CS 7690, Advanced Image Processing
Project5 Snakes: Deformable Contour Segmentation
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The implementation of the contour initialization, the image force field and the snake algorithm.

Contour initialization:

I have two choices.

1) Choose the contour by clicking the mouse, after finished, press Enter.
2) Initialize a circle contour. First click the center, and then click a point on the boundary of the circle. Then you will get a circle contour. The radius is the distance of the two points.

Image force field:

I simply use the E_image = - || ▼I ||. But when I compute the E_image, I normalize the norm of the spatial gradient as $\frac{(|\blacktriangledown I|-m)}{(M-m)}$.

The snake algorithm:

I follow the steps of Trucco and Verri instructions.

While (the the change of the energy function < a threshold) & (# of iteration < a certain number).

Step1:
For each point i = 1,..., N, find the next position in its neighborhood by minimizing the energy. After each point has found its next position. Move them to the new position.

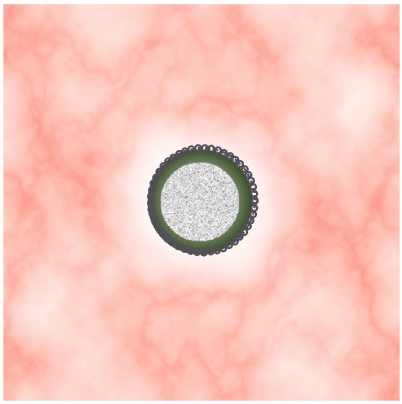
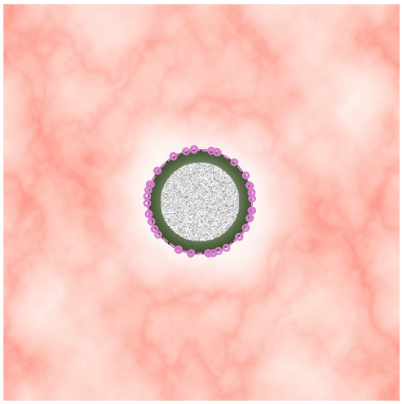
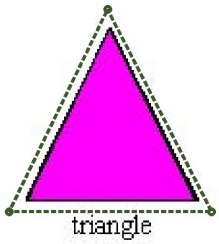
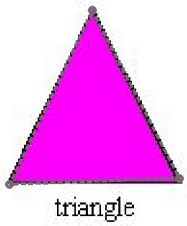
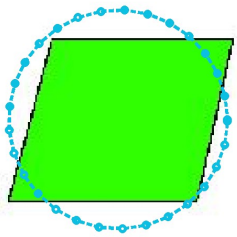
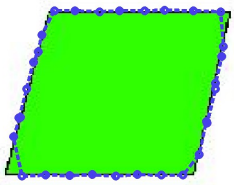
Step2:
For each point i = 1,..., N, estimate the curvature k ad p_i as

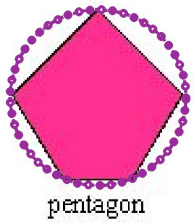
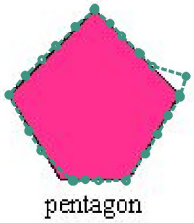
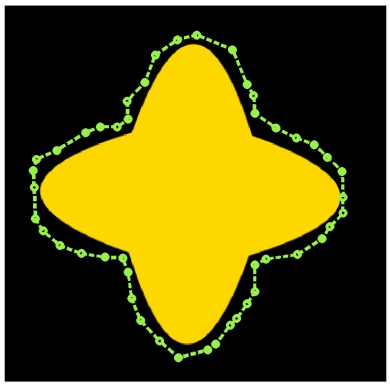
$$k = |p_{i-1} - 2p_i + p_{i+1}|$$

Find the local maxima, and set beta_j = 0 if the curvature exceeds a user-defined minimum value and its gradient intensity is very large.

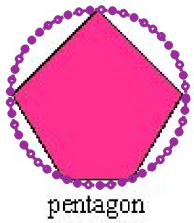
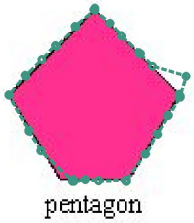
Step3:
Update the value of the average distance, d.

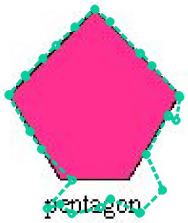
Description of the success of segmentation.

