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FACULTY OF EGINEERING

Digital Image Processing
LECTURE-15

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OUTLINE

- Histogram Processing
- Histogram Equalization
- Histogram Matching (or Specification)
- Method
- Image Smoothing or Averaging
- MCQ
- References

Histogram Processing

The histogram of a digital image with gray levels from 0 to L-1 is a discrete function h(rk)=nk, where

rk is the kth gray level

nk is the # pixels in the image with that gray level

n is the total number of pixels in the image

k = 0, 1, 2, …, L-1

Normalized histogram: p(rk)=nk/n

sum of all components = 1

Types of processing:

Histogram equalization

Histogram matching (specification)

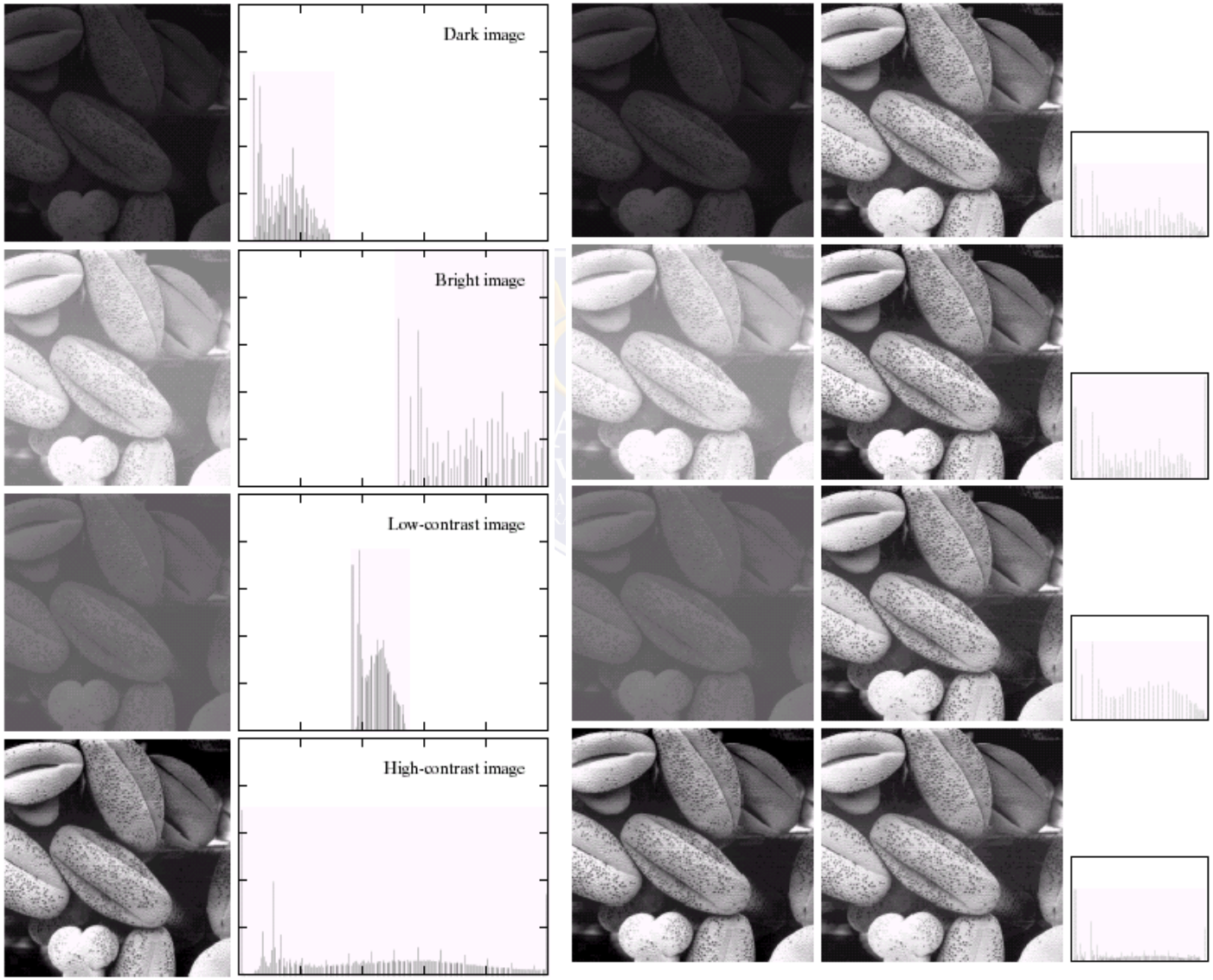
Local enhancement

Histogram Equalization

$$s_k = T(r_k) = \sum_{j=0}^{k} \frac{n_j}{n} = \sum_{j=0}^{k} p_r(r_j)$$

Histogram equalization (HE) results are similar to contrast stretching but offer the advantage of full automation, since HE automatically determines a transformation function to produce a new image with a uniform histogram.

