Lecture 9 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

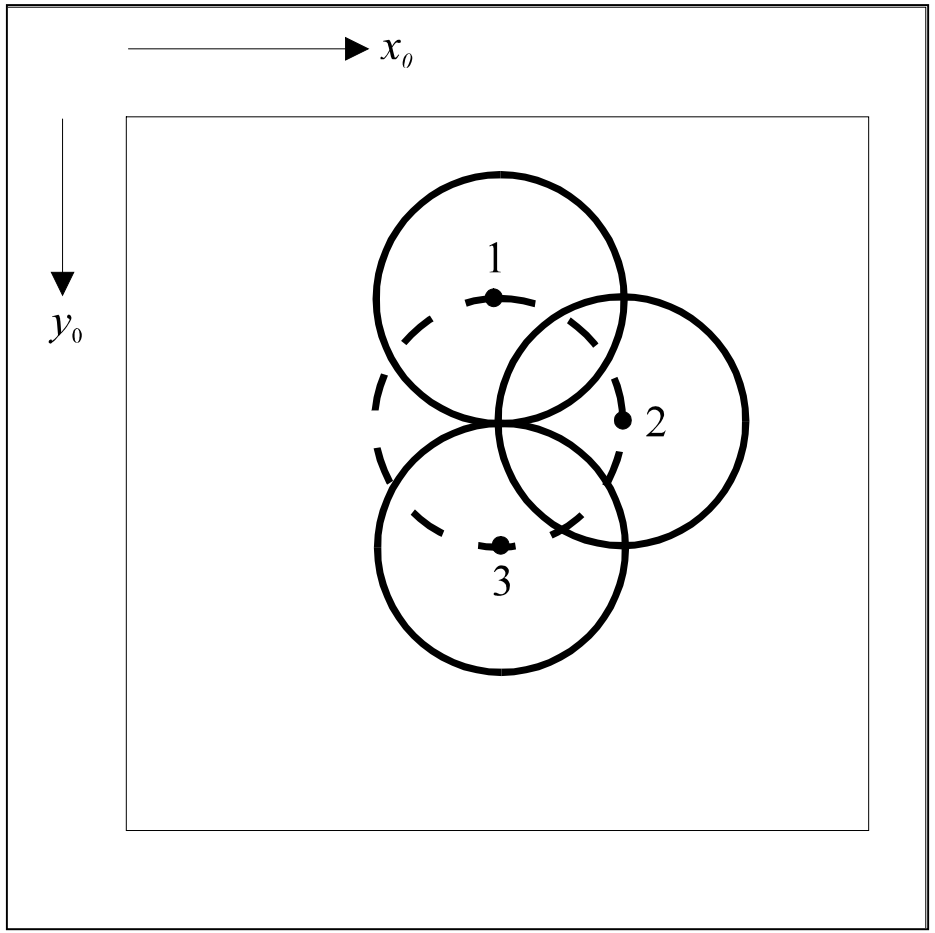
UNIVERSITY OF Southampton
School of Electronics and Computer Science