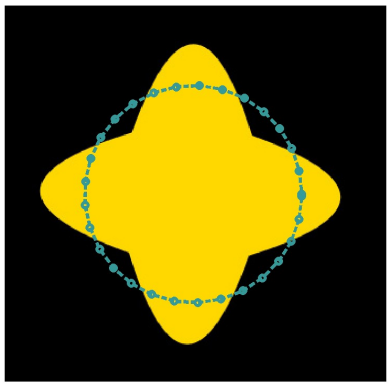
Initialization	Results
	
	
	

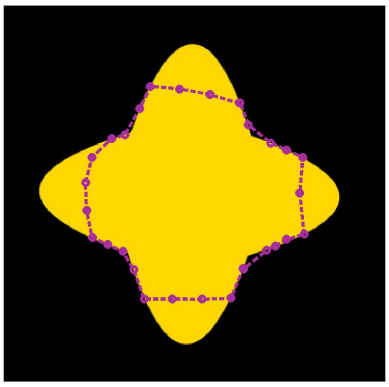
	
	

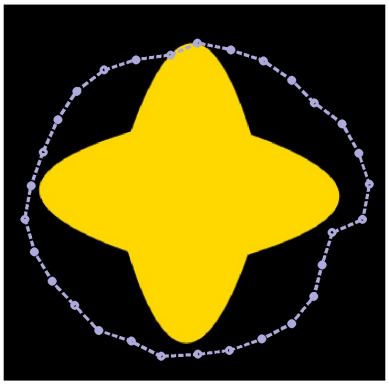
Comparison of difference initialization:

Initialization	Results
	



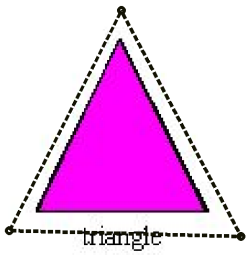
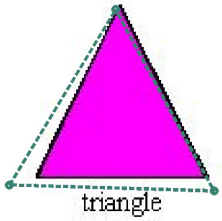
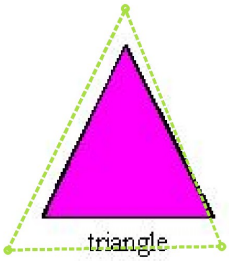
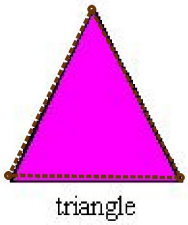




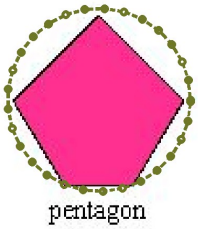
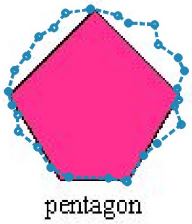


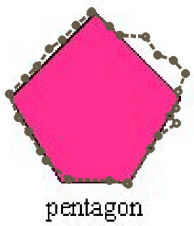
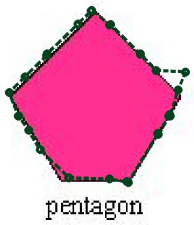
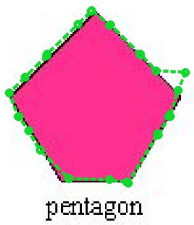
Comparison of different Gaussian smoothing:

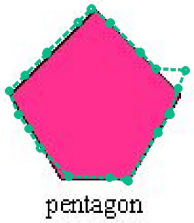
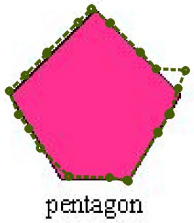
Initialization	Results

 Gaussian Filter: 1x1	
 Gaussian Filter: 8x8	

Demonstration of the snake evolution process.

Initialization	Iteration1
	
Iteration2	Iteration3

	
Iteration4	Iteration5
	
Iteration6	Iteration7
	
Iteration8	Iteration9

	
Iteration10	Final result
	

Discussion

The results of the snakes is dependent on the initialization of the contours, which is not good. But the “Snakes: Active Shape Models ” improve it by using correlation.

The Trucco and Verri implementation compute each control point's new position at each step, but when computing the control point's new position, it only care the single point. This may cause problems. My suggestion is if when computing the control point's new position, we may need to take care of the central point and its neighborhood.