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FACULTY OF EGINEERING

Digital Image Processing
LECTURE-17

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OUTLINE

- Frequency Domain Methods
- Mathematical/Logical Operations on Images
- Image Averaging for Noise Reduction
- Image Subtraction
- MCQ
- References

Frequency Domain Methods

•We simply compute the Fourier transform of the image to be enhanced, multiply the result by a filter (rather than convolve in the spatial domain), and take the inverse transform to produce the enhanced image.

•Low pass filtering involves the elimination of the high frequency components in the image. It results in blurring of the image

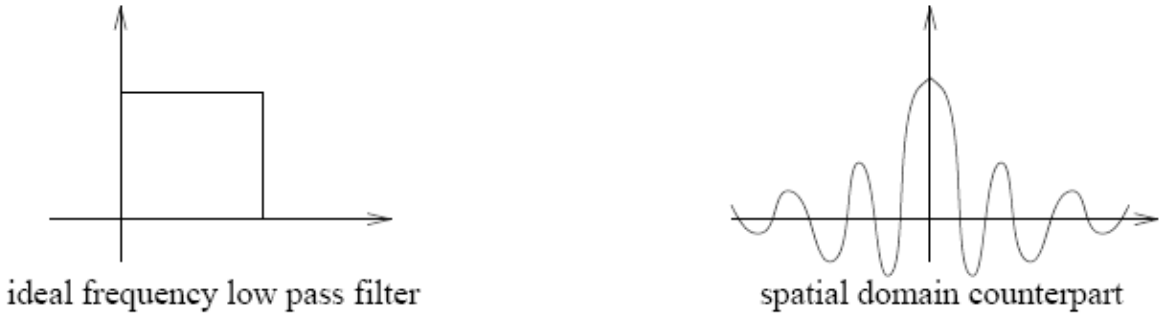


Figure 5: Transfer function for an ideal low pass filter.

Mathematical/Logical Operations on Images

- **Addition**
  - —Averaging images for noise removal
- **Subtraction**
  - –Removal of background from images
  - –Image enhancement
  - –Image matching
  - –Moving/displaced object tracking
- **Multiplication**
  - —Superimposing of texture on an image
  - –Convolution and correlation of images
- **And and or operations**
  - —To remove the unnecessary area of an image through mask operations

Image Averaging for Noise Reduction

A noisy image can be represented by

$$g(x, y) = f(x, y) + \eta(x, y),$$

where $\eta(x, y)$ denotes the noise in the image

Since the noise is random and the content $f(x, y)$ is fixed,

The noise can be removed by taking more noisy images of the same object and averaging them out

