

Too bright or too dark? Using the histogram in the uEye Cockpit

Do you know that? Your image looks flat or in the dark, low-contrast image, you cannot distinguish the objects. In this case, it is helpful to use the histogram in the uEye Cockpit.

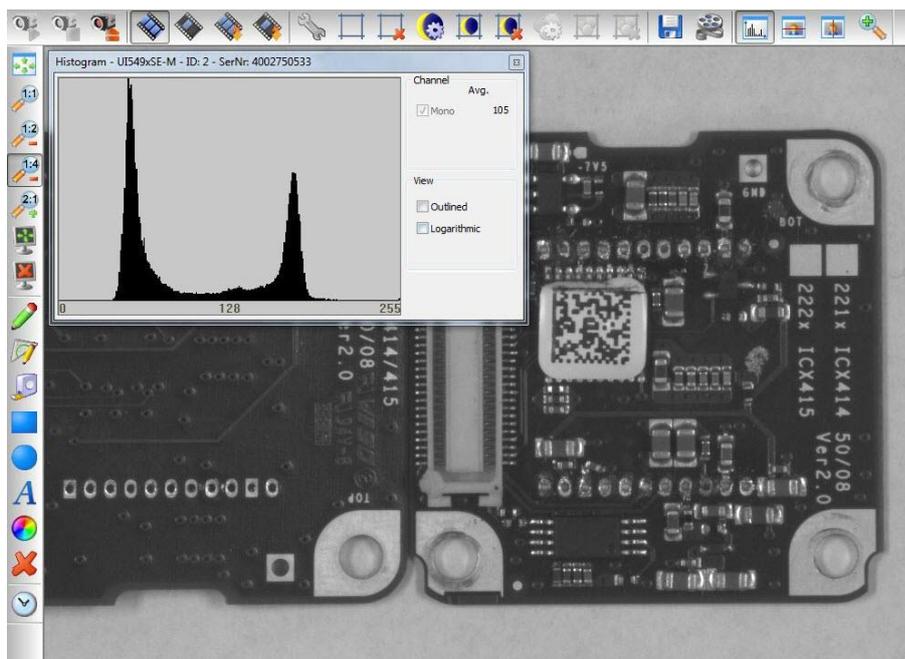
The aim is to spread the intensity of the image as evenly as possible over a wide intensity range. There is no general rule for creating the optimum histogram. It will look different depending on the application and scene.

Background

A histogram shows the distribution of brightness across the entire digital image. The frequency of individual brightness values is indicated in a bar chart.

The black value 0 is shown on the left of the histogram, followed by the individual gray scale values through to the brightest point on the far right of the histogram, with a value of 255. This corresponds to a bit depth of 8 bits per pixel. At a higher bit depth, the number of gray levels increases accordingly. If an image has optimum contrast, the histogram includes practically all brightness values between 0 and the highest value.

Example: A black work piece on a light background. This histogram should ideally consist of just two “peaks”. One is a rise at around a gray scale value of 60 for the dark object, and another peak for the light background at a gray scale value of 150. To ensure that the work piece is clearly delineated from the background, these two peaks should be as far apart as possible in the histogram and minimal other gray scale values should be present.

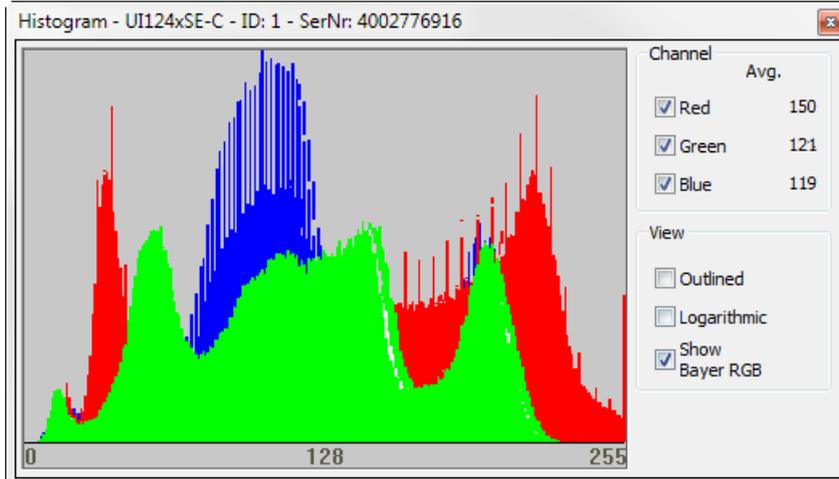


Two brightness values in the histogram

TechTip: Histogram in the uEye Cockpit

Histogram in the uEye Cockpit

Open the histogram window in uEye Cockpit via “View > Histogram”. Below “Channel” you can enable or disable the display for each color channel via the “Red”, “Green”, and “Blue” check boxes. Additionally, below “Avg.” the average of each color value is displayed. For monochrome images, the average grayscale value is displayed.



