MSAI 495 Introduction to Computer Vision - Assignment 3

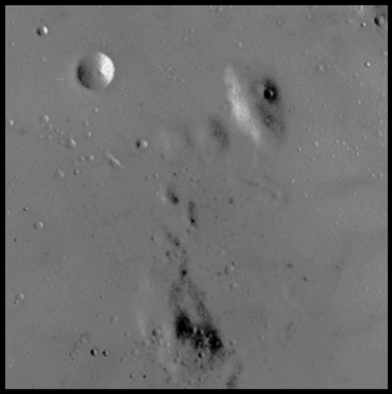
Sayantani Bhattacharya

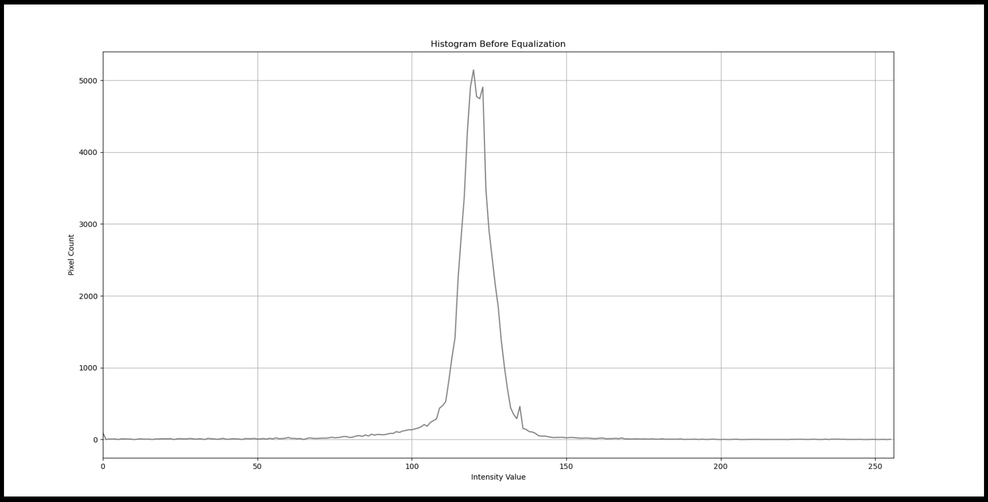
# Histogram Equalization

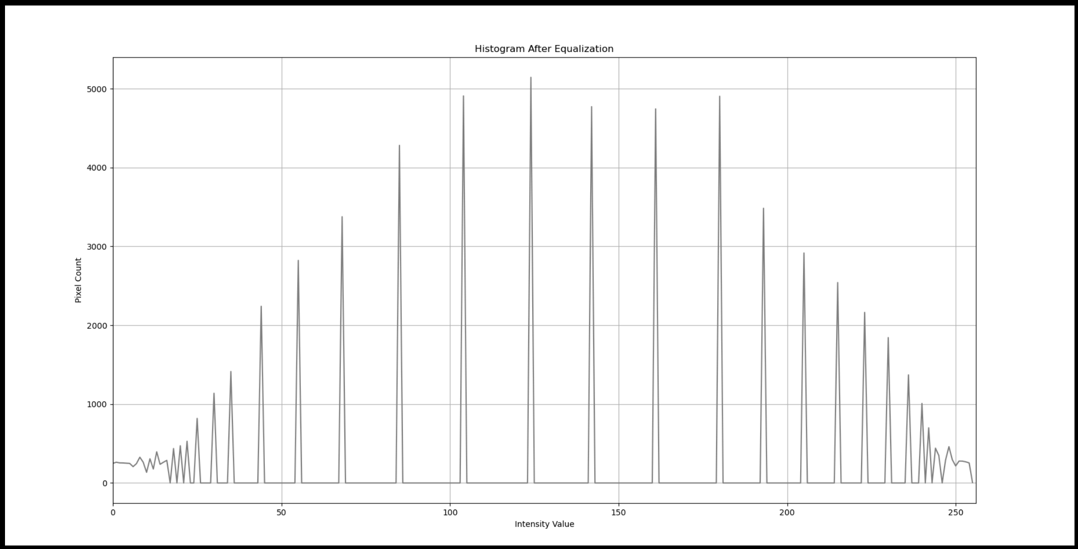
## Algorithms Used:

A. Read the input grayscale image.
B. Compute the histogram: count how many times each intensity value (0–255) appears in the image.
C. Normalize the histogram by dividing each count by the total number of pixels — this gives the probability of each intensity.
D. Compute the cumulative distribution function (CDF) from the normalized histogram — this shows the cumulative probability up to each intensity level.
E. Scale the CDF to the range [0,255] to create a mapping from old intensity values to new ones.
F. Replace each pixel in the original image with its corresponding new value from the CDF mapping.
G. The resulting image has enhanced contrast and a more uniform distribution of brightness.

## Results:







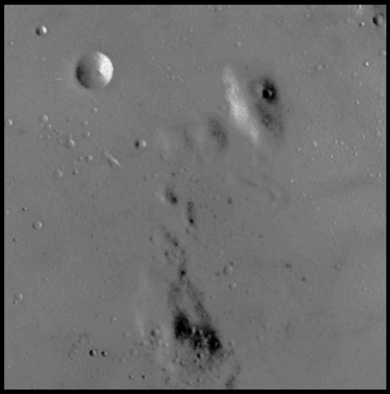

# Lightning Correction

Algorithms Used:

I. Linear:

A. Flatten the grayscale image into a list of brightness values (intensities).
B. For each pixel, record its (u,v) position (row and column).
C. Build a matrix A where each row is [u, v, 1], representing the linear shading model.
D. Construct a vector t containing the intensity value of each corresponding pixel.
E. Solve the normal equation $(A^TA)^{-1}A^Tt$ to find the best-fit plane coefficients [a1,a2,a3].
F. Using these coefficients, compute the shading surface S(u,v)=a1u+a2v+a3 across the entire image.
G. Subtract the shading surface from the original image to remove the lighting trend.
H. Add back the mean of the shading surface to preserve the overall brightness level.
I. The result is a corrected image with smoother and more uniform lighting.

Results:

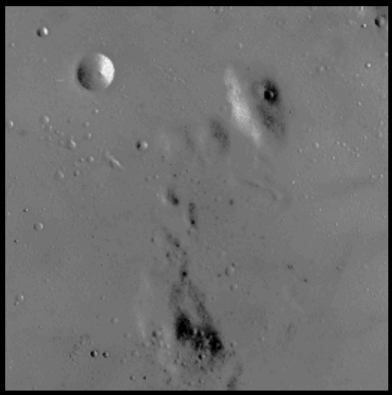


## II. Quadratic:

A. Same as linear but the surface fitting is done with equation:

$$I(u,v) = a1u^2 + a2v^2 + a3uv + a4u + a5v + a6$$

## Results:



## Comparing all the results: