Module 8 : Robot vision II

Lecture 29 : Image enhancements, histrogram Equalisation & specification, discrete transformations

Objectives

In this course you will learn the following

- Machine Vision
- Enhancement
- Histogram Equalization
- Histogram specification
- Image Enhancement

Machine Vision

- Image Acquisition
- Relationship between ‘image' coordinates and ‘world' coordinates
- Basic concepts - Neighborhood, distance connectivity
- Image processing – Spatial domain (Smoothing both gray level & binary), Frequency domain
- Enhancement.

Enhancement

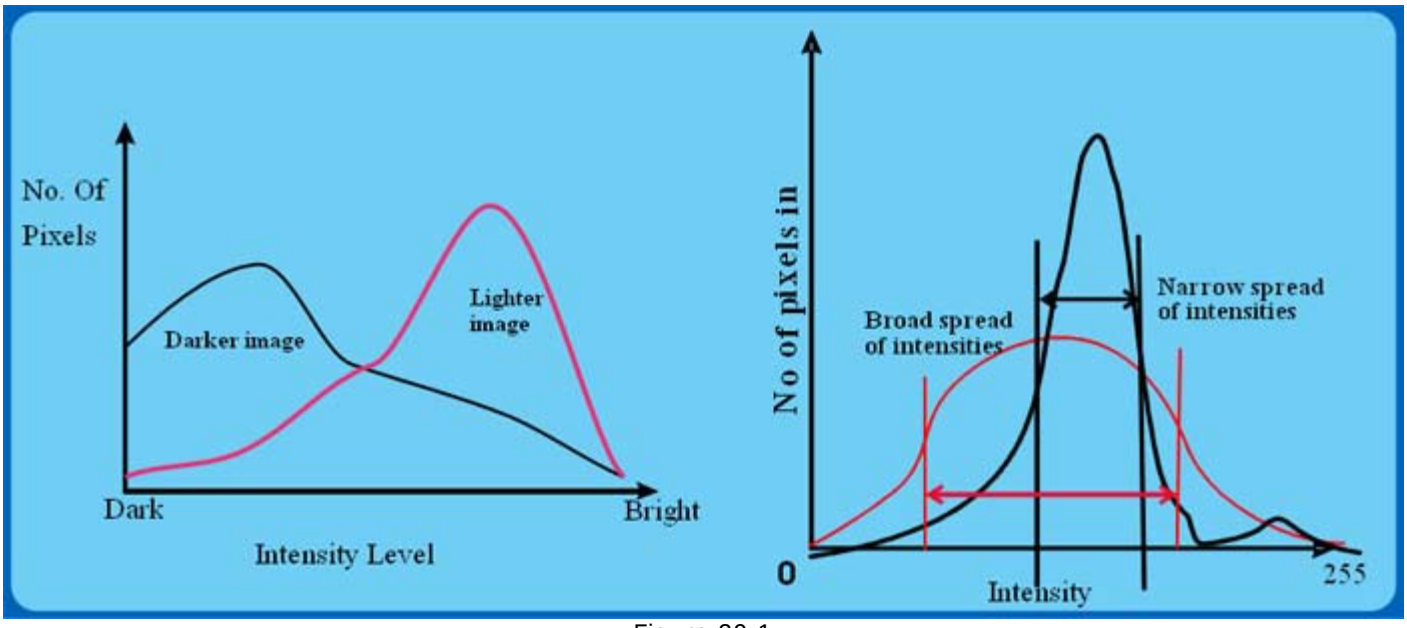

Figure 29.1

Intensity transformations

S = T(r)

$s = T(r)$

$0 \le r \le 1$

$0 \le s \le 1$

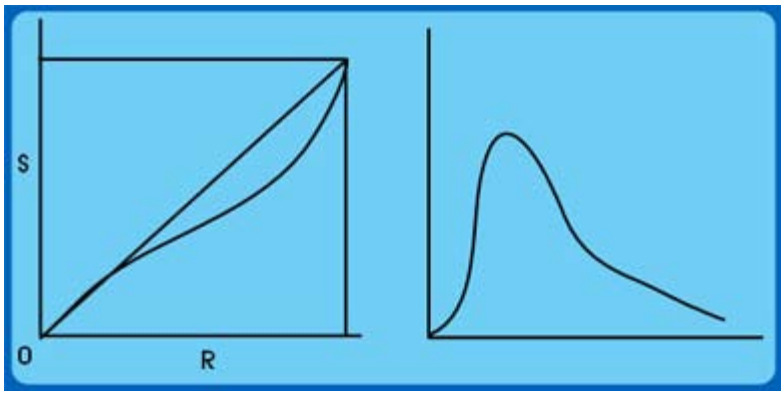

Figure 29.2

Let T be monotonically increasingfunction and single valued. Then inv(T) exists.

