ENHANCEMENT OF PSR OF LUNAR CRATERS Captured by OHRC of Chandrayaan-2

Problem Statement ID- 1732

Space Penguins

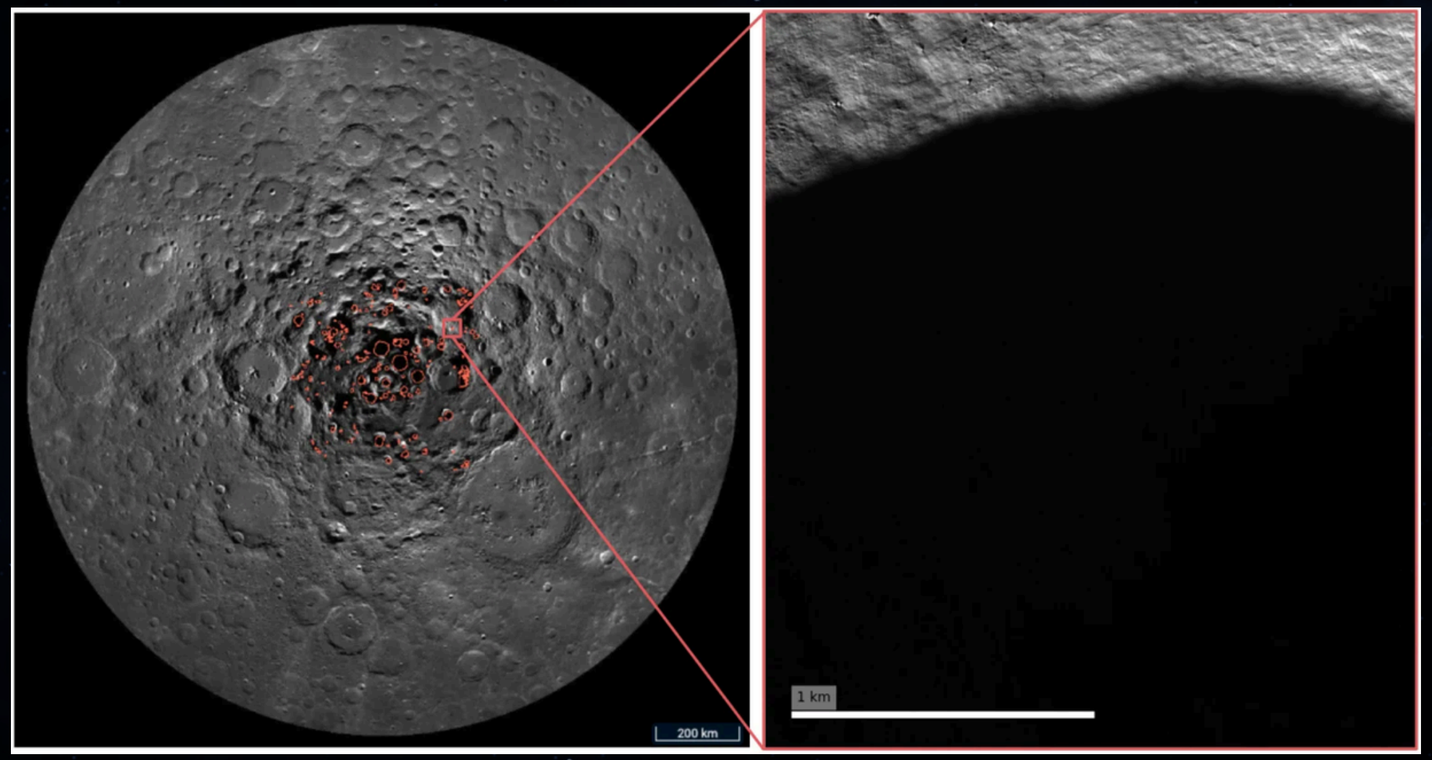
- Theme- Space Technology
- PS Category- Software
- Team ID - 19663

Why are craters?

PSRs are areas near the Moon's poles that remain in perpetual darkness due to the Moon's small axial tilt (1.54°).

No Sunlight: PSRs are among the coldest places in the solar system (as low as 40 K or -233°C).
Water Ice: They likely contain ancient water ice and other volatiles trapped for billions of years.

