Module 8 : Robot vision II

Lecture 28 : Image processing (spatial and frequency domain analysis)

Objectives

In this course you will learn the following

- Image Processing
- Spatial Domain processing example
- Frequency domain approach
- Magnitude of F(u)
- 2-D Discrete Fourier Transform
- Spatial Domain

Image Processing

Spatial domain processing

g(x,y) = h[f(x,y)]

Where,

g- output image

h- depends on properties of p and neighboring pixels

f - input Frequency domain processing

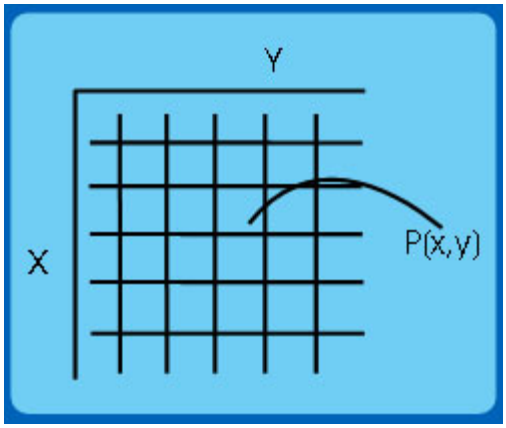

Figure 28.1 Transformation Mapping

$$\sum_{\substack{j=-1,0,1\\k=-1,0,1}} W_{jk} f(x+j,y+k) = W_{-1-1} f(x-1,y-1) + W_{-10} f(x-1,y) + W_{-1+1} f(x-1,y+1) + \ldots$$

$$= W_1 f(x-1,y-1) + W_2 f(x-1,y) + W_3 f(x-1,y+1) + W_4 f(x,y-1) + W_5 f(x,y) +$$

$$W_6 f(x,y+1) + W_7 f(x+1,y-1) + W_8 f(x+1,y) + W_9 f(x+1,y+1)$$

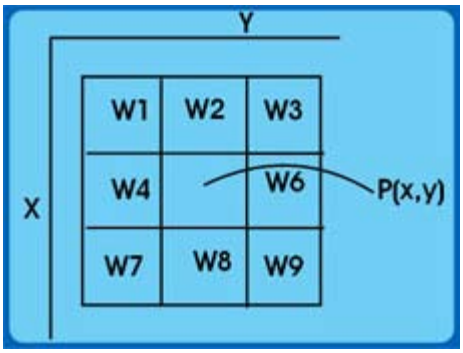

Figure 28.2 Transformation Mapping

Special Case: 1x1 template

S = T(r) Image, Intensity,

Transformation (mapping)

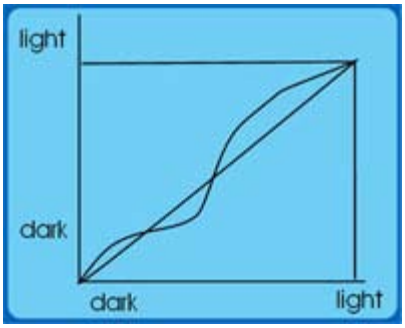

Figure 28.3

Magnitude of F(u)

$$|F(0)| = 3.25$$

$$|F(1)| = \sqrt{\frac{(-2)^2 + 1^2}{16}} = \frac{\sqrt{5}}{4}$$

$$|F(3)| = \frac{1}{4}$$

$$|F(4)| = \frac{\sqrt{5}}{4}$$

2-D Discrete Fourier Transform

$$F(u,v) = \frac{1}{N}\sum_{x=0}^{N-1}\sum_{y=0}^{N-1} f(x,y)e^{\frac{-2\pi j(ux+vy)}{N}}$$

$$f(x,y) = \frac{1}{N}\sum_{u=0}^{N-1}\sum_{v=0}^{N-1} F(u,v)e^{\frac{2\pi j(ux+vy)}{N}}$$

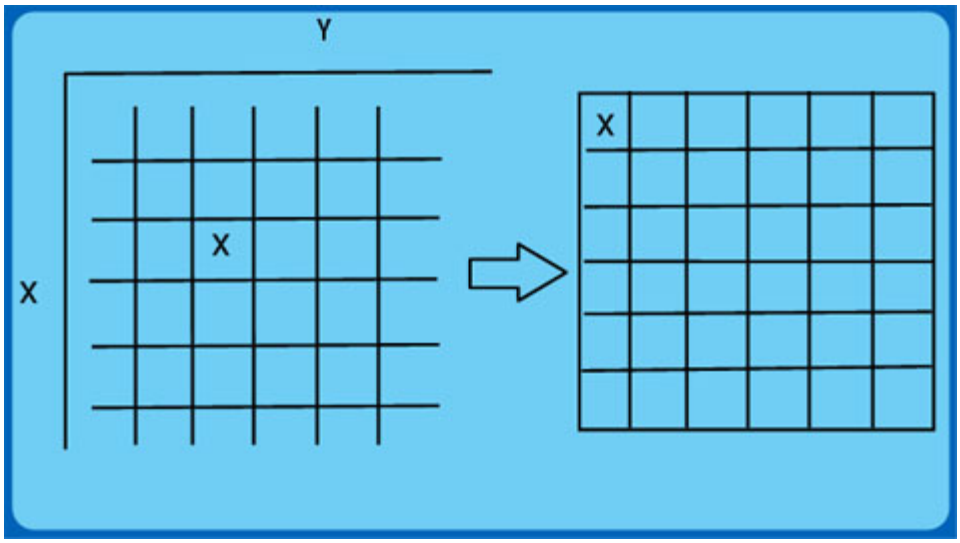

Figure 28.5

Spatial Domain

- Smoothing – reduce the effect of random noise
  - Neighborhood averaging. Boundaries are softer, fuzzier.
  - Median averaging

NA –> 103/9 = 11

MA -> 2 9 10 10 11 11 12 13 25

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

10	12	11
9	13	25
2	10	11

  - Image averaging: Intensity averaging across many images of the same scene
    - Better reduction of noise
    - Requires good registration of images
    - Time consuming

	0	0	1
	0	1	

  - Binary Image smoothing
  - Binary – Boolean expressions. Logic expressions

B1 = p+b.g.(d+e) + d.e.(b+g) -fill one pixel whole
B2 = p.[(a+b+d).(e+g+h) + (b+c+e).(d+f+g)] - fill notch
B3 = p + (d.f.g).(a+b+c+e+h) - fill missing corner

A	B	C
D	P	E
F	G	h

Recap

In this course you have learnt the following

- Image Processing
- Spatial Domain processing example
- Frequency domain approach
- Magnitude of F(u)
- 2-D Discrete Fourier Transform
- Spatial Domain

Congratulations, you have finished Lecture 28. To view the next lecture select it from the left hand side menu of the page.