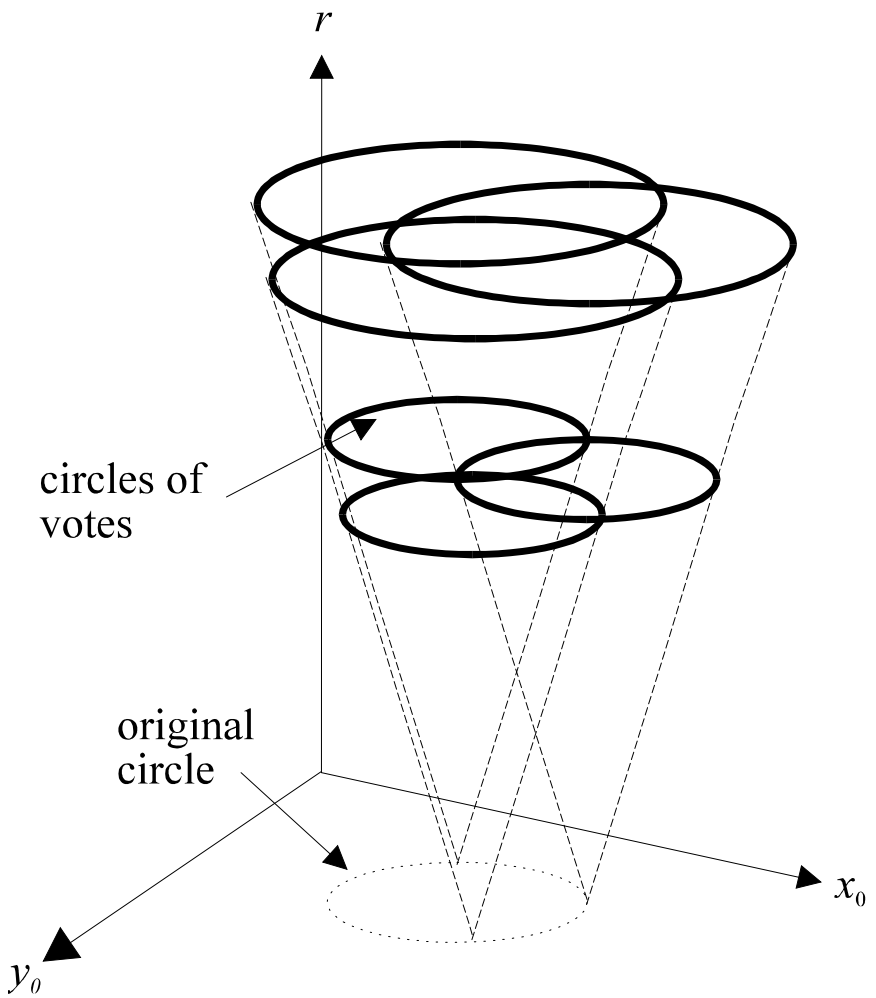
Hough Transform for Circles

- 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



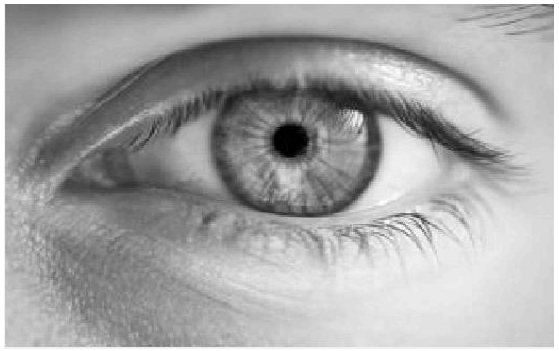


Speeding it up……

- 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

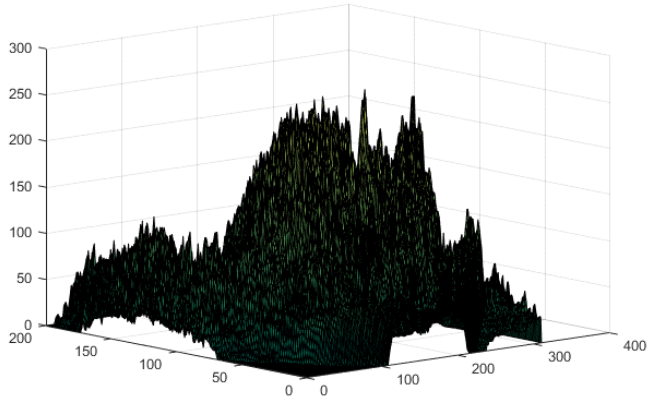
$$\left(\frac{dy}{dx}\right)^2 (y - y_0)^2 + (y - y_0)^2 = r^2$$

