Lecture 8 Finding More Shapes

COMP3204 & COMP6223 Computer Vision

How can we go from conic sections to general shapes?

Book pp
250-258;
271-279

Department of Electronics and Computer Science

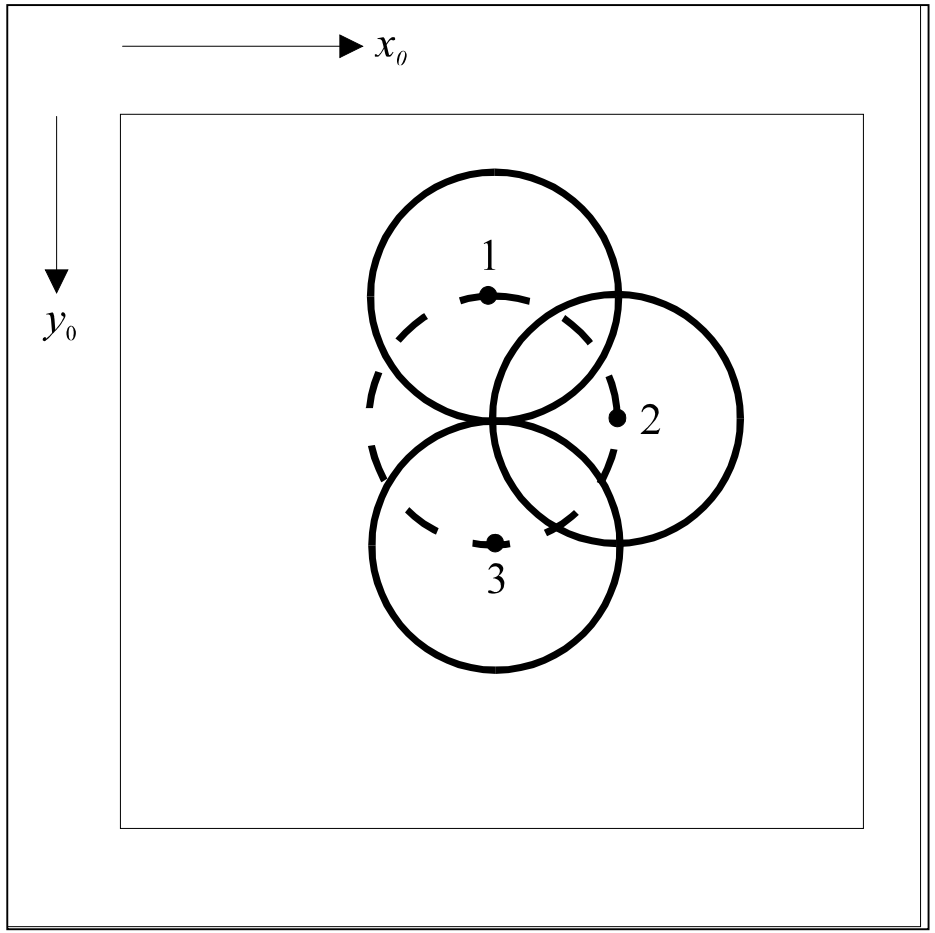
UNIVERSITY OF Southampton
School of Electronics and Computer Science

