Programming Assignment 3
CS111: Digital Image Processing (Fall 2016)

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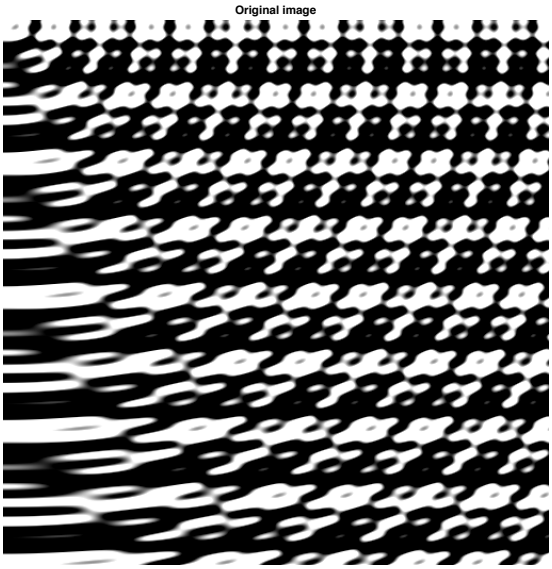
Part1: Discrete Fourier Transform

Step1 & Step2:

For each pixel (x,y) in the 512×512 matrix, we do the equation:

$$\mathrm{mtx}(i,j) = \sin(0.1 * i) + \sin(0.2 * i) + \cos(0.4 * i) + \sin(\mathrm{sqrt}(i.\hat{}2 + j.\hat{}2) * 0.15) + \sin(\mathrm{sqrt}(i.\hat{}2 + j.\hat{}2) * 0.35);$$

and then we can get the origin image:



Step3:

Calculate the DFT of this image using: $\mathrm{dft} = \mathrm{fft2}(\mathrm{mtx});$

and shift the DC to the center of the dft: $\mathrm{sdft} = \mathrm{fftshift}(\mathrm{dft});$

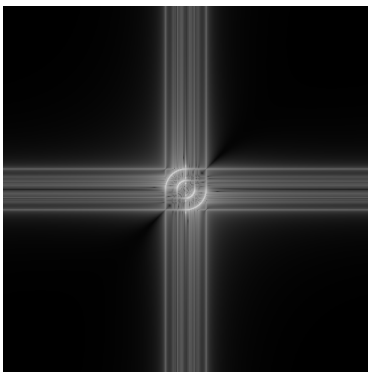
and the we can get magnitude and phase information from:

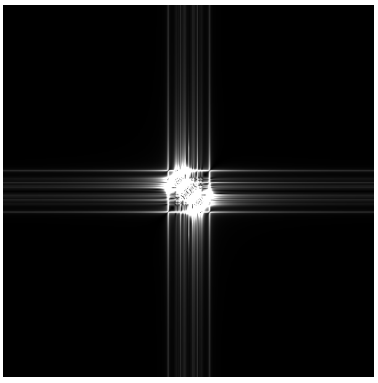
$\mathrm{mag} = \mathrm{abs}(\mathrm{sdft});$

$\mathrm{phase} = \mathrm{angle}(\mathrm{sdft})/2;$

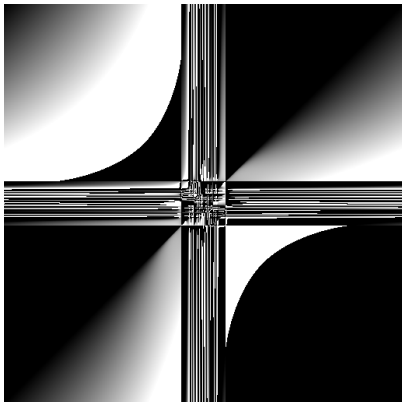
To plot magnitude, I choose two kinds of way: one is using log one is using scaling to deal with the data in original magnitude matrix. Because the range of the data in original magnitude matrix is too large.

Here is the magnitude after log process in the left and the magnitude after scale process in the right:





Here is the phase:



Step4:
After multiply the magnitude by 2 and do IDFT we can get the reconstruction image:

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mag2 = mag * 2;
mag2 = ifft2(ifftshift(mag2));
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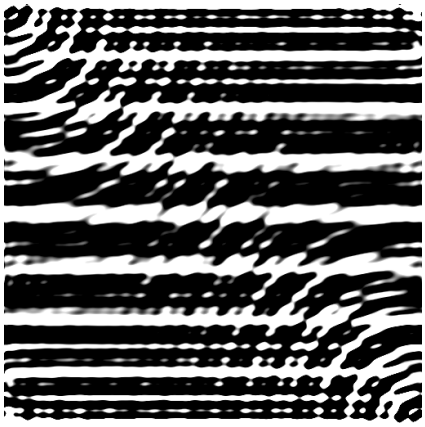
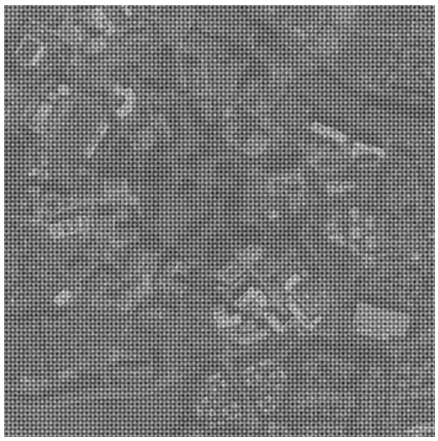
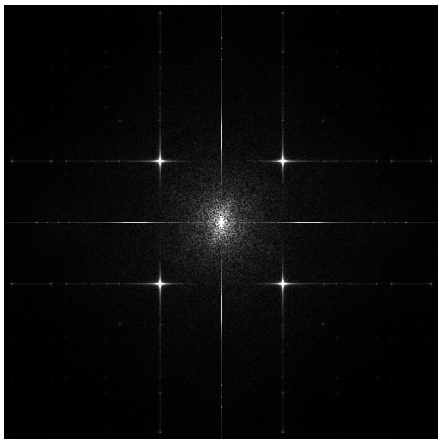