Applying the HT for circles

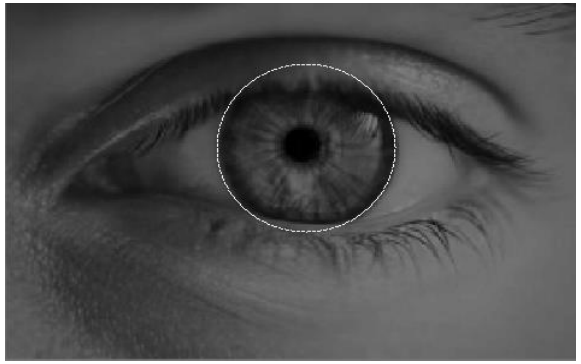


image

(Sobel) edges

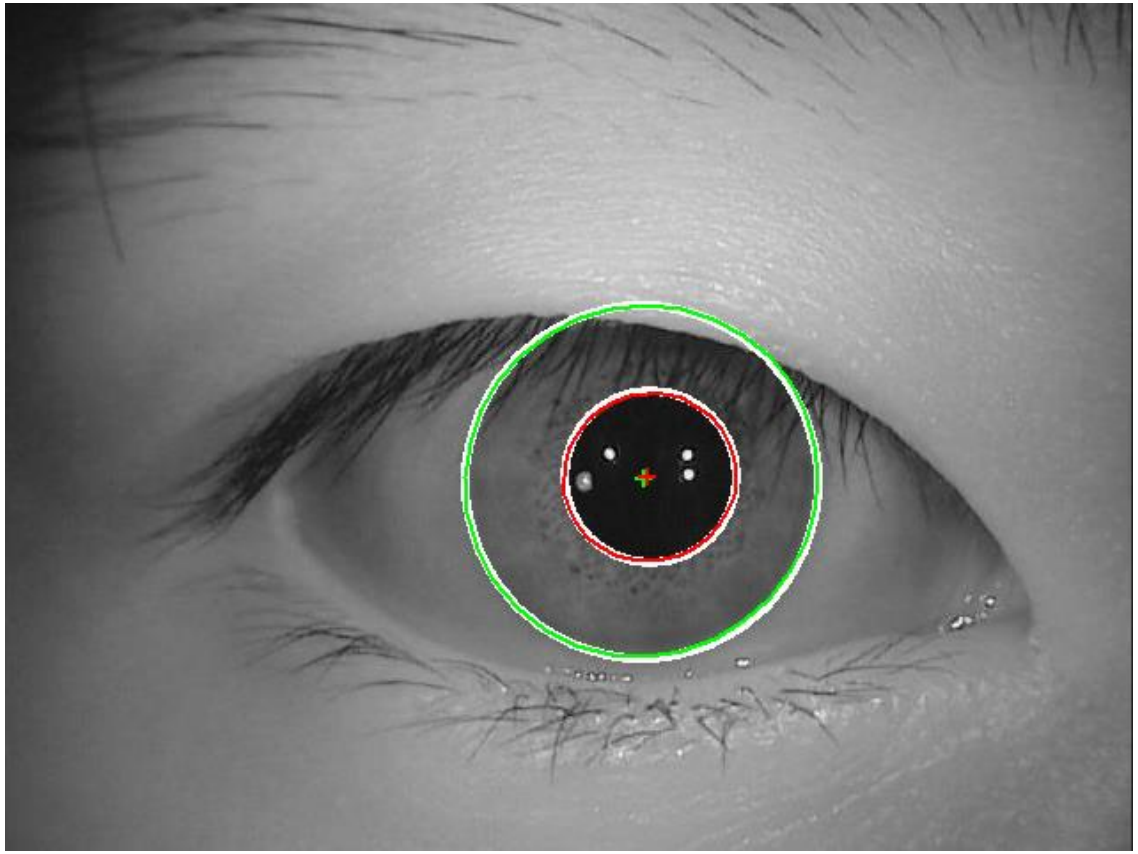


accumulator



small and large circles

Integrodifferential operator?

