DIP Course
Homework 1
Lecture 1

Discrete convolution in two dimensions

1- Determine the convolution of $x(m,n)$ with each of the following arrays, where the boxed element denotes the (0, 0) location. $x(m,n)=\begin{matrix}1 & 4 & 1\\ \boxed{2} & 5 & 3\end{matrix}$

a) $\begin{matrix}0 & -1 & 1\\ -1 & \boxed{4} & -1\\ 0 & -1 & 0\end{matrix}$

b) $\begin{matrix}0 & 1\\ \boxed{-1} & 1\end{matrix}$

c) $\begin{matrix}0 & \boxed{1}\\ -1 & 1\end{matrix}$

d) compare the result of b and c.

Fourier Transform

2- An image determined by the following function and is sampled such that $\Delta_x = \Delta_y = 0.125$

$$f(x,y) = 4\,sin(8x + 10y)$$

a) compute the Fourier transform $f(x,y)$ and plot $F(u,v)$.

b) What is the Nyquist frequency for this function? Has the Nyquist rate been met?

c)compute the sampled image spectrum $F_s(u,v)$ and plot $F_s(u,v)$ accurately (Up to 5 harmony).

d) apply a low-pass filter to the sampled image spectrum and determine the reconstructed image $\hat{f}(x,y)$.

(Low-pass filter: have a rectangular region of support with cutoff frequency at half the sampling frequencies).