



# SNS COLLEGE OF ENGINEERING

(Autonomous)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING



## 19EC351 – IMAGE PROCESSING AND COMPUTER VISION

### UNIT -2

### Image Enhancement





# Introduction

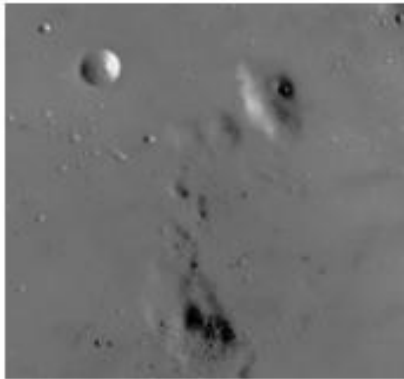
Histogram processing methods are **global processing**, in the sense that pixels are modified by a transformation function based on the gray-level content of an entire image.

Sometimes, we may need to enhance details over small areas in an image, which is called a local enhancement.

A local histogram of an image is a **histogram of the values of the pixels that lie in a neighborhood of a given pixel's location**. It indicates the particular combination of pixel intensities or colors that appear in that neighborhood.



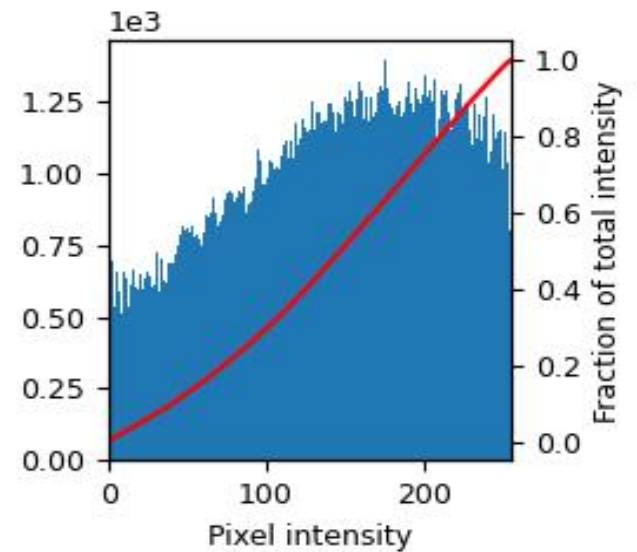
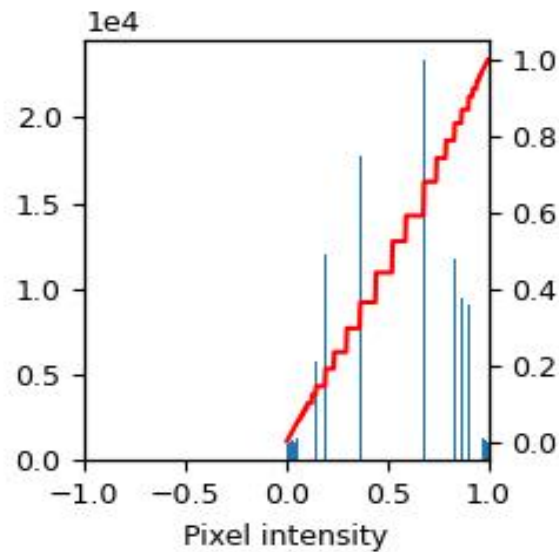
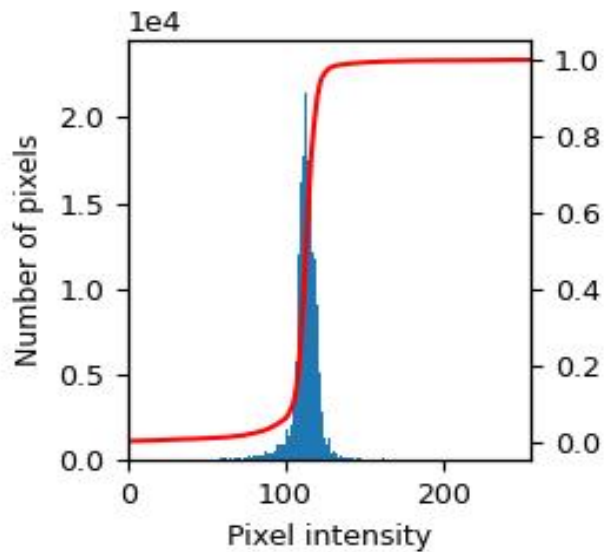
Low contrast image



Global equalise



Local equalize





# Procedure of Local Histogram



Step 1 : A square or rectangular neighbourhood is defined.

Step 2: The center of this neighbourhood is moved from pixel to pixel.

Step 3: At each location, the histogram of the points inside the window is computed and a histogram equalization transformation function is obtained.

Step 4: Now the grey level of the neighbourhoods center pixel is mapped by the obtained transformation function.

