

Homework 4

Due **in my mailbox, 12 noon March 3, 2003**

1. The image $f(x,y) = 4\cos(4\pi x)\cos(6\pi y)$ is sampled with (case A) $X = Y = 0.5$ units and (case B) $X = Y = 0.2$ units. The sampled image is reconstructed with an ideal low-pass filter with cutoff frequencies of $\pm 1/(2X)$ and $\pm 1/(2Y)$ cycles/unit. Find the reconstructed image in each case. (20%)

2. An image, $f(x,y) = 4 \cos(4\pi x)\cos(4\pi y)$, is sampled at a rate of 5 cycles/unit in x and y . The sampled image is reconstructed with a square display spot of size 0.2×0.2 units, that is band-limited to ± 5 cycles/unit. Calculate the reconstructed image. (20%)

3. This problem deals with “reverse engineering” of “SMPTEdegraded.ipt.” (60%)

a. Given the undegraded image “SMPTe.ipt,” estimate the linear DN transformation that was applied to create “SMPTEdegraded.ipt.”

b. Determine the blurring Edge Spread Function (ESF) in x and y from “SMPTEdegraded.ipt” from edge features in the image. Attempt to minimize noise in your measurement. Calculate the Line Spread Function (LSF) in x and y from the ESF and compare graphically and numerically to a direct measurement of the LSF from line features in the image. **NOTE: read part (c) before doing part (b).**

c. Using the above determined LSFs, and assuming separability in the system response, create a 2-D MTF sampled at $1/512$ cycles/pixel and simulate the blurring of the undegraded image “SMPTe.ipt” using Fourier transforms. Compare visually to “SMPTEdegraded.ipt”. Would you expect this procedure to be perfect in general, even if there were no noise - why or why not?