NATIONAL PARK SERVICE

Conserve O Gram

August 2008 Number 22/4

Understanding Histograms for Digital Photography

A histogram is a bar graph accessible through a SLR (single lens reflex) camera menu displaying the distribution of light, dark and color tonal values inside a digital image. These tonal values are sometimes referred to as a camera's dynamic range.

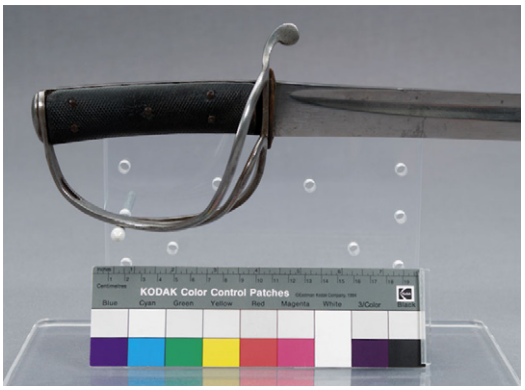


Figure 1. Object Image

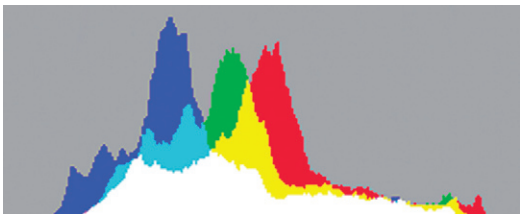


Figure 2. Histogram of the Object in Figure 1

The histogram displays all the available tonal values of a digital image along the horizontal axis (bottom) of the graph from left (darkest) to right (lightest). The vertical axis represents how much of the image data is found at any specific brightness value. The colors in the histogram reveal the tonal values of each color channel. White represents the tonal data of all three color channels overlapped.

The histogram is one of the most valued tools in digital imaging capture. It is used to:

- Provide real-time information to immediately adapt and shoot better pictures balance and light adjustment.
- Adjust the image during processing by providing a graphic display and target for editing actions

Figure 3. Camera View of Figure 2 Histogram

Digital image editing relies on histograms to reveal the outcome of each editing and red, green and blue color alteration. It enables the production of consistent quality digital images by providing ideal targets for tonal values.

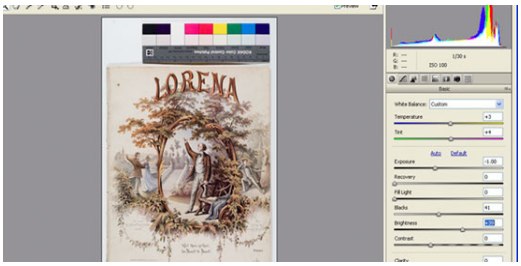


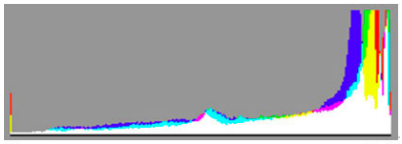
Figure 4. Editing Software Showing the Relationship Between the Image and the Histogram

One of the main uses of histograms is to prevent "clipping," the cutting off or removal of tonal data in digital images. Clipping is shown on a histogram when tonal data goes below 0, true black, or above 255, true white, and is eliminated from the edges of the histogram. A small amount of clipping is acceptable. Accented highlights of metal subjects or dark shadows may clip a little in a histogram but the overall image itself may still look good. Clipped data is not recoverable when processing the image for use. The histograms in Figs 7-12 illustrate clipping at both ends of the spectrum by showing at either end of the scale beyond the 0 and 255.

The histogram is a **guide**. The best way to judge exposure is looking at the image and color chart, not just the histogram. Generally, a histogram representing a "good" exposure has tonal data gently sloping up from 0, shadows, peaking in the midtones and then gently sloping down to 255 at the highlights. Fig. 2 shows a good standard distribution in the histogram for this object. However, the tonal data doesn't have to peak in the midtones or gently slope down to shadows and highlights for a "good" digital image. A dark subject, like a cannonball, will have most of its tonal data clustered near the shadows while a light subject, like a white china plate, will place most of its tonal data clustered near the highlights. Figs 5 and 6 show a good example of a histogram representing a light object with most of its tonal data near but not beyond 255.