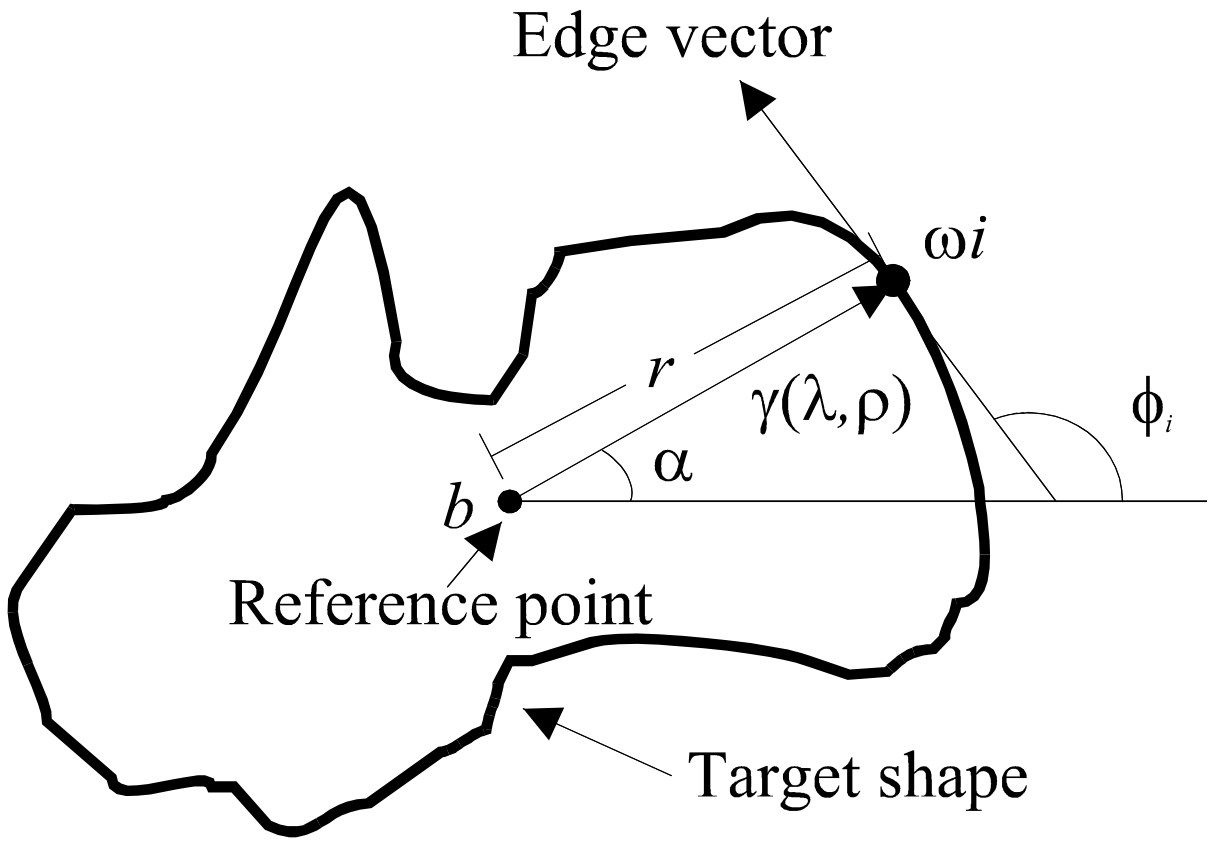


https://stackoverflow.com/questions/27058057/comparing-irises-images-with-opencv

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

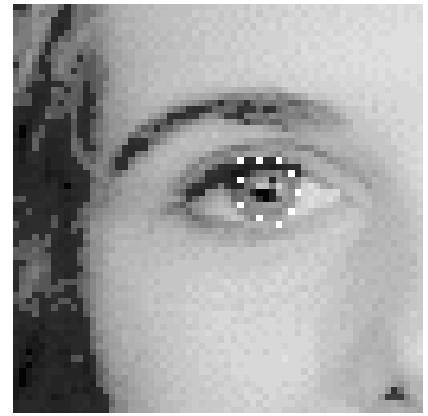


$\hat{\varphi}_i'$	$\gamma = (r, \alpha)$
0	$(r_0, \alpha_0), (r_1, \alpha_1), (r_2, \alpha_2)$
$\Delta\phi$	⋮
$2\Delta\phi$	⋮
…	…