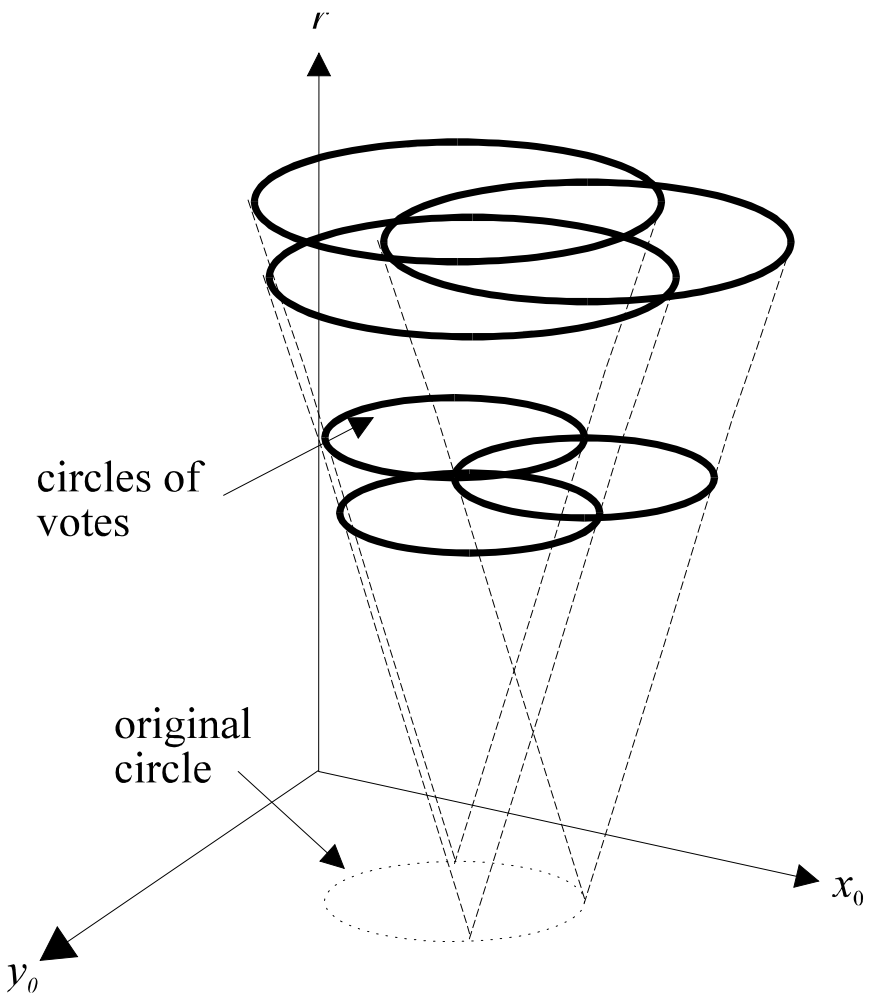
Hough Transform for Circles

- Again, it's duality: $(x - x_0)^2 + (y - y_0)^2 = r^2$

- Points: x, y parameters x_0, y_0 radius r
- Points: x_0, y_0 parameters x, y radius r

Circle Voting and Accumulator Space

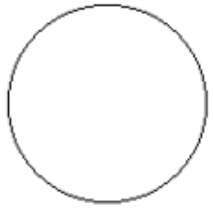




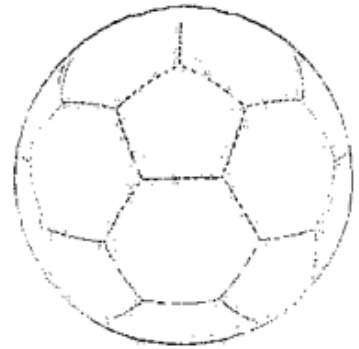
Speeding it up…..

- Now it's a 3D accumulator, fast algorithms are available
- E.g. by differentiation $\frac{dy}{dx} = -\frac{(x - x_0)}{(y - y_0)}$
- So edge gradient direction can be used, e.g. 2D accumulator by

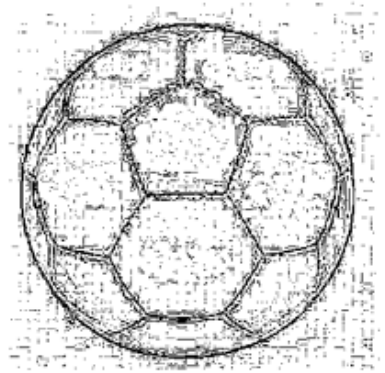
$$\left(\frac{dy}{dx}\right)^2 (y - y_0)^2 + (y - y_0)^2 = r^2$$



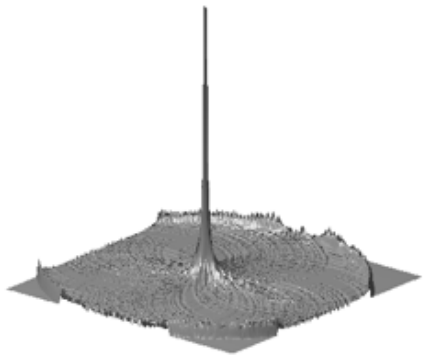
(a) circle



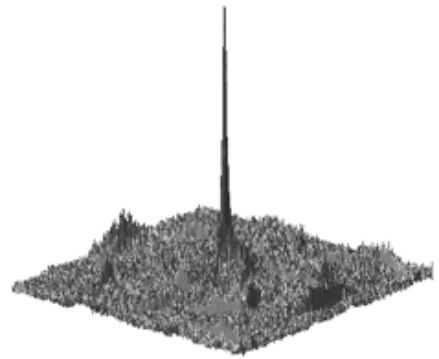
(b) soccer ball edges



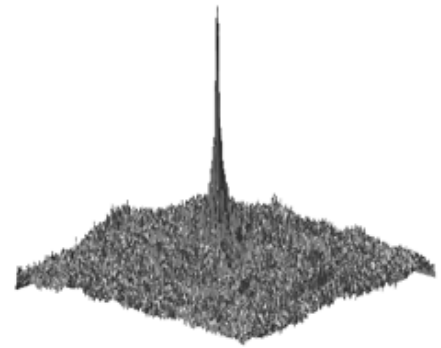
(c) noisy soccer ball edges



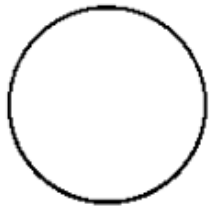
(d) accumulator for (a)