Continuous intensity levels. Histogram - > PDF (Refer Figure 29.3)

Histogram Equalization

$$p_s(s) = \left[p_r(r) \frac{dr}{ds} \right]_{r=T^{-1}(s)}$$

$$\frac{ds}{dr} = p_r(r) \Rightarrow ds = p_r(r)dr$$

$$s = \int_0^r p_r(w)dw = T(r)$$

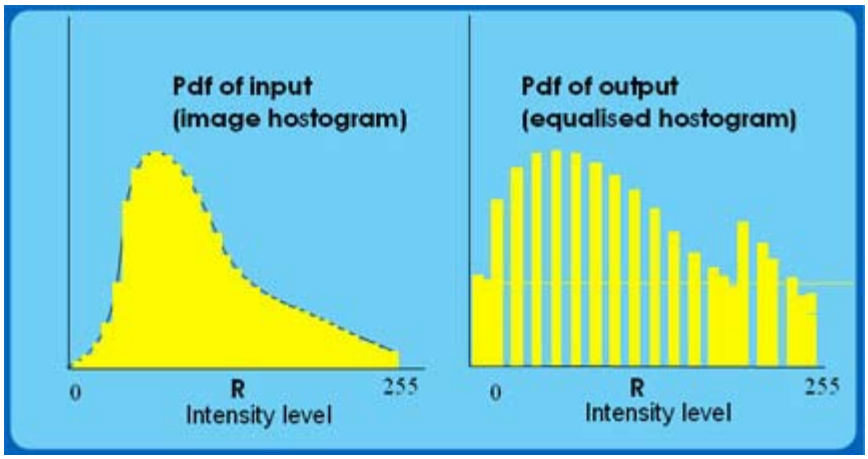

Figure 29.3 Intensity Level

Example

$$s = T(r)$$

$$r = T^{-1}(s)$$

$$p_s(s) = p_r(r)\frac{dr}{ds}\Big|_{r=T^{-1}(s)}$$

$$= 2(1-r)\frac{d(1-\sqrt{1-s})}{ds}\Big|_r$$

$$= \frac{2\sqrt{1-s}}{2\sqrt{1-s}} = 1$$

$$p_r(r) = 2(1-r)$$

$$T = \int_0^r 2(1-w)dw = \left|2w - \frac{2w^2}{2}\right|_0^r$$

$$s = -r^2 + 2r \Rightarrow r = 1-\sqrt{1-s}$$

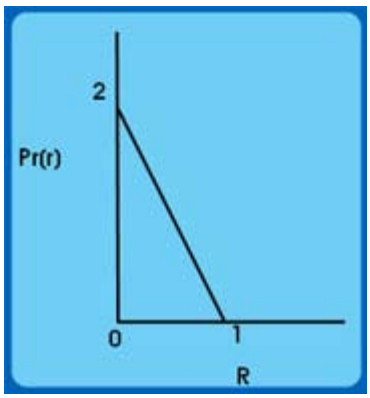

Figure 29.4

Discrete

$$p_r(r_k) = \frac{n_k}{n}$$

Histogram – plot of

$p_r(r_k) vs. r_k$

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

where, p_r : probability of a pixel being of gray level k.

n_k : no. of pixels belonging to gray level k.

n: Total no. of pixels

Example

k	r_r	n_k	$p_r(r_k)$	
0	0	790	0.19	0.19
1	1/7	1023	0.25	0.44
2	2/7	850	0.21	0.65
3	3/7	656	0.16	0.81
4	4/7	329	0.08	0.89

5	5/7	245	0.06	0.95
6	6/7	122	0.03	0.98
7	1	81	0.02	1.00

Histogram specification

$P_r(r)$ original Image pdf

$P_z(z)$ desired out image pdf

$$s = T(r) = \int_0^r p_r(w)dw \quad - \text{ equalizes } s$$

$$z = G^{-1}(s) = G^{-1}(T(r))$$

$$v = G(z) = \int_0^z p_z(w)dw \quad - \text{ equalizes } z$$

Image Enhancement

$$G_x = \frac{\partial f}{\partial x} \approx f(x,y) - f(x-1,y)$$

$$G_y = \frac{\partial f}{\partial y} \approx f(x,y) - f(x,y-1)$$

$$= f(x-1,y+1) - f(x-1,y-1) + 2f(x,y+1)$$
$$-2f(x,y-1) + f(x+1,y+1) - f(x+1,y-1)$$

$$g(x,y) = \begin{matrix} 1 \\ 0 \end{matrix}$$

otherwise

$G_y =$

-1	0	1
-2	0	2
-1	0	1

SOBEL MASK OPERATOR

-1	-2	-1
0	0	0
1	2	1

Recap

In this course you have learnt the following

- Machine Vision

- Enhancement
- Histogram Equalization
- Histogram specification
- Image Enhancement

Congratulations, you have finished Lecture 29. To view the next lecture select it from the left hand side menu of the page.