Fatemeh Changizian

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ImProc

- **LAB session #2:**
  **Exercise 1 Linear filtering in the frequency domain**
  **C.** Questions:
  - What is the geometrical shape of the filter?
    In the defined mask function freqLPF, the filter is a matrix of dimensions (dim(1) , dim(2)) [dim (1): # rows and dim (2): # columns] but the geometrical shape of the filter is a circle with the radius of Fc which can be noticed from the 2D spectrum of image in frequency domain.

  - What does parameter fcoupure stand for?
    fcoupure is the Cut Off frequency (Fc) or the threshold which we have to compare the value of the obtained R matrix in the mask function for LPF (for a low pass filters) and then extract the indices that have values less than this threshold: (indices = find(R<fcoupure).
    For HPF:
    When a low pass filter is used, the frequencies below the cutting frequency will pass and vice versa for a high pass filter, therefore the only change to be made in the code of freqLPF.m is we need to find the indices of R where the value is greater than fcoupure (indices = find(R>fcoupure).

    In other word, fcoupure means the radius of the LPF circle in 2D spectrum of the image in Frequency domain: log(abs(FFTshift)+1

  - If the filtering frequency change, for example in our case when the cutting frequency increases, the circle in the frequency domain becomes wider on the other hand if the circle is going to be smaller (low Fc) the image would be more blurred, since the low pass filter cuts the higher frequencies that are the ones corresponding to the edges in the image.

### Exercise 2 Linear filtering in the spatial domain

***** All noisy image has the same noise strength.

In the first average filter with size 3*3, the filter is not working good enough to clean the noisy image.

The second one, the filter size is increased to 5*5, by that the noisy image look cleaner but the borders and edges between the inner and the outer squares are a little blurred.

In the last one, the filter size again is increased to 9*9, in this way, the filter is working quiet good to clean the noisy image but the result has very blurred edges.

The three cases show the link between the size of the filter in the spatial and frequency domains. The average filter works like a low pass filter this means that it reduces noise (denoising) in the image but smooths the edges.

## Exercise 3 Nonlinear filtering

To comparison, the median filter works better than the average filter, since the median one keep the edges, so it shows a cleaner result with less noise compared to the blurred average filtered image.