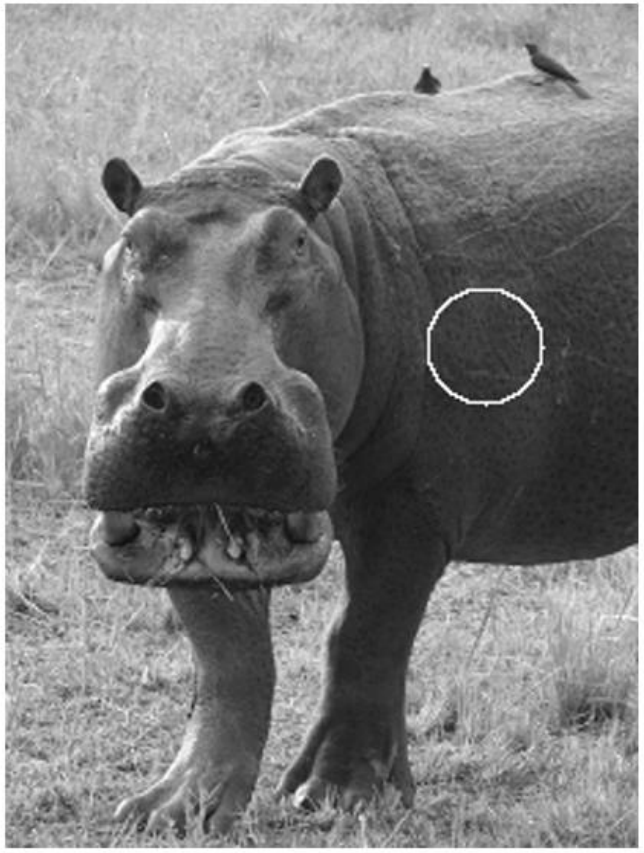
Active Contours

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

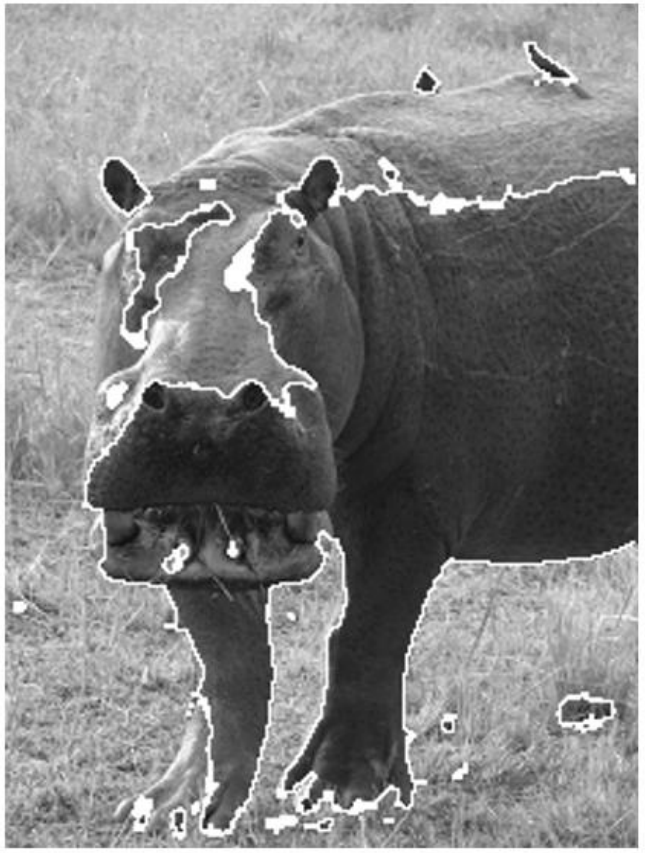


Geometric active contours



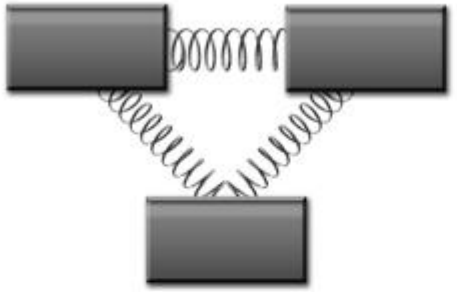
(a) initialisation



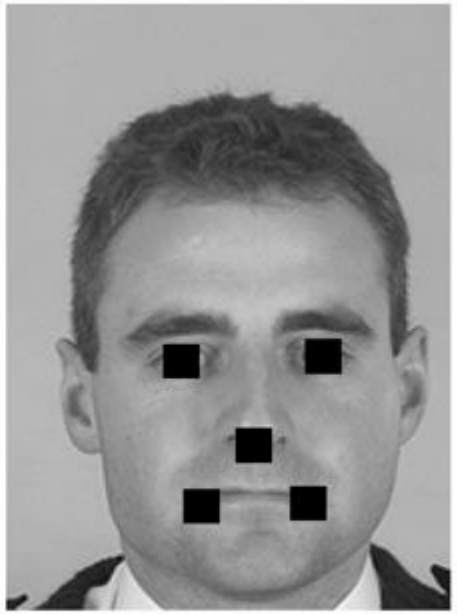
