

# Image Enhancement and CLAHE Algorithm

Welcome to this presentation exploring the world of image enhancement and the powerful CLAHE algorithm. We will delve into the importance of image enhancement, its core principles, and the inner workings of the CLAHE algorithm. We will also discuss its advantages and applications across diverse fields.

Name & USN:

Tarun Ranganath Bombalekar (ENG22CS0197)

Veeresha R (ENG22CS0204)

Rakesh Rathod (ENG22CS0133)



# Understanding Image Enhancement

## Definition

Image enhancement refers to the process of improving the visual quality of images, often by enhancing contrast, sharpness, and detail.

## Purpose

It aims to make images easier to interpret, analyze, and process by enhancing specific features and suppressing unwanted noise.

# Before



# Before

## The Need for Image Enhancement



### Poor Lighting

Enhancement helps improve visibility in low-light conditions, enhancing detail and clarity.



### Image Degradation

It can restore clarity to images affected by noise, blur, or compression artifacts.



### Visual Analysis

It aids in medical imaging, satellite imagery, and object detection by making critical features more prominent.

# Principles of Image Enhancement

## Contrast Enhancement

Increases the difference between light and dark areas, making details more visible.

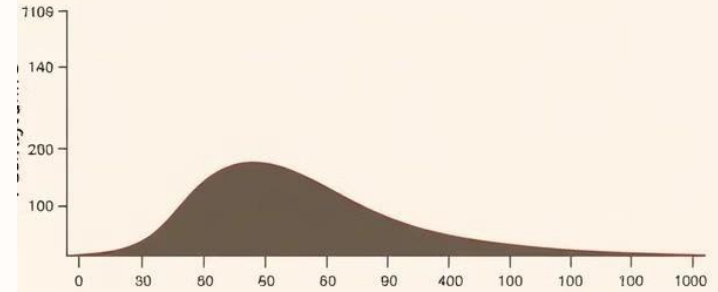
## Sharpening

Enhances edges and boundaries, making objects appear more defined.

## Noise Reduction

Reduces unwanted noise and artifacts, improving image clarity and detail.

magle conteontri Minn  
esseechrlessterelilting



2. Contratten sstelnnng up



sharpning ariflles

3. shrening filterr



# Introduction to CLAHE Algorithm

## **Histogram Equalization**

CLAHE is an advanced form of histogram equalization, a technique used to enhance contrast.

## **Contrast Enhancement**

CLAHE aims to distribute pixel intensities more evenly, boosting overall image contrast.

## **Local Adaptation**

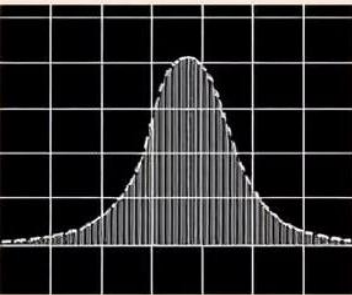
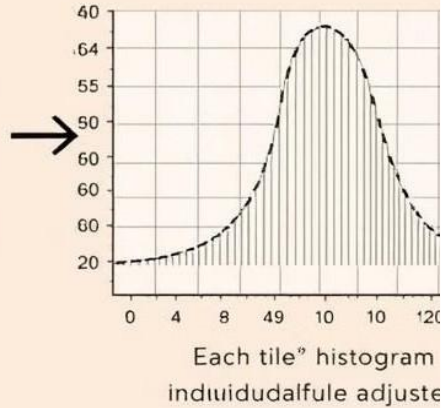
It operates on smaller regions of the image, adaptively adjusting contrast for better detail preservation.



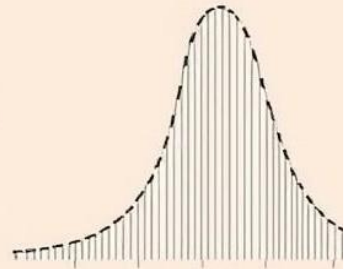
# CLAHE



Original image with low contrast.



Original image



Enhanced image

## How CLAHE Works

1

### Divide Image

The image is divided into smaller blocks, each representing a local region.

2

### Calculate Histogram

A histogram is calculated for each block, analyzing the distribution of pixel intensities.

3

### Equalize Histogram

The histogram is equalized within each block, spreading out intensities for better contrast.

4

### Combine Blocks

The equalized blocks are combined to create the final enhanced image.

# Advantages of CLAHE

1

## Enhanced Contrast

CLAHE effectively enhances contrast, making details more visible in low-light or high-contrast areas.

2

## Preserved Detail

It avoids over-enhancing details, preventing distortion or blurring, unlike traditional histogram equalization.

