Jack Hanke
MSAI 495 Computer Vision
MP #3

Histogram Equalization Report

In this assignment we implement histogram equalization. This technique is used to increase contrast in low-contrast images by identifying common clusters of pixels. We now consider grayscale images, while in the past we considered bitmap images.

To identify high clusters of pixels, the algorithm creates a raw frequency histogram for pixel values over the image using a list. The list's index is the pixel value, and the item in the list is the number of pixels with that value. Then the cumulative frequency, simply produced by taking a running sum over the frequency histogram, followed by normalizing this running sum to be between 0 and 255, produces a map that transforms an arbitrary pixel distribution into a nearly uniform distribution. This alone works to produce an image of significantly better contrast than given.

However, such a large change in pixel values can amplify slight differences in lighting. This can be corrected by identifying the general lighting trend in the processed image by fitting a low-parameter model of pixel locations to their values. In this assignment we consider a linear and quadratic model, and directly compute the optimal coefficients by calculating the pseudo inverse of the data matrix, and multiplying it by the data matrix transposed and the pixel values. Finally, the trend is subtracted by adding the difference between the true pixel value and the trend, multiplied by some value less than 1, to the processed image. I chose 0.25 as my value.

These techniques were tested on an image of the moon. Below is the increased contrast image, and the increased-contrast-linear/quadratic-adjustment image.