Geometry feature

- Our ultimate aim is to measure some geometric attributes of the object, in any image analysis problems.
- Such as:
1. Perimeter
2. Area
3. Radii
4. Numbers of holes
5. Euler number
6. Corners
7. Bending energy
8. Roundness,or compactness
9. symmetry

1. Perimeter

- Perimeter can be defined as:

- $$T = \int \sqrt{x^2(t) + y^2(t)}\, dt$$

- Where t denotes the boundary parameter but not its length and $x\ and\ y$ is the axis co-ordinates.
- T denotes the Perimeter.

2. Area

- Area is generally represented by A.

- $A = \iint_{\mathfrak{R}} dxdy = \int_{\partial\mathcal{R}} y(t)\frac{dx(t)}{dt}dt - \int_{\partial\mathcal{R}} x(t)\frac{dy(t)}{dt}dt$

- Where $\mathcal{R}$ denotes the object region and $\partial\mathcal{R}$ denotes its boundary.

- $x\ and\ y$ denotes the axis co-ordinates.

- t denotes the boundary parameter.

3. Max and Min Radii

- Maximum radii is represented by R_{max}, is the maximum distance from the center of mass to its boundary.

- Minimum radii is represented by R_{min}, is the minimum distance from center of mass to its boundary.

- We can measure eccentricity or elongation of the object with the help of ratio R_{max}/R_{min}.

$$\text{Elongation} = R_{max}/R_{min}$$

4. Number of holes

- It is denoted by n_h .

 Where n_h denotes the no. of holes.

5. Euler number

- $\mathcal{E} \triangleq$ **number of connected regions – n_h where $\mathcal{E}$ denotes the Euler number and n_h denotes the no. of holes.**

6. Corners

- The location where the curvature k(t) becomes unbounded ,that particular location on the boundary is called corners.

- We can obtain corner with the help of equation: $|\boldsymbol{k}(t)|^2 \triangleq \left(\dfrac{\mathbf{d^2y}}{\mathbf{dt^2}}\right)^2 + \left(\dfrac{\mathbf{d^2x}}{\mathbf{dt^2}}\right)^2$

- In practice,a corner is declared whenever $|k(t)|$ assumes a large value.

Cond…..
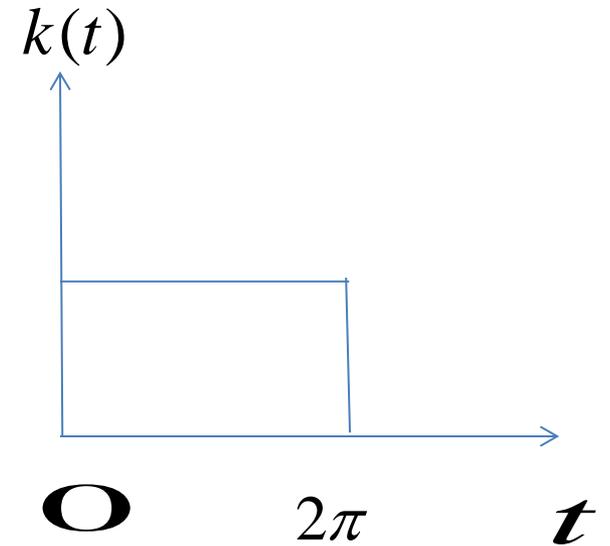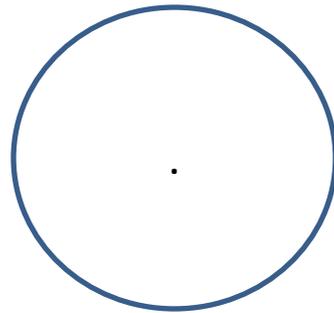
Curvature function for corner detection

7. Bending energy

- The another attribute is bending energy.

- The equation is

$$E = \frac{1}{T} \int_0^T |k(t)|^2 \, \mathbf{dt}$$

- In terms of $\{a(k)\}$, the FDs of $u(t)$, this is given by

$$E = \sum_{k=-\infty}^{\infty} |a(k)|^2 \left(\frac{2\pi k}{T}\right)^4$$

where E is the bending energy.

8. Roundness or Compactness

- Roundness or compactness can be defined as

$$\gamma = \frac{(perimeter)^2}{4\pi(area)}$$

- For a disc, γ is minimum and equals to 1.
  where $\boldsymbol{\gamma}$ is the Roundness or compactness.

9. Symmetry

- There are two common types of symmetry of shapes, rotational and mirror.

- Another forms of symmetry are twofold, fourfold, eightfold and….many more.

- Analysis of symmetry of shapes can be performed from distance from the center of mass to different points on the boundary.

- Corner location are also useful in determining object symmetry.

References

1. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI Learning Education ,Inc.,3rd Edition

Thank You!