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

Image Averaging for Noise Reduction

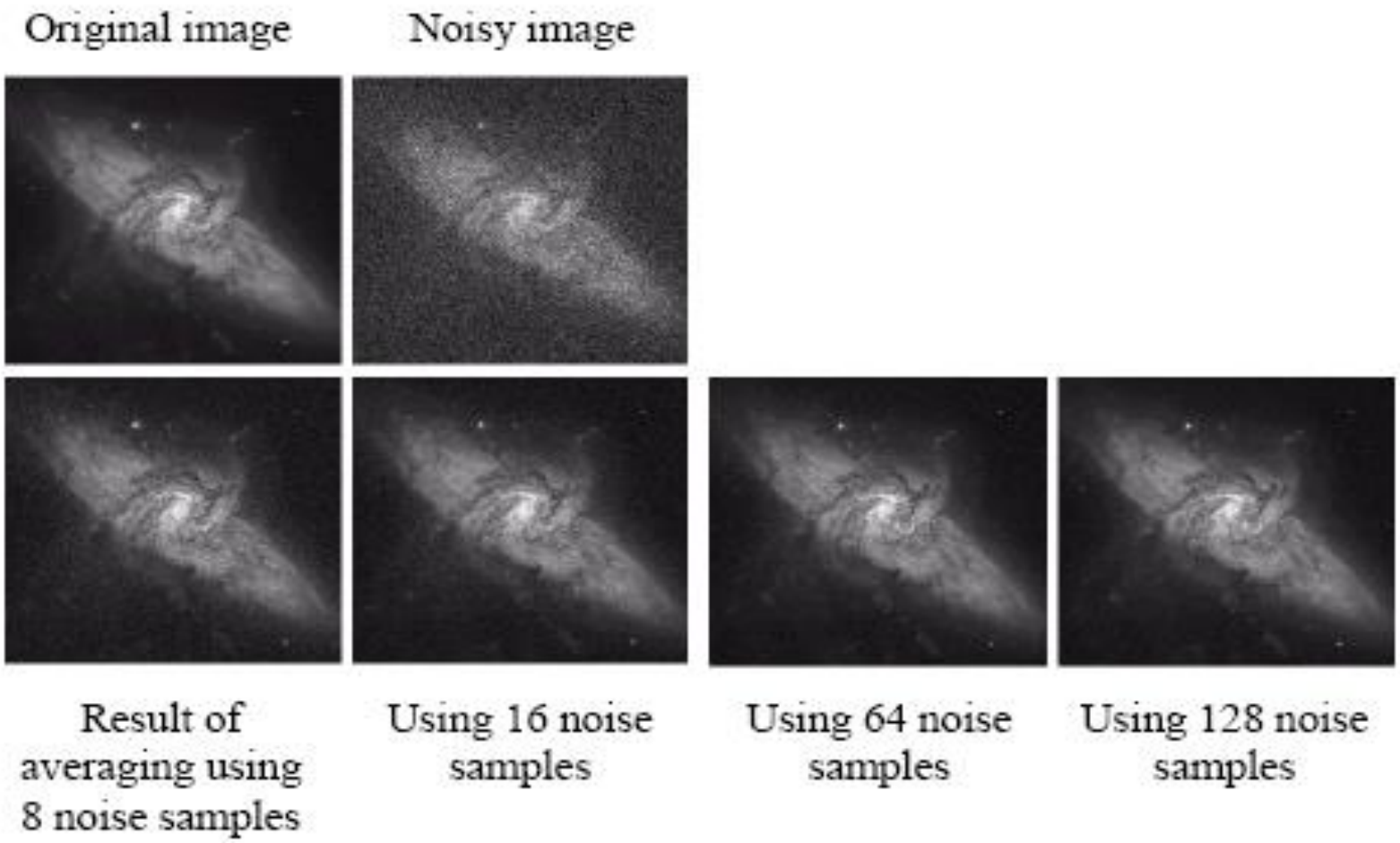
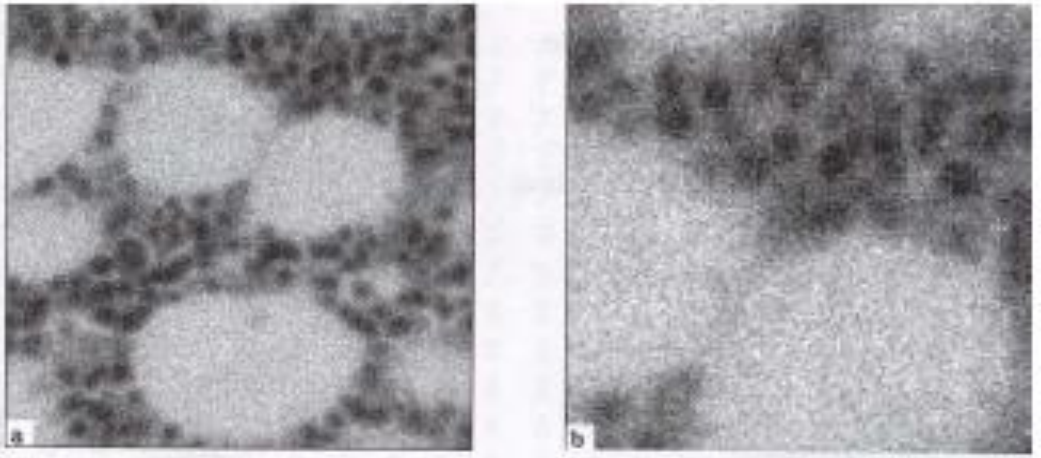


