The Image Histogram

Vedat Tavşanoğlu
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Number of pixels

Brightness
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I = imread('pout.tif')
imshow(I)
figure, imhist(I)
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Notice how the intensity range is rather narrow. It does not cover the potential range of $[0, 255]$, and is missing the high and low values that would result in good contrast.

Now call histeq to spread the intensity values over the full range, thereby improving the contrast of I. Return the modified image in the variable I2.

$$I_2 = \text{histeq}(I); \quad \% \text{Equalize } I \text{ and output in new array } I_2.$$ 

Display the new equalized image, I2, in a new figure window.

$$\text{figure, imshow}(I_2) \quad \% \text{Display the new equalized image } I_2.$$ 

Call imhist again, this time for I2.

$$\text{figure, imhist}(I_2) \quad \% \text{Show the histogram for the new image } I_2.$$
close all
I = imread('pout.tif')
I2 = histeq(I)
imshow(I2)
figure, imhist(I2)
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HISTOGRAM EQUALIZATION

See how the pixel values now extend across the full range of possible values.
Here’s What Just Happened

**Step 3.** You adjusted the contrast automatically by using the function `histeq` to evenly distribute the image’s pixel values over the full potential range for the storage class of the image. For an image $X$, with a storage class of `uint8`, the full range is $0 \leq X \leq 255$, for `uint16` it is $0 \leq X \leq 65535$, and for `double` it is $0 \leq X \leq 1$. Note that the convention elsewhere in this user guide (and for all MATLAB documentation) is to denote the above ranges as $[0,255]$, $[0,65535]$, and $[0,1]$, respectively.

If you compare the two histograms, you can see that the histogram of $I_2$ is more spread out and flat than the histogram of $I_1$. The process that flattened and spread out this histogram is called *histogram equalization*.

For more control over adjusting the contrast of an image (for example, if you want to choose the range over which the new pixel values should span), you can use the `imadjust` function, which is demonstrated under “5. Adjust the Image Contrast” on page 1-13 in Exercise 2.
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