Math 155, Spring 2006, Vese

Homework # 2 Due on Tuesday, April 18

[1] Suppose that a digital image is subjected to histogram equalization. Show that a second pass of histogram equalization will produce exactly the same result as the first pass.

[2]

(a) Write a computer program for computing the histogram of an image.

(b) Implement the histogram equalization technique discussed in the class and in Section 3.3.1 of the textbook.

(c) Download Fig. 3.8(a) and perform histogram equalization on it (the MRI of a fractured human spine).

As a minimum, your project solution should include the original image, a plot of its histogram, a plot of the histogram-equalization transformation function, the enhanced image, and a plot of its histogram. Use this information to explain why the resulting image was enhanced as it was.

[3] Show that the Laplacian operation $\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$ is isotropic (invariant under rotations, or rotationally invariant). You will need the following equations relating coordinates after axis rotation by an angle θ:

$$x = x' \cos\theta - y' \sin\theta$$

$$y = x' \sin\theta + y' \cos\theta$$

where (x, y) are the unrotated and (x', y') are the rotated coordinates.

[4]

(a) Show that the magnitude of the gradient $|\nabla f| = \sqrt{(f_x)^2 + (f_y)^2}$ is an isotropic operation.

(b) Show that the isotropic property is lost in general if the gradient magnitude is approximated by $|\nabla f| \approx |f_x| + |f_y|$.