Image Averaging for Noise Reduction

Noisy image



Noise reduction by averaging 256 samples

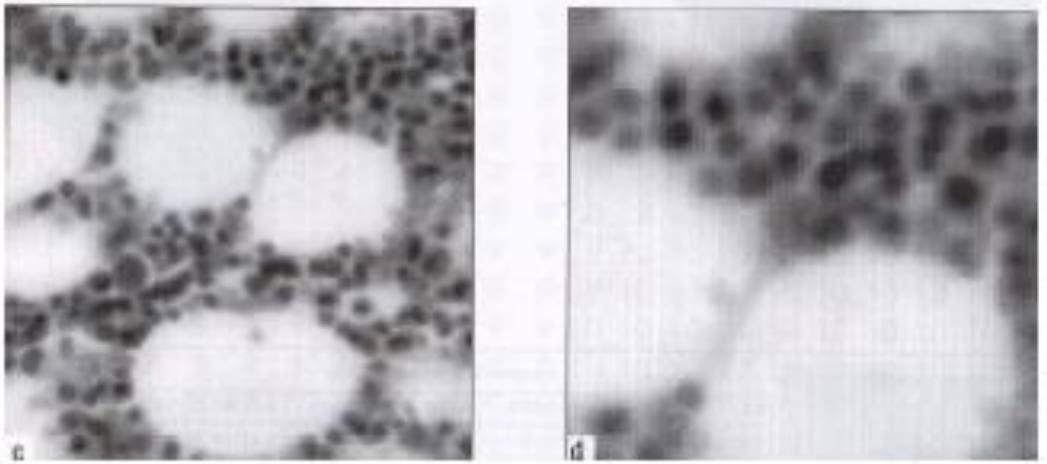


Image Subtraction

•Takes two images as input and produces a third image whose pixel values are those of the first image minus the corresponding pixel values from the second image

Variants

•It is also often possible to just use a single image as input and subtract a constant value from all the pixels

•Just output the absolute difference between pixel values, rather than the straightforward signed output.

Image Subtraction

- The subtraction of two images is performed in a single pass

$$Q(i,j) = P_1(i,j) - P_2(i,j)$$

- If the operator computes absolute differences between the two input images then:

$$Q = |P_1(i,j) - P_2(i,j)|$$

- If it is simply desired to subtract a constant value C from a single image then:

$$Q = P_1(i,j) - C$$

Image Subtraction

•If the operator calculates absolute differences, then it is impossible for the output pixel values to be outside the range

•In rest of the two cases the pixel value may become negative

•This is one good reason for using absolute differences.

•How to solve problem of negative pixels?

Image Subtraction

- How to solve problem of negative pixels?
- Let we have an 8 bit Grayscale image (Value Range= 0 t0 255)
- The result of image subtraction may come in the range of -255 to +255
- One scheme can be to add 255 to every pixel and then divide by 2
- Method is easy and fast
- Limitations
    - Truncation errors can cause loss of accuracy
    - Full range of display may not be utilized

Image Subtraction

- How to solve problem of Negative Pixels?
- Another scheme can be
- first, find the minimum gray value of the subtracted image
- second, find the maximum gray value of the subtracted image
- set the minimum value to be zero and the maximum to be 255
- while the rest are adjusted according to the interval [0, 255], by timing each value with 255/max

MCQ

1. What is the name of process used to correct the power-law response phenomena?
   a) Beta correction
   b) Alpha correction
   c) Gamma correction
   d) Pie correction
2. Which of the following transformation function requires much information to be specified at the time of input?
   a) Log transformation
   b) Power transformation
   c) Piece-wise transformation
   d) Linear transformation
3. In contrast stretching, if r1=s1 and r2=s2 then which of the following is true?
   a) The transformation is not a linear function that produces no changes in gray levels
   b) The transformation is a linear function that produces no changes in gray levels
   c) The transformation is a linear function that produces changes in gray levels
   d) The transformation is not a linear function that produces changes in gray levels

MCQ

4. In contrast stretching, if r1=r2, s1=0 and s2=L-1 then which of the following is true?

   a) The transformation becomes a thresholding function that creates an octal image

   b) The transformation becomes a override function that creates an octal image

   c) The transformation becomes a thresholding function that creates a binary image

   d) The transformation becomes a thresholding function that do not create an octal image

5. In contrast stretching, if r1≤r2 and s1≤s2 then which of the following is true?

   a) The transformation function is double valued and exponentially increasing

   b) The transformation function is double valued and monotonically increasing

   c) The transformation function is single valued and exponentially increasing

   d) The transformation function is single valued and monotonically increasing

References

- https://www.javatpoint.com/digital-image-processing-tutorial
- https://www.geeksforgeeks.org/
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- Digital Image Processing and Computer Vision, R.J. Schalkoff. Published by: JohnWiley and Sons, NY.
- Fundamentals of Digital Image Processing, A.K. Jain. Published by Prentice Hall,Upper Saddle River, NJ.