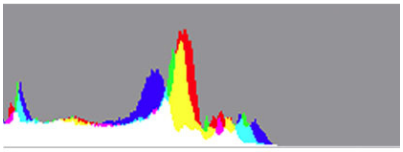
Histogram Examples

Figures 5 and 6. Good Exposure
This is a good exposure for this item. Since this object is so light to begin with, the highlights bunch a little instead of ideally gently sloping down to 255. But the shadows do ideally start at 0 and gently slope upward revealing details in darkest areas.



0 255

Figures 7 and 8. Overexposed
This histogram reveals too many tonal values that are close to 255 or more, indicating clipped highlights. Details in the highlights are lost and shadows are not dark enough.

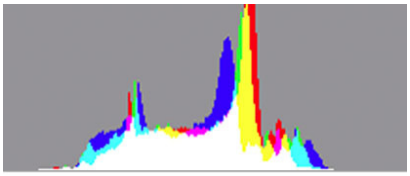


0 255

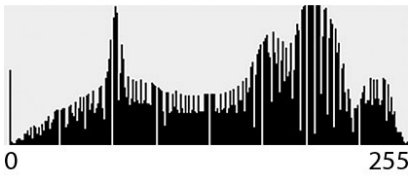
Figures 9 and 10. Underexposed
This histogram reveals too many tonal values near or below 0, indicating clipped shadows. There should only be values near 0 if there is pure black in the image. Details in the dark areas are lost and there is not enough information near 255 to reveal highlights.

0 255

Figures 11 and 12. Too Much Contrast
This histogram shows clipped highlights and clipped shadows. This indicates either the exposure and contrast settings are off or the dynamic range of the subject is too much for the camera.



Figures 13 and 14. Too Little Contrast
This histogram shows only midtones, lacking any highlight or shadow tonal information. This lack of contrast results in a hazy image.



Figures 15 and 16. Over Manipulated Contrast
This histogram shows how contrast is improved when using curves or levels in Photoshop to "stretch" the above histogram see in Figs 13 & 14. As the same amount of tonal data is now stretched over a wider area, some data are missing. This is represented by gaps in this "combed" histogram. Too much combing or stretching of data may lead to posterization (data loss that leads to artificial infill and distortion of the image when viewed).

References

Fraser, Bruce *Real World Camera Raw with Adobe Photoshop CS2*. Peachpit Press, Berkeley, CA, pp.109-110. 2005.

Grogh, Peter *The DAM Book, Digital Asset Management for Photographers*. O'Reilly Media, Sebastopol, CA, p. 179. 2006.

Hogan, Thom "Histogram," By Thom, 2001. http://www.bythom.com/histogram.htm

Northeast Document Conservation Center. Digital Preservation Readiness Webliography April 2008. http://nedcc.org/resources/leaflets/6Reformatting/08DigitalPreservationReadiness.php

James Carey
Museum Technician
Digital Imaging Project
Sponsored by the Park Museum Management Program
National Park Service
Harpers Ferry Center, WV 25425

The *Conserve O Gram* series is published as a reference on collections management and curatorial issues. Mention of a product, a manufacturer, or a supplier by name in this publication does not constitute an endorsement of that product or supplier by the National Park Service. Sources named are not all inclusive. It is suggested that readers also seek alternative product and vendor information in order to assess the full range of available supplies and equipment.

The series is distributed to all NPS units and is available to non-NPS institutions and interested individuals on line at <http://www.nps.gov/history/museum/publications/conserveogram/cons_toc.html>. For further information and guidance concerning any of the topics or procedures addressed in the series, contact NPS Park Museum Management Program, 1849 C Street NW (2265), Washington, DC 20240; (202) 354-2000.