Step 5: The center of the neighborhood region is then moved to an adjacent pixel location and the procedure is repeated





# Histogram Matching



Histogram matching is **to take an input image and generate an output image that is based upon the shape of a specific (or reference) histogram**





# Smoothing Linear Filters



- Smoothing is often used to reduce noise within an image.
- Image smoothing is a key technology of image enhancement, which can remove noise in images. So, it is a necessary functional module in various image-processing software.
- Image smoothing is a method of improving the quality of images.
- Smoothing is performed by spatial and frequency filters





# Spatial Filtering



- Spatial filtering term is the filtering operations that are performed directly on the pixels of an image. The process consists simply of moving the filter mask from point to point in an image.
  - Smoothing spatial filters
  - Sharpening spatial filters





# Smoothing Spatial Filters



- Smoothing filters are used for noise reduction and blurring operations.
- It takes into account the pixels surrounding it in order to make a determination of a more accurate version of this pixel.
- By taking neighboring pixels into consideration, extreme “noisy” pixels can be filtered out.
- Unfortunately, extreme pixels can also represent original fine details, which can also be lost due to the smoothing process







# Smoothing Linear Filters



- Smoothing linear spatial filter is the average of the pixels contained in the neighborhood of the filter mask.
- Averaging filters or low pass filters.
  - Mean filter
  - Gaussian filter

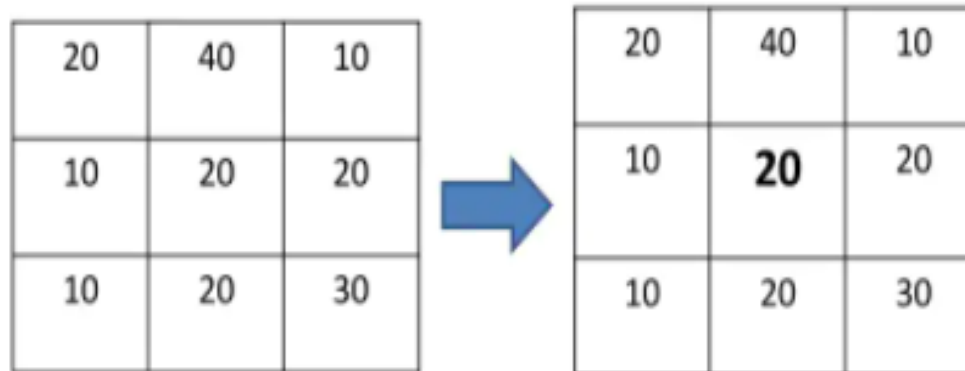




# Mean Filter/Box Filter



- Mean filtering is simply to replace each pixel value in an image with the mean ('average') value of its neighbors, including itself.
- 3×3 normalized box filter:



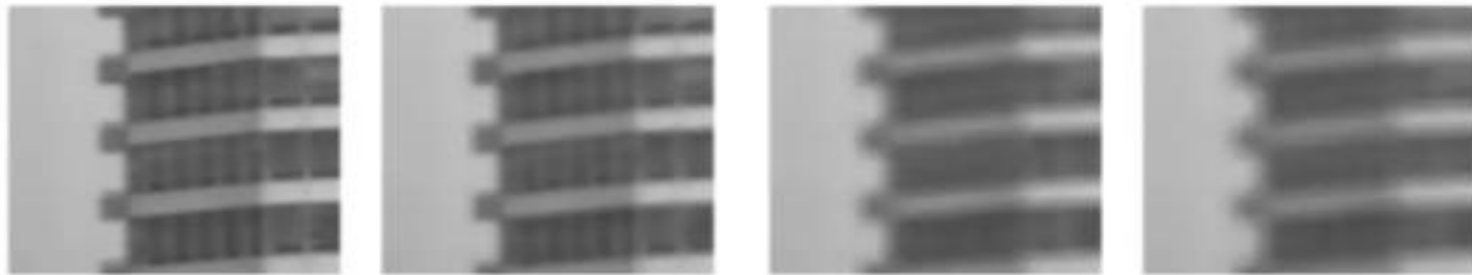
7





## Mean Filter cont..

- Image smoothed with  $3 \times 3$ ,  $5 \times 5$ ,  $9 \times 9$  and  $11 \times 11$  box filters



- Often a  $3 \times 3$  square matrix is used, although larger matrix (e.g.  $5 \times 5$  squares) can be used for more severe smoothing.
- **Drawback:**
  - smoothing reduces fine image detail



# Gaussian Filter

- A Gaussian filter smoothens an image by calculating weighted averages in a filter box.
- It is used to 'blur' images and remove detail and noise.
- Gives more weight at the central pixels and less weights to the neighbors.
- The farther away the neighbors, the smaller the weight.
- Gaussian Blurs produce a very pure smoothing effect without side effects.

$$\frac{1}{2\pi\sigma^2} \exp\left\{-\frac{x^2 + y^2}{2\sigma^2}\right\}$$

10





# Sharpening Spatial Filters



Sharpening Spatial Filter: It is also known as derivative filter. The purpose of the sharpening spatial filter is just the opposite of the smoothing spatial filter.

**Its main focus is on the removal of blurring and highlight the edges.** It is based on the first and second order derivative

## Some Applications

- Photo Enhancement
- Medical image visualization
- Industrial defect detection
- Electronic printing
- Autonomous guidance in military systems





# THANK YOU