Histogram Equalization



Histogram Matching (or Specification)

Histogram equalization does not allow interactive image enhancement and generates only one result: an approximation to a uniform histogram.

Sometimes though, we need to be able to specify particular histogram shapes capable of highlighting certain gray-level ranges.

Method

Specify the desired density function and obtain the transformation function G(z):

$$v = G(z) = \sum_{0}^{z} p_z(w) \approx \sum_{i=0}^{z} \frac{n_i}{n}$$

pz: specified desirable PDF for output

– Apply the inverse transformation function z=G-1(s) to the levels obtained in step 1.

Image Smoothing or Averaging

A noisy image:

$$g(x,y)=f(x,y)+n(x,y)$$

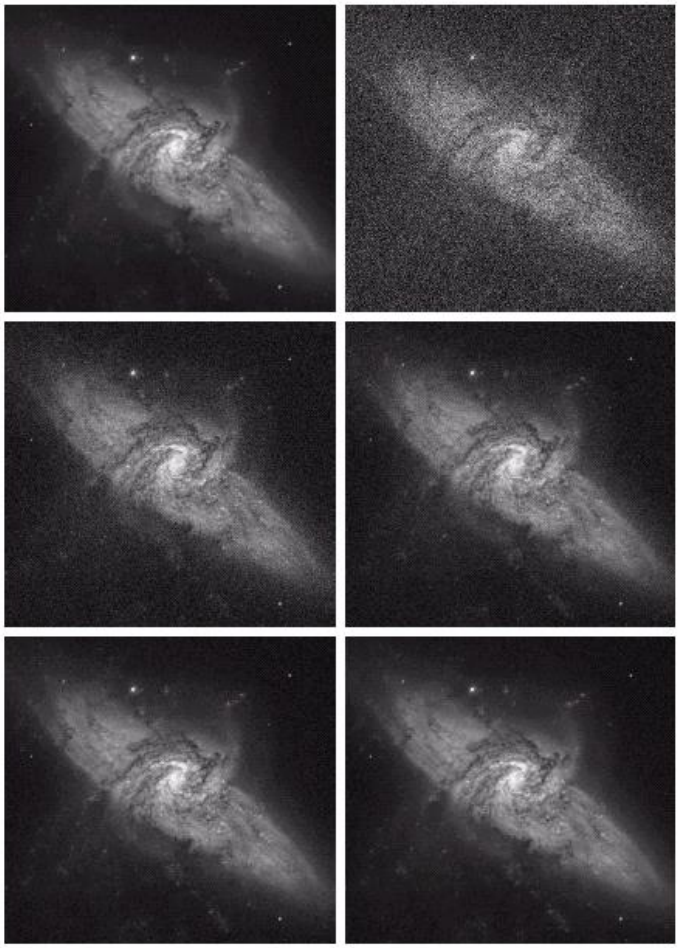
Averaging M different noisy images:

$$g(x,y)=\frac{1}{M}\sum_{i=1}^{M}g_i(x,y)$$

As M increases, the variability of the pixel values at each location decreases.

This means that g(x,y) approaches f(x,y) as the number of noisy images used in the averaging process increases.

Image Smoothing or Averaging



a b
c d
e f

FIGURE 3.30 (a) Image of Galaxy Pair NGC 3314. (b) Image corrupted by additive Gaussian noise with zero mean and a standard deviation of 64 gray levels. (c)–(f) Results of averaging $K = 8, 16, 64$, and 128 noisy images. (Original image courtesy of NASA.)

MCQ

1. Which of the following comes under the application of image blurring?
    a) Object detection
    b) Gross representation
    c) Object motion
    d) Image segmentation
2. Which of the following filters response is based on ranking of pixels?
    a) Nonlinear smoothing filters
    b) Linear smoothing filters
    c) Sharpening filters
    d) Geometric mean filter
3. Median filter belongs to which category of filters?
    a) Linear spatial filter
    b) Frequency domain filter
    c) Order static filter
    d) Sharpening filter
4. Median filters are effective in the presence of impulse noise.
    a) True
    b) False

MCQ

5. What is the maximum area of the cluster that can be eliminated by using an n×n median filter?

a) n^2

b) $n^2/2$

c) $2*n^2$

d) n

References

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