# CSP780 Computer Vision

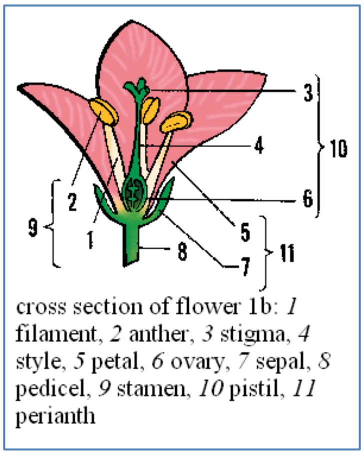
## Lab Assignment No 3: **Fourier Transforms and Filtering**

<u>Date uploaded :19 Feb 2020</u>

Instructions: First two questions in Lab itself and last HW

1. In this homework, we want to analyze the energy distributions of different types of images.

lena.bmp




ris-illustration.bmp

(a) First, convert the input color image to the grayscale format. Plot the log magnitude of the 2D DFT of the grayscale image, with center shifted.

(b) Then apply the truncation windows discussed in the class to keep 25%, 12.5%, and 6.25% of the DFT coefficients.

(c) Apply the 2D inverse DFT to reconstruct the image for each of the truncated spectra. Plot the reconstructed images. Compute the SNR value for each of the reconstructed images.

(d) Repeat the above processes for both lena and iris images shown above. Discuss the differences between these two types of images, i.e., natural photos vs. diagrams.

2. Analysing DFT: Choose a 64x64 image and find the Discrete Fourier Transform for the image. Now Add 64 columns and rows of zeros to the right and bottom side of the original image. Now find the DFT of this new image again. Repeat this process 2 more times each time doubling the image size and padding the pixels on the right and bottom by zeroes. You will therefore have 4 images – first one 64 x 64 with no zero padding and then 128x128, 256x256 and 512 x 512 after padding. Find the DFTs of all these images. Show all your results in the pdf file and explain the relationship between the four DFTs you get. Justify the relationship you discover.

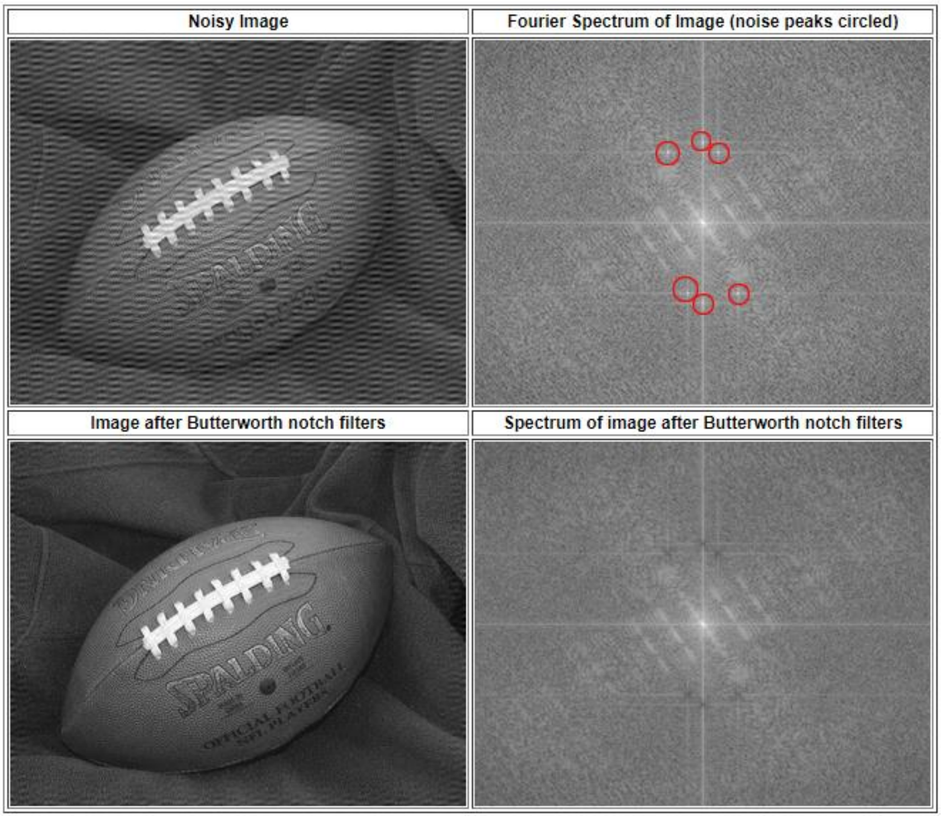
3. Notch Filters:

A band-pass filter is a filter that passes most frequencies, but attenuates those in a specific range to very low levels. Notch filters are the most useful of the selective filters. A notch filter rejects (or passes) frequencies in a predefined neighborhood of the frequency rectangle.

Notch filters are used to remove repetitive "Spectral" noise from an image are like a narrow highpass filter, but they "notch" out frequencies other than the dc component attenuate a selected frequency (and some of its neighbors) and leave other frequencies of the Fourier transform relatively unchanged

Repetitive noise in an image is sometimes seen as a bright peak somewhere other than the origin. You can suppress such noise effectively by carefully erasing the peaks. One way to do this is to use a notch filter to simply remove that frequency from the picture. This technique is very common in sound signal processing where it is used to remove mechanical or electronic hum, such as the 60Hz hum from AC power. Although it is possible to create notch filters for common noise patterns, in general notch filtering is an ad hoc procedure requiring a human expert to determine what frequencies need to be removed to clean up the signal.

The following is an example of removing synthetic spectral "noise" from an image.




You are required to implement notch filters and perform the processsing to remove spectral noise for the images shown above.