

Homework 2 : Due Feb 23, 2007

CS 791/593

February 7, 2007

1 Curvature Based Evolution

Load the sample signed distance function `shape.mat`. Evolve the shape using the equation

$$\frac{\partial \psi}{\partial t} = -\kappa \|\nabla \psi\|$$

Show the contours of ψ at 4 different times during the smoothing process.

2 Segmentation using Level Sets

For this problem use the evolution equation

$$\frac{\partial \psi}{\partial t} = -k(x, y) \epsilon \kappa \|\nabla \psi\| - k(x, y) \alpha \|\nabla \psi\|.$$

When discretizing this equation, use central differences to approximate the curvature term (the first term on the right-hand-side). Use the upwind scheme to approximate the advection term (the second term on the right-hand-side).

Use the speed term

$$k(x, y) = \frac{1}{1 + \|\nabla(G_\sigma * I)\|}$$

2.1 Synthetic Data

Load the `synth.mat` image. Create the speed function, $k(x, y)$ for this image and display.

Initialize ψ to be a signed distance function such that the zero level set of ψ is a circle centered at (64, 64) with radius 50. Set the advection parameter $\alpha < 0$ so that the level curve tends to shrink during evolution.

Display the $\psi = 0$ contour when the 2 shapes are segmented, and also at two intermediate times.

2.2 Brain Data

Extract slice 90 ($z = 90$) of the dataset, as in the first homework. Create the speed function, $k(x, y)$ for this image and display.

Initialize ψ to be a circle centered at (110, 90) with radius 45. Set the advection parameter $\alpha > 0$ so that the level curve tends to expand during evolution.

Display the $\psi = 0$ contour as it approaches the cortical (outer) surface of the brain.

3 If you are registered for CS 791

Extend the evolution equation used in the previous problem as was done in the paper "Geodesic active contours".

$$\frac{\partial \psi}{\partial t} = -k(I) \kappa \|\nabla \psi\| + \nabla k \cdot \nabla \psi$$

Show your results on the brain data and synthetic data.