Why is this important?

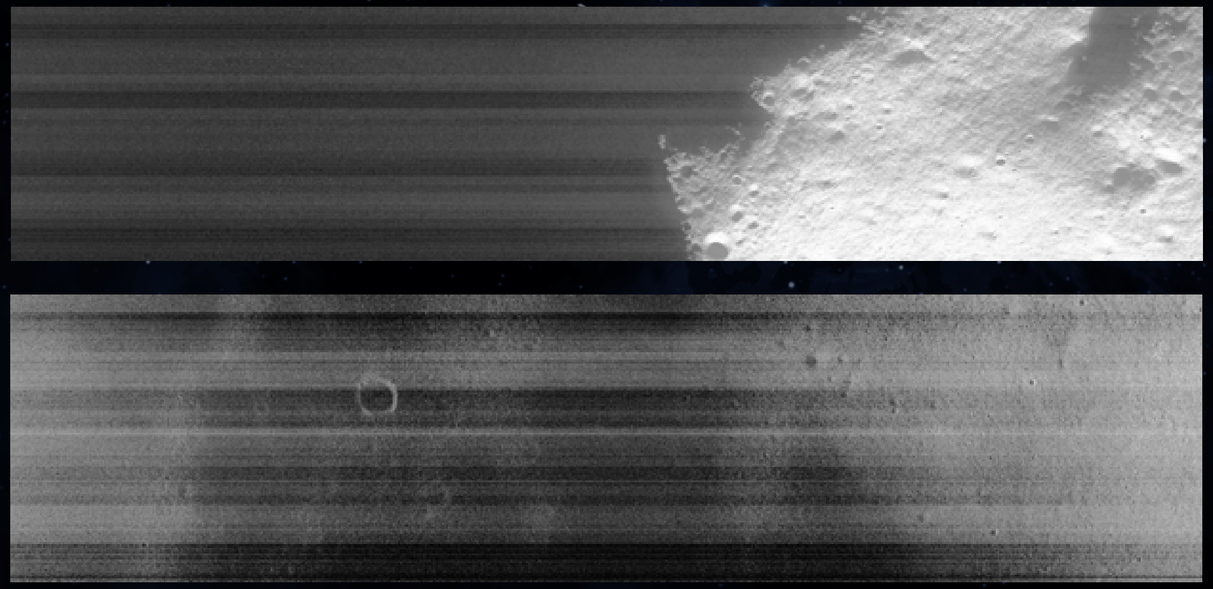


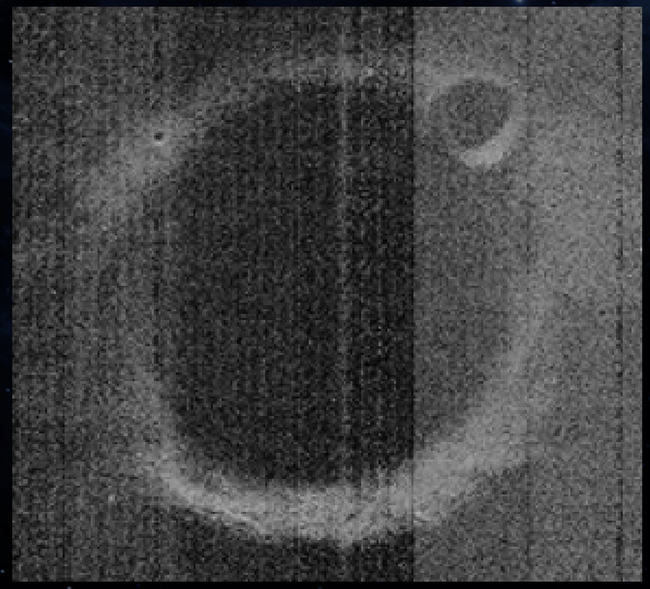
- PSR images are noisy.
  BANDING NOISE
- Introduced by the camera when it reads data from the sensor
  GRAININESS
- Few photons reach the camera in low light, causing graininess.