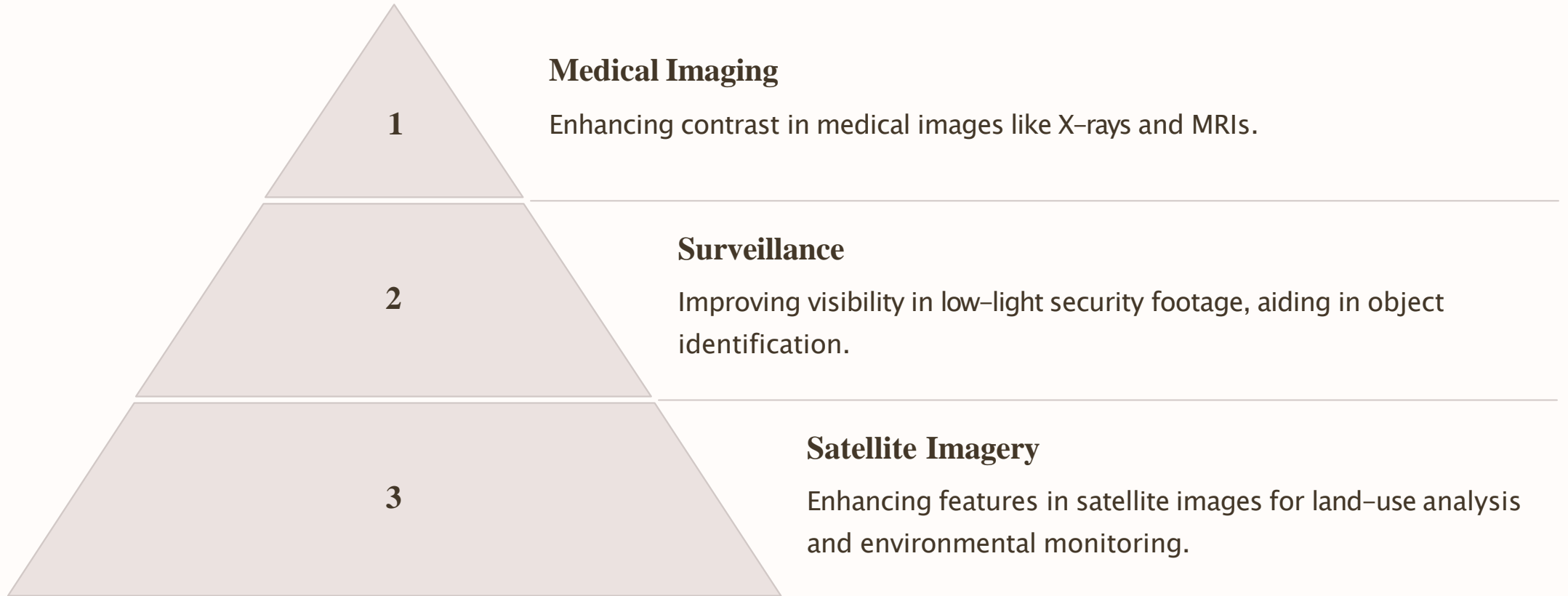
3

## Local Adaptation

CLAHE's localized approach ensures that different regions of the image are enhanced appropriately.

