)



Adding one unground uplight fixture in 4 different positions: (with pressing **combine/auto** in menu -> Tools, we can add the new files including images showing different positions for the fixture)



The output of **Combine/auto**: (Both true color and falsecolor images are similar to an image taken when we have 4 fixtures placing them in right position.)



Combine/reset: This option reset all changes in the image to the original values

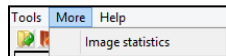




Image statistics: This option gives us some statistic values for the image such as mean value, maximum value (Absolute max. value), minimum value (Absolute min. value), min/max value, min/mean value, Median value, Standard Deviation. Moreover by defining a value in the input box **“Selected min. value”** (Selected min. value:) and pressing the refresh button (), we can see here (% below min. value: . . .) how much of the image is below this value. In the same way, by defining a value in the input box **“Selected max. value”** (Selected max. value:) and pressing the refresh button (), we can see here (% above max. value: . . .) how much of the image is below this value. Finally with checking **“Exclude black pixels”** (Exclude black pixels) it exclude all the black points with zero values when measuring mean and minimum values.

Shortcuts and mouse buttons:

In the main page:

Shift + mouse left click: Start to draw a polygon selection area

Ctrl + mouse left click: Finish the polygon selection area drawing

Alt + mouse left click: Start to draw a circular selection area

mouse right click: Undo the last selection point or area

In the Show Diagram Panel:

mouse right click: Zoom in and zoom out the diagram

In the main page but when we cropped the image:

Ctrl + mouse left click: Zoom in and zoom out the image

