

Chapter-10

Image Features Representation and Description

1. The image is

$$\begin{pmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 0 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{matrix} 2 \\ 0 \\ 1 \\ 3 \\ 2 \\ 1 \end{matrix}$$

The vertical projection is the sum of columns that is { 3 2 4 }

2. The given image is

$$\begin{pmatrix} 1 & 1 & 1 \\ 1 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

All one constitute one region and all zeros contribute one region.

3. Let the image be

$$\begin{pmatrix} 12 & 13 & 15 \\ 1 & 13 & 5 \\ 3 & 4 & 0 \end{pmatrix}$$

[Hint] Histogram features are mean, median, mode, variance.

4. The English Letters A B C D E

Solution: Euler number is connected component – Hole

A: $1-1 = 0$

B: $1-2 = -1$

C: $1-0 = 1$

D: $1-1 = 0$

E: $1-0 = 1$

5. Consider the image $\begin{pmatrix} 1 & 1 & 5 \\ 1 & 3 & 5 \\ 3 & 4 & 0 \end{pmatrix}$. Find moments.

Hint. The moments are mean, variance etc.

6. Let the image be $\begin{pmatrix} 1 & 1 & 5 \\ 1 & 1 & 2 \\ 1 & 3 & 1 \end{pmatrix}$. Let the template pattern be (1 1). The maximum grey value

is 3. So the GLCM matrix would be

$$\begin{array}{c} 0 \\ 1 \\ 2 \\ 3 \end{array} \left| \begin{array}{cccc} (0 & 0 & 0 & 0) \\ (0 & 2 & 0 & 1) \\ (0 & 1 & 0 & 0) \\ (0 & 2 & 0 & 0) \end{array} \right. \\ \hline \begin{array}{cccc} 0 & 1 & 2 & 3 \end{array}$$

If the template is changed to $\begin{pmatrix} x & 0 \\ 0 & y \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, This yields the GLCM matrix

$$\begin{array}{c} 0 \\ 1 \\ 2 \\ 3 \end{array} \left| \begin{array}{cccc} (0 & 0 & 0 & 0) \\ (0 & 2 & 0 & 0) \\ (0 & 1 & 0 & 0) \\ (0 & 0 & 0 & 0) \end{array} \right. \\ \hline \begin{array}{cccc} 0 & 1 & 2 & 3 \end{array}$$

7. Find correlation

X	Y	XY	X^2	Y^2
5	12	60	25	144
10	40	400	100	1600
15	60	900	225	3600

20	80	1600	400	6400
40	120	4800	1600	14400
$\sum_{i=1}^N X =$ 90	$\sum_{i=1}^N Y =$ 312	$\sum_{i=1}^N XY =$ 7760	$\sum_{i=1}^N X^2 =$ 2350	$\sum_{i=1}^N Y^2 = 26144$
$\frac{\sum_{i=1}^N X}{N}$ = 18	$\frac{\sum_{i=1}^N Y}{N}$ = 62.4	$\frac{\sum_{i=1}^N XY}{N} = 155$ 2	$\frac{\sum_{i=1}^N X^2}{N} = 47$ 0	$\frac{\sum_{i=1}^N Y^2}{N} = 5228.$ 8

$$r = \frac{1522 - (18)(62.4)}{\sqrt{(470 - (18)^2) \times (5228.8 - (62.4)^2)}} = \mathbf{0.971}$$

This clearly shows that the correlation is very high.