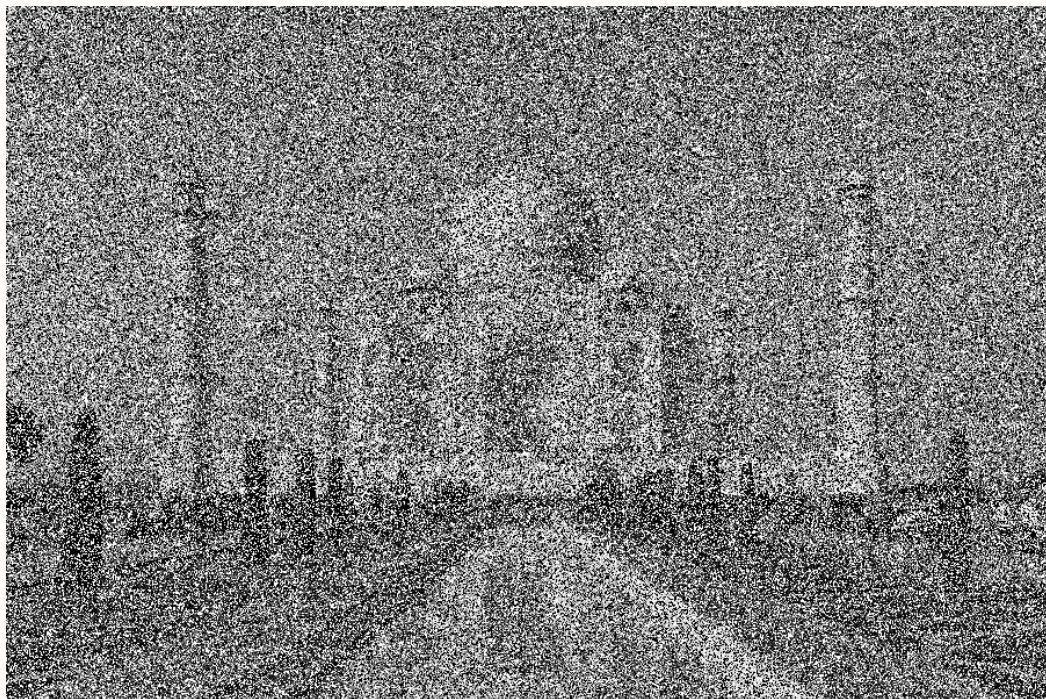


# Practical Applications of CLAHE





**Before**



**After**



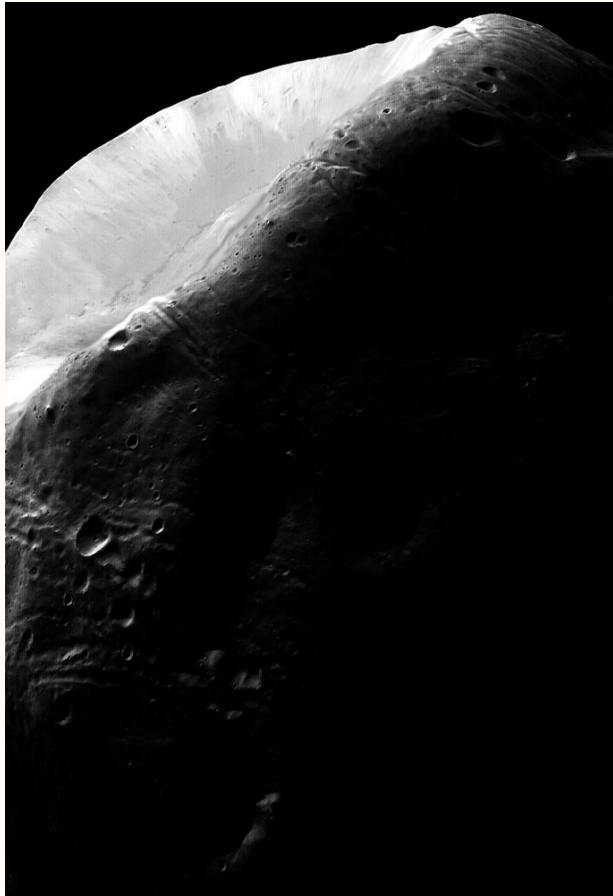
**Before**



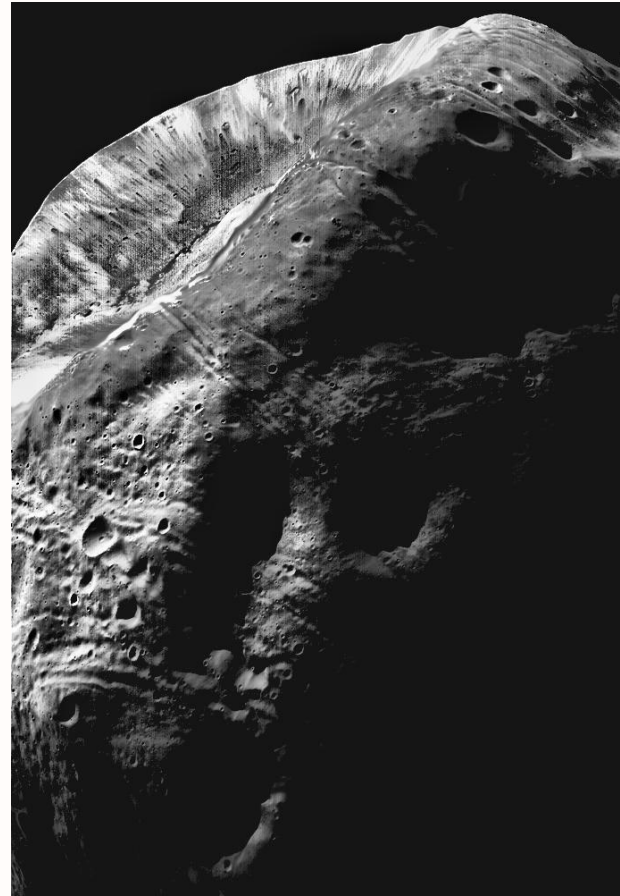
**After**



**Before**



**After**





# Conclusion and Key Takeaways

1

## Image Enhancement

A powerful tool for improving image quality and revealing hidden details.

---

2

## CLAHE

An advanced algorithm that provides excellent contrast enhancement while preserving detail.

---

3

## Applications

CLAHE finds wide application in diverse fields like medical imaging, surveillance, and remote sensing.