1051-716-20071 Homework #4 Due 10/29/2007 (M)

0. Read Chapter 10 of notes *2-D Fourier transforms*, SKIM Chapter 11 *Spectra of Circular Functions* and read Chapter 14 *Discrete Linear Systems, Sampling* (Chapter 1 in Volume 2)

1. Find general expressions for the spectra of $(\cos[2\pi\xi_0 x])^n$ and $(\sin[2\pi\xi_0 x])^n$, where n is a positive integer.

2. Consider the 2-D separable function and evaluate the functions listed:

$$f[x,y] = SINC[x-1]\ SINC^2\left[\frac{y}{2}\right]$$

   (a) $F[\xi,\eta]$

   (b) $f[x,y] * (1[x] \times \delta[y])$

   (c) $f[x,y] * (\delta[x] \times 1[y])$

3. A 2-D "Fourier self-reciprocal transform" is a function $f[x,y]$ that satisfies the criterion:

$$\mathcal{F}_2\{f[x,y]\} = f[\xi,\eta]$$

   where $\mathcal{F}_2\{\ \}$ is the 2-D Fourier transform operator. Describe how to construct a Fourier self-reciprocal transform from an arbitrary real-valued 2-D function $g[x,y]$ (i.e., $g[x,y]$ may exhibit even, odd, or no symmetry).

4. Find the Fourier transforms of the following 2-D separable functions and sketch them as profiles or as "images":

   (a) $TRI[x] \cdot \delta[y]$

   (b) $TRI[x] \cdot 1[y]$

   (c) $TRI[x,y] * \left(\frac{1}{2}\delta\delta\left[\frac{x}{2}\right] \cdot \delta[y]\right)$

   (d) $TRI[x,y] \cdot \cos[2\pi x]\ \ 1[y]$