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FACULTY OF EGINEERING

Digital Image Processing
LECTURE-16

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OUTLINE

- Spatial Filtering
- Neighborhood Averaging
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- Non-linear Filter
- Sharpening Filters
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Spatial Filtering

Use of spatial masks for image processing (spatial filters)

Linear and nonlinear filters

Low-pass filters eliminate or attenuate high frequency components in the frequency domain

(sharp image details), and result in image blurring.

$$g(x,y)=\sum_{s=-a}^{a}\sum_{t=-b}^{b}w(s,t)f(x+s,y+t)$$

a=(m-1)/2 and b=(n-1)/2,

m x n (odd numbers)

For x=0,1,…,M-1 and y=0,1,…,N-1

The basic approach is to sum products between the mask coefficients and the intensities of the pixels under the mask at a specific location in the image:

$$R=w_1z_1+w_2z_2+\ldots+w_9z_9$$

Neighborhood Averaging

Each point in the smoothed image, $\hat{F}(x, y)$ is obtained from the average pixel value in a neighbourhood of (x, y) in the input image.

For example, if we use a 3×3 neighbourhood around each pixel we would use the mask

$$\begin{matrix} 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \\ 1/9 & 1/9 & 1/9 \end{matrix}$$

General Spatial Filter

FIGURE 3.33 Another representation of a general 3×3 spatial filter mask.

w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

Non-linear Filter

Median filtering (nonlinear)

•Used primarily for noise reduction (eliminates isolated spikes)

•The gray level of each pixel is replaced by the median of the gray levels in the neighborhood of that pixel (instead of by the average as before).

Non-linear Filter

original

added noise

average

median

Sharpening Filters

•The main aim in image sharpening is to highlight fine detail in the image

•With image sharpening, we want to enhance the high-frequency components; this implies a spatial filter shape that has a high positive component at the centre

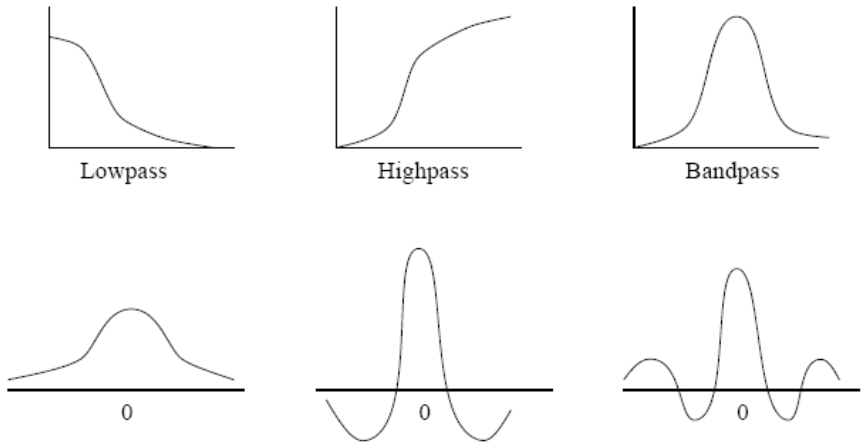

Figure 4: Frequency domain filters (top) and their corresponding spatial domain counterparts (bottom).

Derivatives

First derivative

$$\frac{\partial f}{\partial x} = f(x+1) - f(x)$$

Second derivative

$$\frac{\partial^2 f}{\partial x^2} = f(x+1) + f(x-1) - 2f(x)$$

MCQ

1. Which of the following expression is used to denote spatial domain process?

   a) g(x,y)=T[f(x,y)]

   b) f(x+y)=T[g(x+y)]

   c) g(xy)=T[f(xy)]

   d) g(x-y)=T[f(x-y)]

2. Which of the following shows three basic types of functions used frequently for image enhancement?

   a) Linear, logarithmic and inverse law

   b) Power law, logarithmic and inverse law

   c) Linear, logarithmic and power law

   d) Linear, exponential and inverse law

3. Which expression is obtained by performing the negative transformation on the negative of an image with gray levels in the range[0,L-1] ?

   a) s=L+1-r

   b) s=L+1+r

   c) s=L-1-r

   d) s=L-1+r

MCQ

4. What is the general form of representation of log transformation?

a) s=clog10(1/r)

b) s=clog10(1+r)

c) s=clog10(1*r)

d) s=clog10(1-r)

5. What is the general form of representation of power transformation?

a) s=crγ

b) c=srγ

c) s=rc

d) s=rcγ

References

- https://www.javatpoint.com/digital-image-processing-tutorial
- https://www.geeksforgeeks.org/
- Digital Image Processing 2nd Edition, Rafael C. Gonzalvez and Richard E. Woods. Published by: Pearson Education.
- 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.