With enhancement, we can :

- Can create PSR image map of lunar pole images by OHRC of Chandrayan 2
- Supporting Landing Site Selection

Input – OHRC Images



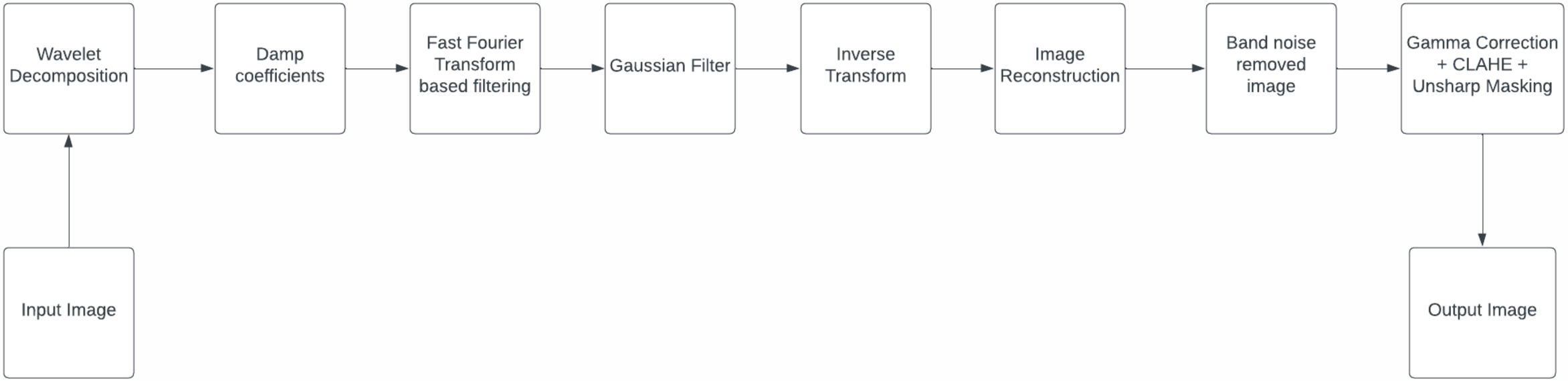


BANDING NOISE
SPECKLE/GRAIN NOISE

DENOISING

Denoising

Removing Band noise from OHRC Images

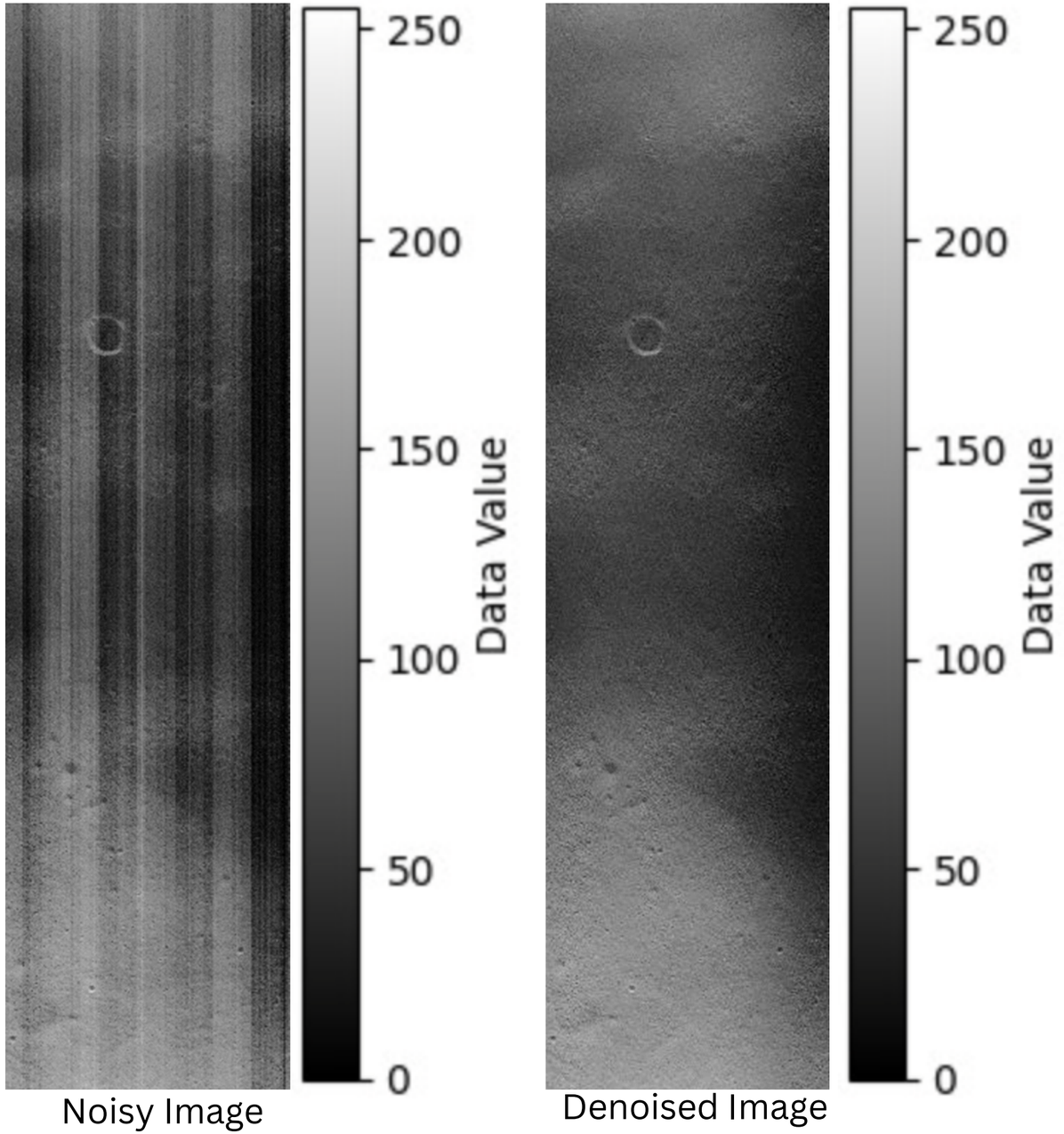


BANDING NOISE: Discrete Wavelet Transform (DWT) and Fast Fourier Transform (FFT)