Histogram in the uEye Cockpit

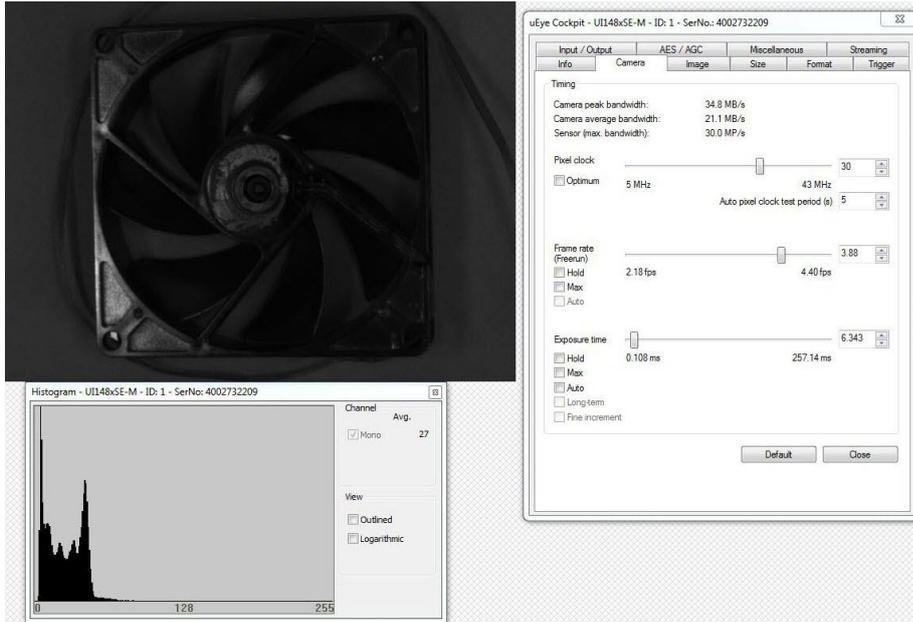
The “Outlined” check box enables you to toggle the color value display between an area diagram and a line diagram. Enable the “Logarithmic” check box to display the values with logarithmic scaling. This illustrates extremes in the histogram more clearly.

The “Show Bayer RGB” check box is only available when a color camera is running in “Direct raw Bayer” mode. If you select this check box, the histogram represents the individual Bayer color components as red, green and blue channels.

Below the histogram, the bit depth of the set color format is displayed.

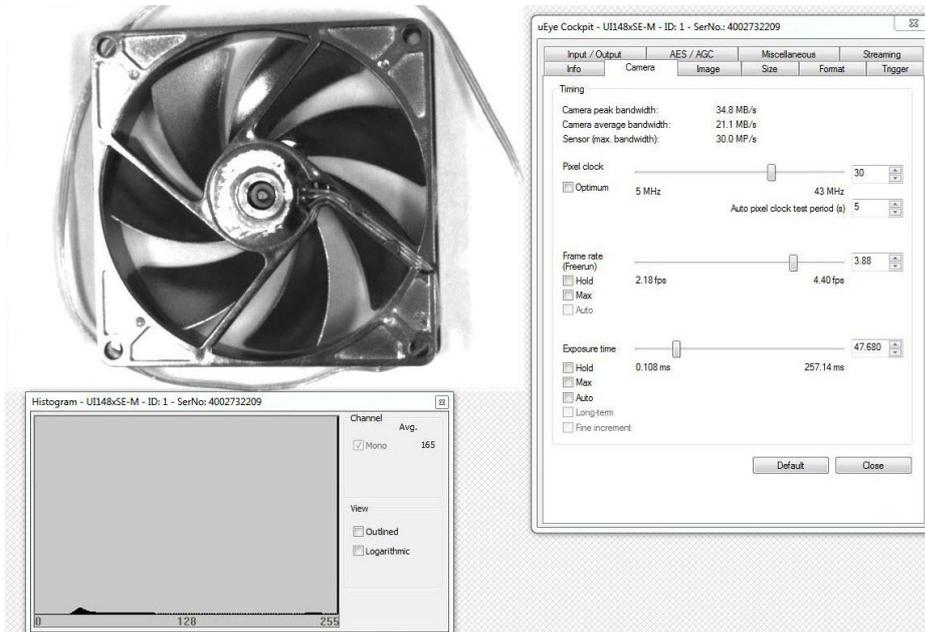
“Reading” the histogram

An under exposed image can be identified by the fact that despite the presence of white points in the object, no deflection can be seen on the far right of the histogram. As a result, contrast is lost and the image has a matt and dull appearance.