Part2: Notch Filter

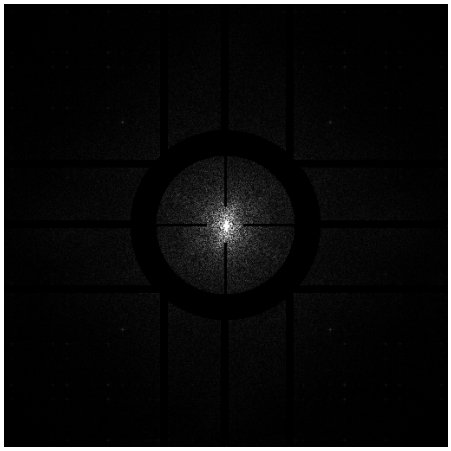
Here is the origin image with noise:



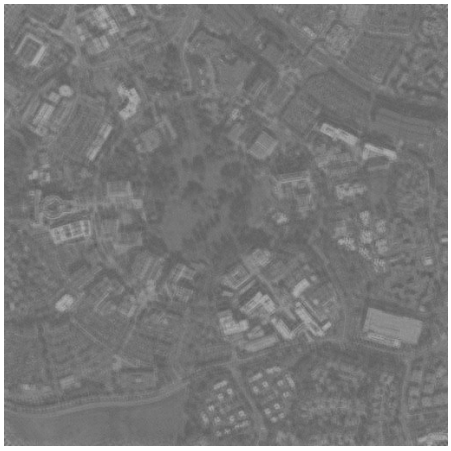
The magnitude of this image is:



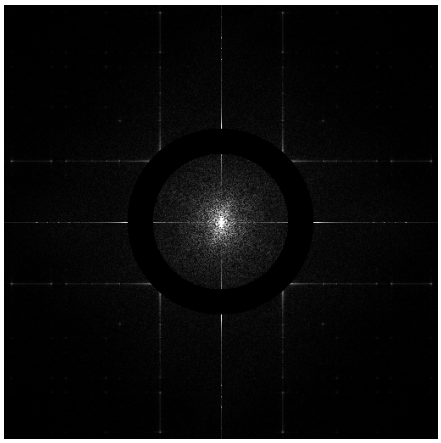
1. Here is the first notch filter I take:



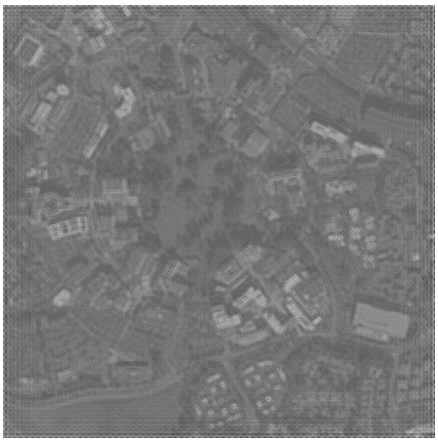
and the reconstruction image after this filter is:



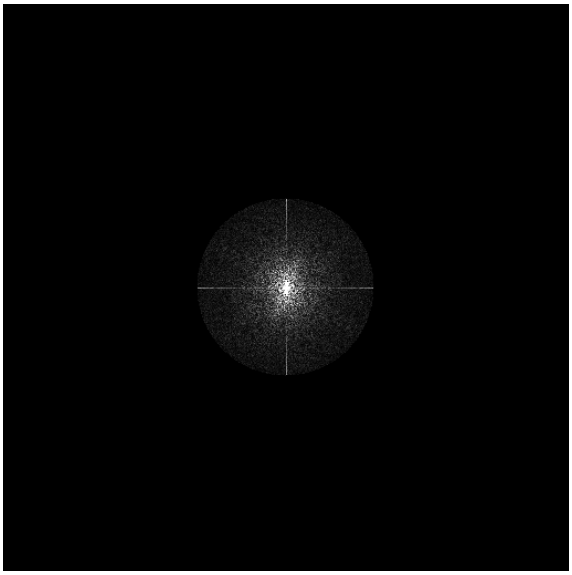
2. This is a simpler notch filter for the magnitude:



we can see that the reconstruction image is not as good as the first one, there are still some noise at the boundary of the image:



3. And here is a wider notch filter:



Here is the reconstruction image: