Math 155, Vese

Reminder: Final exam on Monday, March 19, 2007, 3:00pm-6:00pm, in MS 6229.

All sections are covered for the final exam. However, more questions will be given from the material after the midterm.

Sections covered before the midterm: 2.3.4, 2.4 (except 2.4.4), 3.1, 3.2 , 3.3, 4.1, 3.4.1, 3.4.2, 3.5, 3.6, 3.7, Chapter 4 (except 4.3.4, 4.6.3, 4.6.6, 4.6.7).

Sections covered after the midterm: Chapter 5 (all sections), 10.1, 10.2.1, 10.2.2.

Homework # 9, due on Friday, March 16, or on Monday, March 19

(no homework is accepted after Monday, March 19).

[1] Suppose that, instead of using quadrilaterals, you use triangular regions in Section 5.11 to establish a geometric spatial transformation and gray-level interpolation. What would be the equations analogous to equations (5.11-5), (5.11-6), and (5.11-7) for triangular regions ?

[2] (a) Recall the definition of the convolution $f * g(x, y)$ in continuous variables and two dimensions.

(b) Show that $\nabla^2(f * g) = f * (\nabla^2 g)$, where ∇^2 denotes the Laplace operator in (x, y).

[3]

(a) Give the main steps of edge finding using the zero-crossings of the Laplacian of Gaussian (as in Example 10.5).

(b) Implement and apply this method to the angiogram image from Figure 10.15(a), as in example 10.5 (do not compare with the Sobel gradient).

[4] Recall the Laplacian of Gaussian operator (equation (10.1-17))

$$\nabla^2 h(r) = -\Big[\frac{r^2 - \sigma^2}{\sigma^4}\Big] e^{-\frac{r^2}{2\sigma^2}}.$$

(a) Show that the average value of the Laplacian operator $\nabla^2 h$ is zero. Hint: use the identities $\frac{1}{\sqrt{2\pi\sigma^2}} \int_{-\infty}^{+\infty} e^{-r^2/(2\sigma^2)} dr = 1$, $\sigma^2 = \frac{1}{\sqrt{2\pi\sigma^2}} \int_{-\infty}^{+\infty} r^2 e^{-r^2/(2\sigma^2)} dr$.

(b) Prove that the average value of any image convolved with this operator also is zero.

(c) Would (b) be true in general for the approximations to the Laplacian given in eq. (10.1-14) ?

(10.1-14) $\quad \nabla^2 f = 4z_5 - (z_2 + z_4 + z_6 + z_8)$