Under exposed scene

In an over exposed image, the rise on the far right of the histogram can be clearly identified. The histogram indicates that intensity is confined almost exclusively to the bright pixel values.



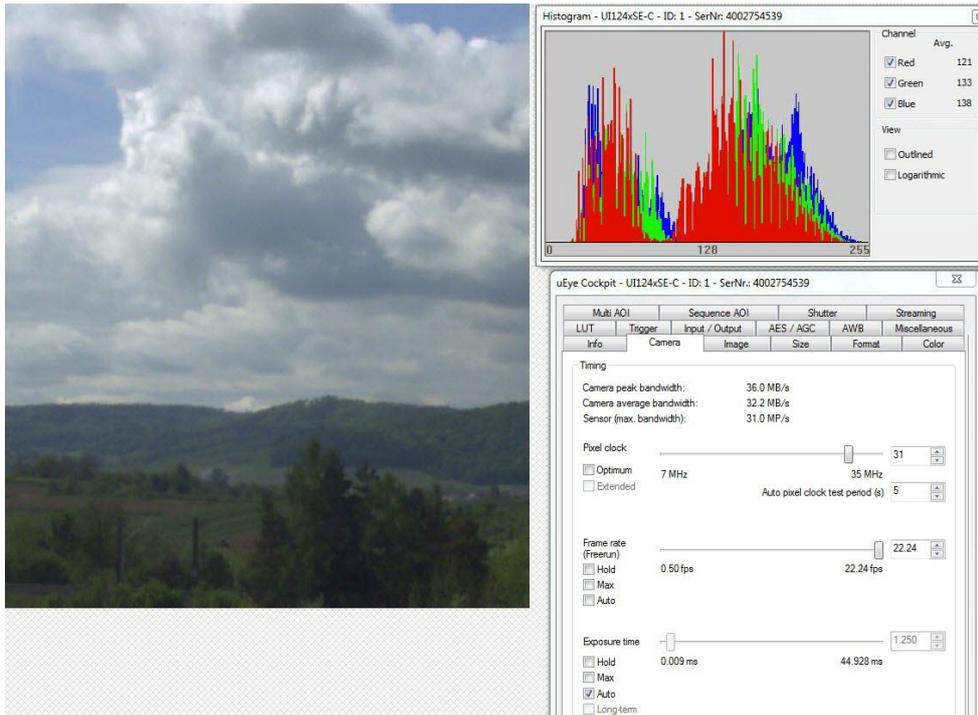
Over exposed scene

Bright objects can no longer be distinguished from very bright objects. Contrasts in these areas of the image disappear altogether. This information cannot be restored by subsequent processing of the image. A further effect of over exposure is that black is normally no longer shown as an absolute black value. For example, a black object towards the left of the histogram has almost no intensity. As a result, this object will only be gray in the image and will lose intensity.

TechTip: Histogram in the uEye Cockpit

Histogram for color sensors

With color sensors, the RGB histogram is critical. This shows the intensity distribution for each color channel. It is important to ensure that none of the three color channels becomes saturated, i.e. it has its maximum intensity on the far right of the histogram. Under some circumstances, a color channel that is saturated would not be identified in a monochrome histogram if the other two color channels are not over exposed. As soon as one color channel is over exposed, there is a risk that the colors will become dull and matt.



Representation of individual color channels

Application areas

The use of the histogram is suitable e.g. for manual white balance by setting an AOI (area of interest). Afterwards, the color channels in the histogram are brought into alignment with the manual white balance.

The brightness of the image and therefore the histogram are determined to a great extent by the aperture setting on the lens and the set exposure time. Digital post-processing also creates gaps in the histogram, which means that some brightness values are eliminated and are no longer present, for example digital gamma correction or digital enhancement.

To avoid under and over exposure, the histogram may not have any peaks at minimum and maximum pixel values. These can be reduced or eliminated by adjusting the exposure time. To maintain the dynamics in high-contrast scenes, the histogram should extend over the widest possible range of pixel values, ideally from 0 to 255.

If you have an application that requires high frame rates, change the aperture setting on the lens. However, if your application requires a wide focus range, change the exposure time.

TechTip: Histogram in the uEye Cockpit

Summary

A histogram shows whether an image is over or under exposed, and how rich the contrast is. Thus, the histogram is a tool for optimizing the camera parameter settings to obtain an image with a richer contrast.

With the uEye API function “is_GetImageHistogram” or the uEye .NET class “Image” you can query the values of the histogram.

For further information on the histogram, refer to the uEye manual at <http://de.ids-imaging.com/manuals-ueye.html>.

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