GRAIN NOISE : Gamma Correction + CLAHE + Unsharp Masking

Denoising

Removing Band noise from OHRC Images

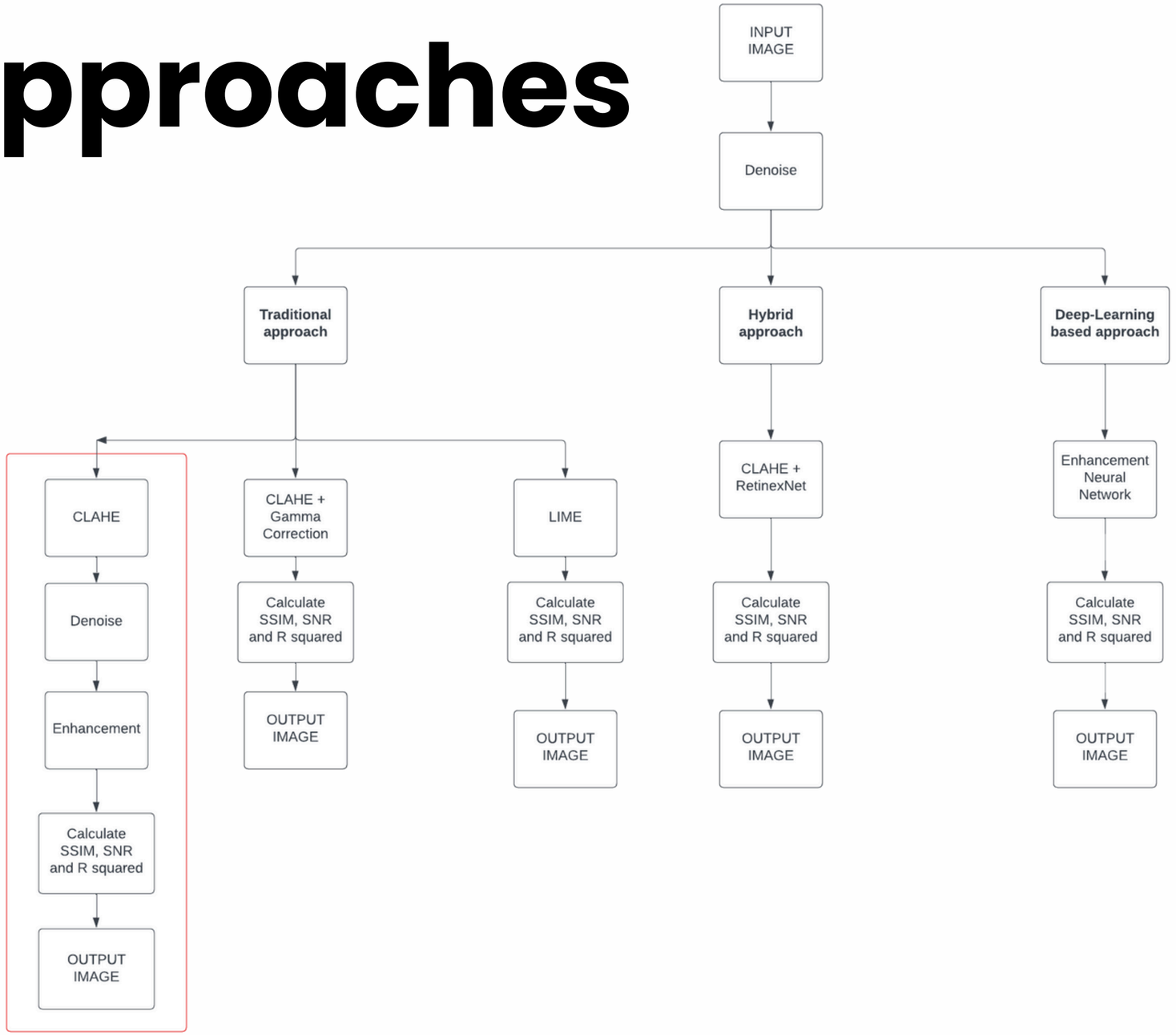


Noisy Image

Denoised Image

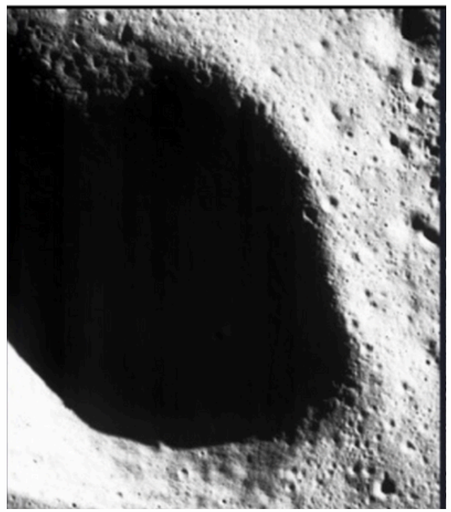
