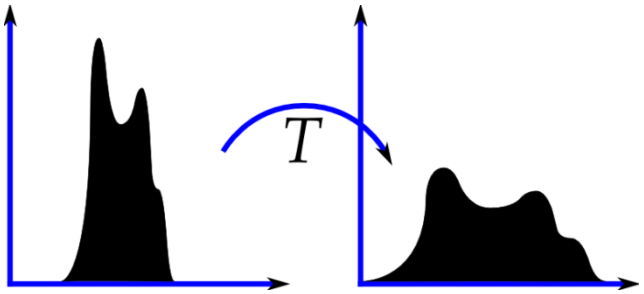
Experiment 2

Histogram Equalization and Matching

Histogram equalization is a method in image processing of contrast adjustment using the image's histogram.

This method usually increases the *global contrast* of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. The method is useful in images with backgrounds and foregrounds that are both bright or both dark. In particular, the method can lead to better views of bone structure in x-ray images, and to better detail in photographs that are over or under-exposed. In theory, if the histogram equalization function is known, then the original histogram can be recovered. The calculation is not computationally intensive. A disadvantage of the method is that it is indiscriminate. It may increase the contrast of background noise, while decreasing the usable signal.

Histogram matching is a process where an image, or higher dimension scalar data is modified such that its histogram matches that of another (reference) dataset. A common application of this is to match the images from two sensors with slightly different responses, or from a sensor whose response changes over time.



Problem Objective

Write C++/Image-J modular functions to

a) Perform histogram equalization on the 512 × 512 grayscale *lena_gray_dark.jpg* image. Perform the same on other low-contrast, dark, normal (gray/colored) images.

b) Perform histogram matching of the same images with respect to a standard image (e.g. l*ena.jpg, cameraman.jpg, walkbridge.jpg* image, etc).

Display the histograms of the original image and the enhanced images and document the observations.

Note

1. **Do not** hardcode the filenames and/or image size into the code.
2. Use proper code commenting and documentation.
3. Use self-explanatory identifiers for variables/functions etc.

References

1. R. C. Gonzalez and R. Woods, *Digital Image Processing*, Reading, MA: Addison-Wesley, 1992.
2. http://en.wikipedia.org/wiki/Histogram_equalization