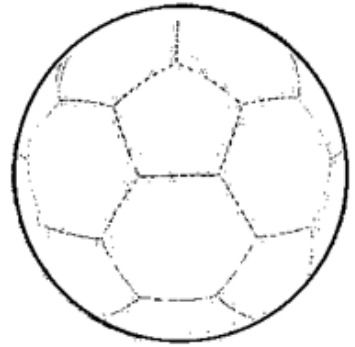
(e) accumulator for (b)



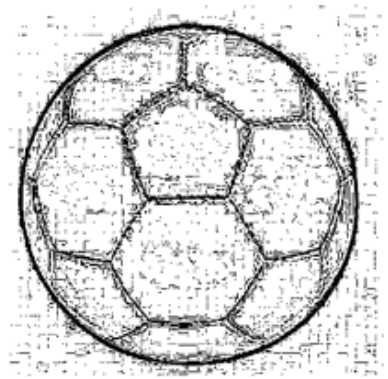
(f) accumulator for (c)



(g) circle from (d)



(h) circle from (e)



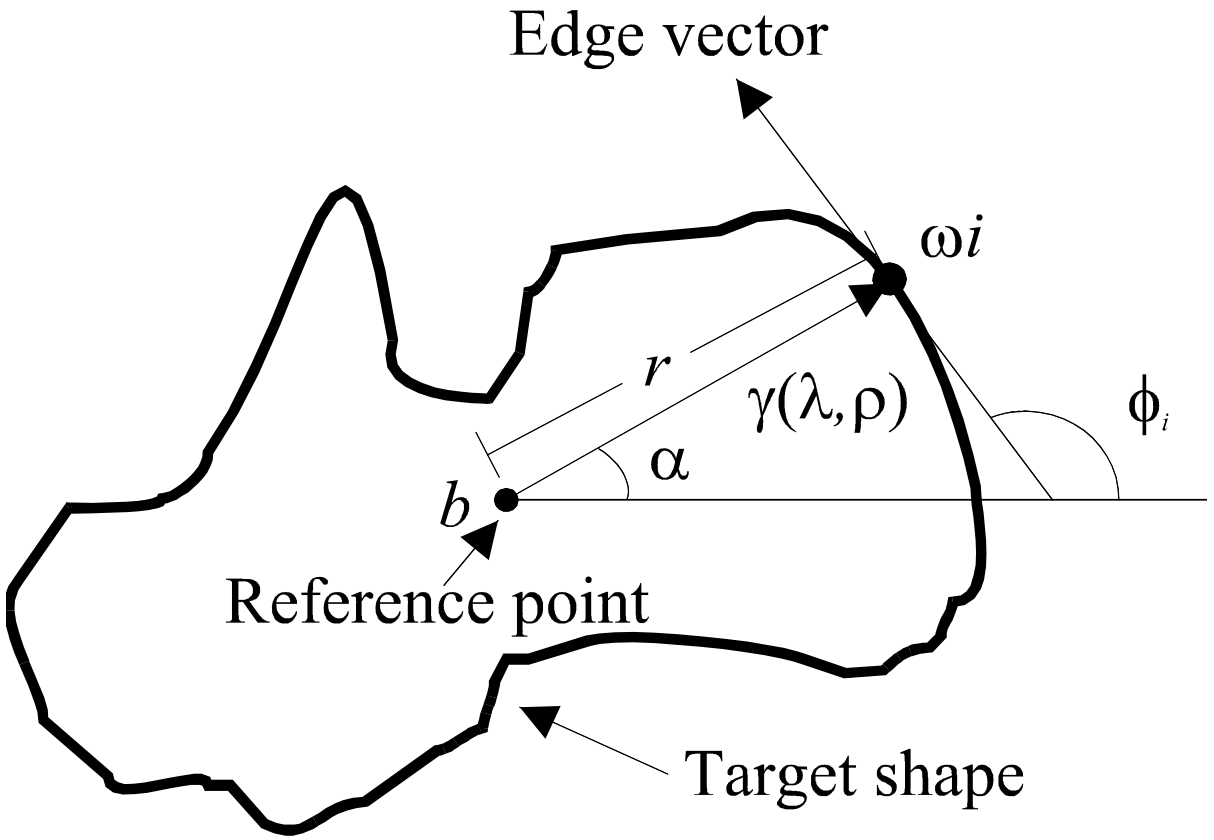
(i) circle from (f)

Applying the Hough Transform for Circles

Arbitrary Shapes

- Use Generalised HT
- Form (discrete) look-up-table (R-table)
- Vote via look-up-table
- Orientation? Rotate R-table voting
- Scale? scale R-table voting
- Inherent problems with discretisation

R-table Construction



$\hat{\varphi}_i'$	$\gamma = (r, \alpha)$
0	$(r_0, \alpha_0), (r_1, \alpha_1), (r_2, \alpha_2)$
$\Delta\phi$	⋮
$2\Delta\phi$	⋮
…	…

Active Contours

- For unknown arbitrary shapes: extract by evolution
- Elastic band analogy
- Balloon analogy
- Discrete vs. continuous
- Volcanoes?