ENHANCEMENT

Explored Approaches



Chosen Approach

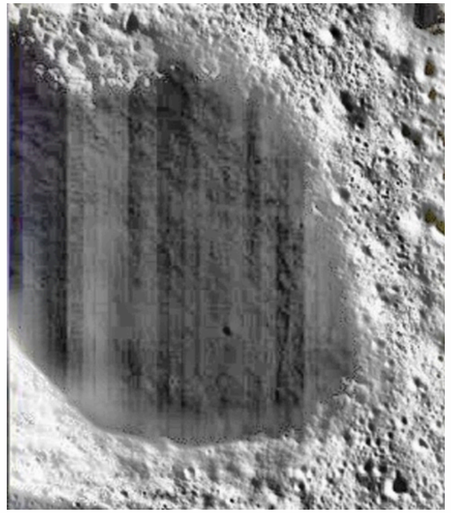
Attempted Approaches



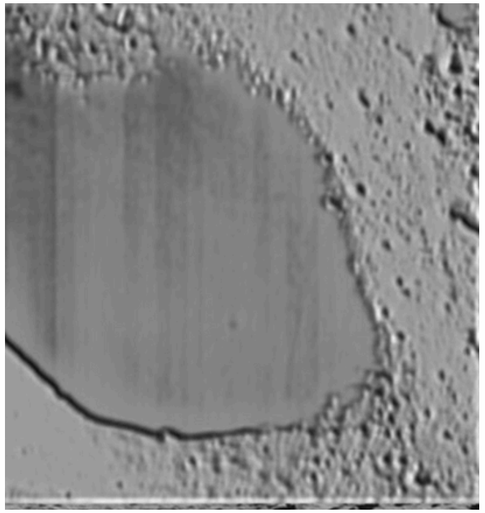
ORIGINAL IMAGE

LIME
(Traditional)

