Math 155, Vese

• Reminder, midterm exam on Wednesday, February 21, 2007.

• Sections covered for the midterm: 2.3.4, 2.4 (except 2.4.4), 3.1, 3.2 , 3.3, 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). Definitions and proofs of properties of various filters and transforms will be given. There will be no programming questions.

• Extra office-hours will be scheduled on Thursday, February 15 and Tuesday, February 20.

**Homework # 5, due on Friday, February 16**

• Reading: Section 4.6

**[1]** (a) Implement the Gaussian lowpass filter in Eq. (4.3-8), using a radius $D_0 = 25$, and apply the algorithm to Fig4.11(a).

(b) Highpass the input image used in (a), using a highpass Gaussian filter of radius $D_0 = 25$ (see eq. (4.4-4)).

**[2]** Show now the converse of [1], Hw#4: assume given $f(x)$ function of $F(u)$ in the discrete case, and show the identity for $F(u)$. Assume the same orthogonality of exponentials.

**[3]** (a) Show that $\mathcal{F}\Big(f(x,y)e^{2\pi i(u_0\frac{x}{M}+v_0\frac{y}{N})}\Big) = F(u-u_0, v-v_0)$, where $F = \mathcal{F}(f)$.

(b) Using (a), deduce the formula used in shifting the center of the transform when $u_0 = M/2$ and $v_0 = N/2$, with $M$ and $N$ even positive integers.

**[4]** Consider the two-dimensional continuous case. If $F(u,v) = \mathcal{F}(f(x,y))$, express the Fourier transform of the mixed partial derivative $\frac{\partial^2}{\partial x \partial y}f(x,y)$, function of $F$.

**[5]** Consider the linear difference operator $g(x,y) = f(x+1,y) - f(x,y)$. Obtain the filter transfer function, $H(u,v)$, for performing the equivalent process in the frequency domain.