(b) result

Extraction by a Level-Set Based Approach

Parts-based shape modelling



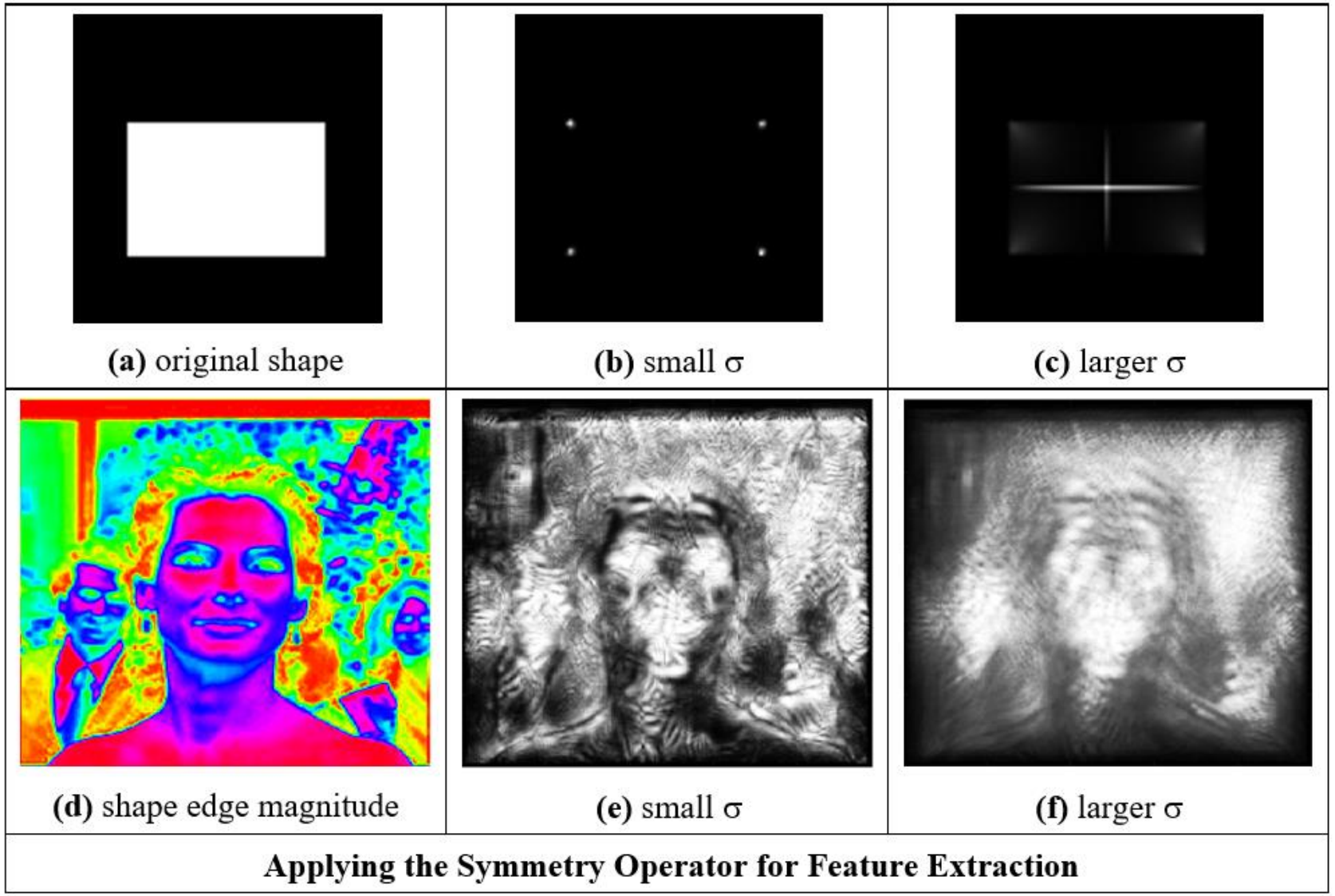
(a) mechanical equivalent



(b) finding face features

Parts-based Shape Model

Symmetry



Applying the Symmetry Operator for Feature Extraction