CLAHE + Retinex
(Hybrid)



CLAHE + Gamma Correction
(Traditional)



CNN
(Deep Learning)

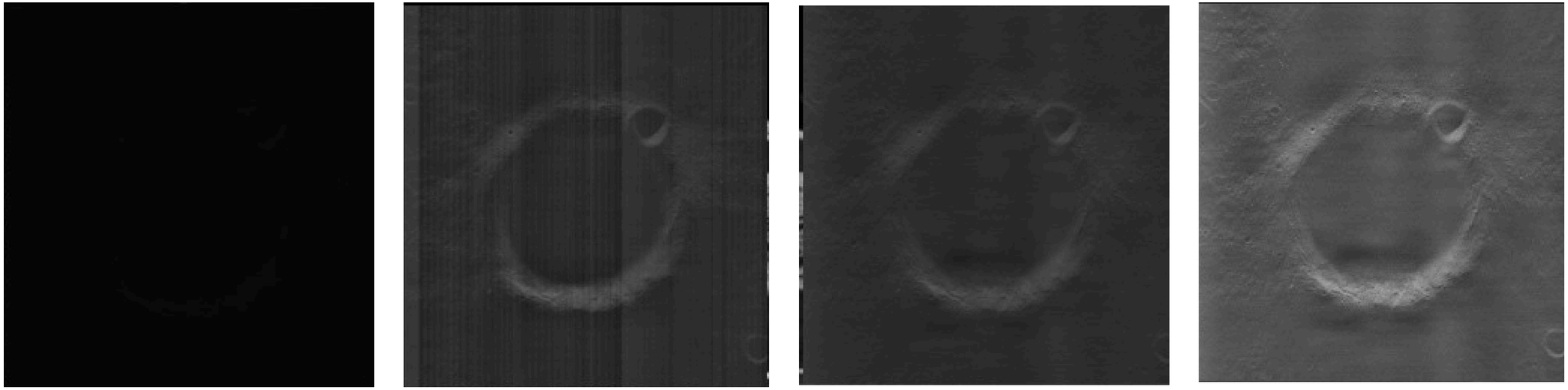
Chosen Approach

Fig 1: Tif lunar image

Fig 2: Histogram Equilization

Fig 3: Band noise removal - (Discrete Wavelet Transform (DWT) and Fast Fourier Transform (FFT))

Fig 4: Speckle noise removal - (Gamma Correction + CLAHE + Unsharp Masking)



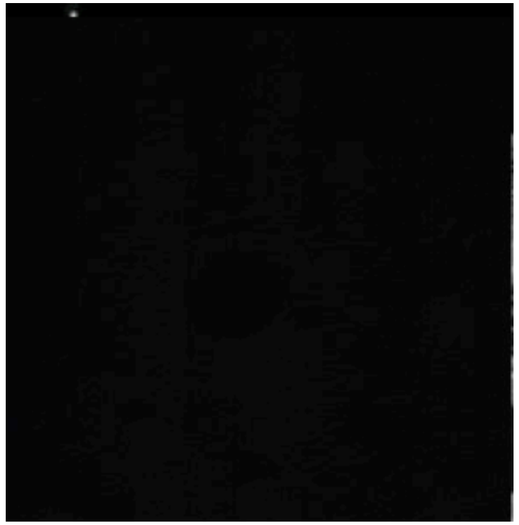
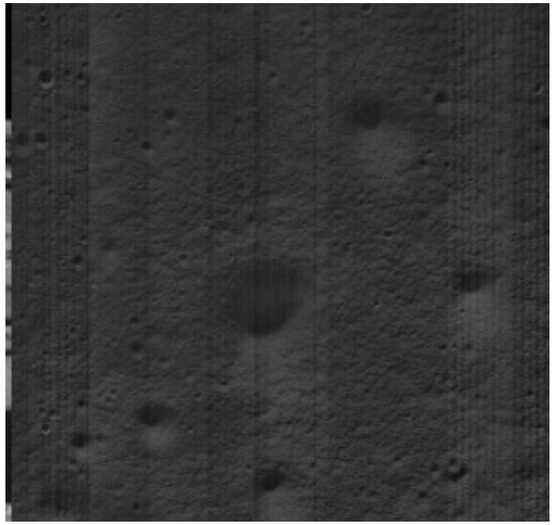
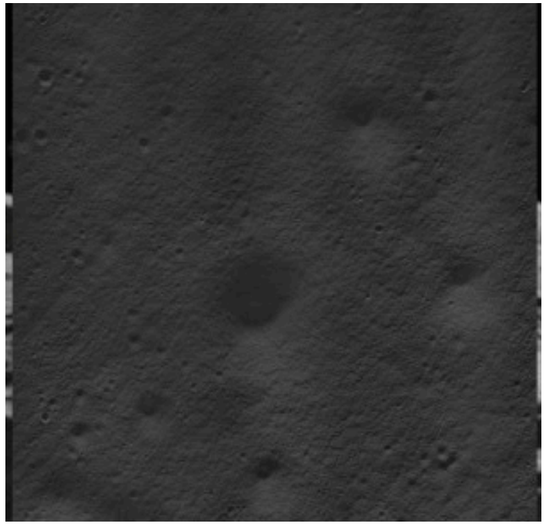
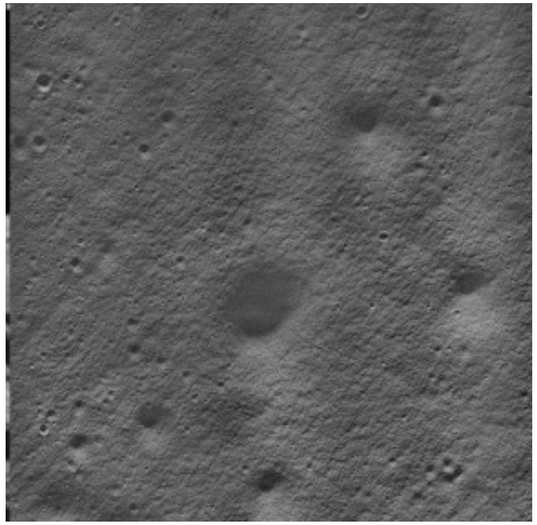
Chosen Approach

Fig 1: Tif lunar image

Fig 2: Histogram Equilization

Fig 3: Band noise removal - (Discrete Wavelet Transform (DWT) and Fast Fourier Transform (FFT))

Fig 4: Speckle noise removal - (Gamma Correction + CLAHE + Unsharp Masking)

VALIDATION

Histogram

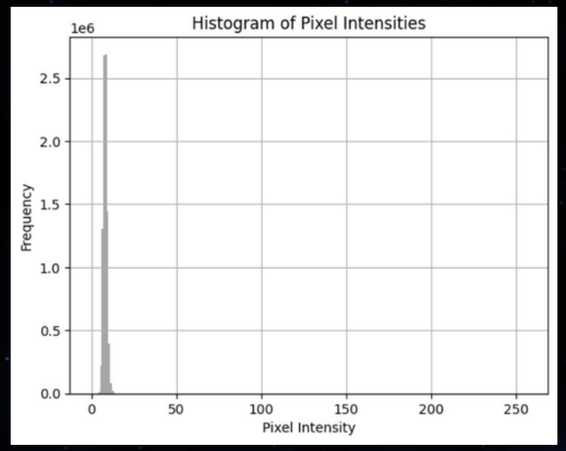


Fig 1: Tif lunar image

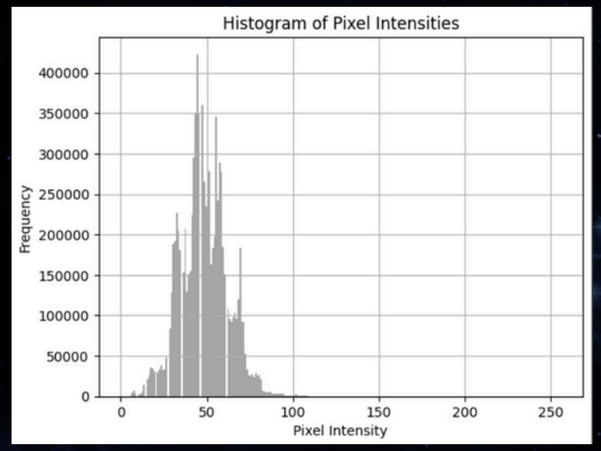


Fig 2: Histogram Equilization

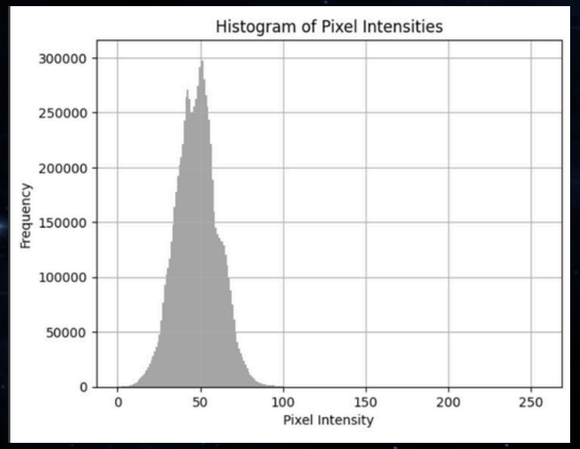


Fig 3: Band noise removal

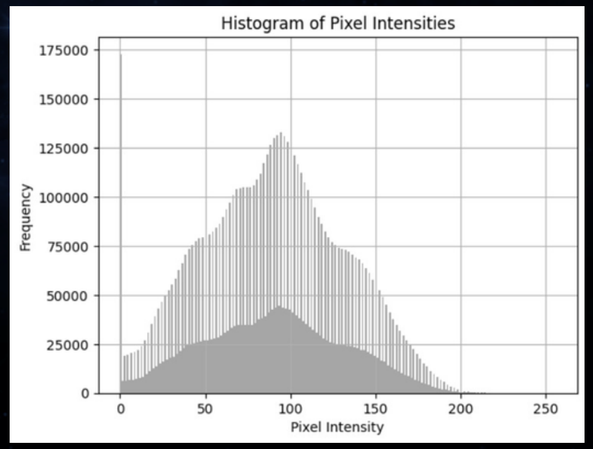
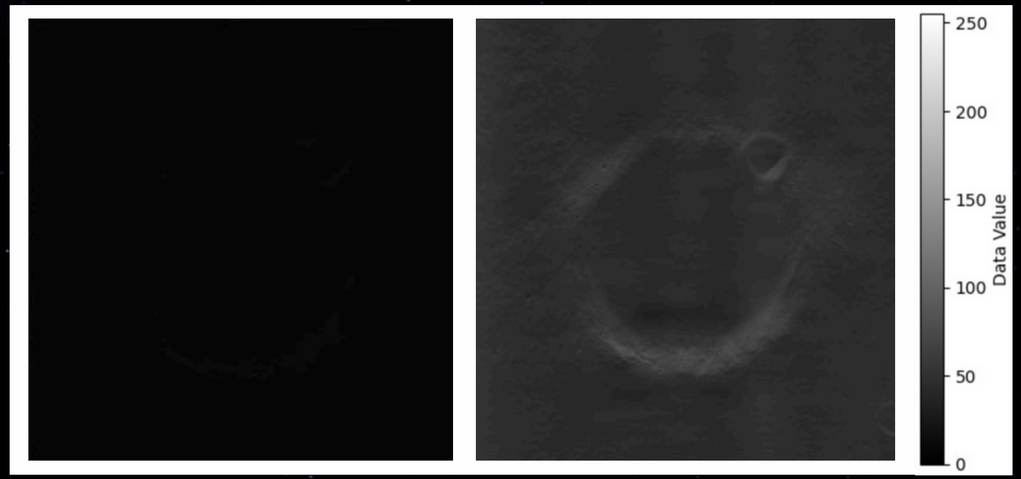


Fig 4: Speckle noise removal)

Performance Metrics

- Structural Similarity Index (SSIM) - 0.98
- Coefficient of Determination (R-squared) - 0.90
- Signal to Noise Ratio (SNR)
    - Input Image - 10.93
    - Denoised Image - 11.45



Thank You !