

## Biomedical image processing: Fall 2020

### Homework 4

Due: 10/14 AM 9:10

Using the axial image of human brain in homework 1, please

- (a) Obtain its spatial spectrum (the 2D Fourier transform of the image, also called k-space in MRI) and display it in magnitude, real part, and imagery part separately. Also perform the inverse 2D Fourier transform to the magnitude spectrum and compare it with the original image.
- (b) Replace the outer spectrum with zero while keeping central  $N/2$ -by- $N/2$  data points unchanged ( $N$ : number of points in each dimension). What is the corresponding image of this truncated spectrum? Show and explain your results.
- (c) Design a low-pass Gaussian filter as introduced in class and apply it on the given data. Show your results (low-pass filtered images) with  $D_0 = 20$  and 40 points.
- (d) Design a high-pass Gaussian filter and obtain the filtered images with  $D_0 = 20$  and 40 points. Can you use your results to obtain an image with enhanced edges or contours?
- (e) BONUS: The Spatial filter of Sobel mask is provided below. Perform filtering in the frequency domain. Show its corresponding frequency domain filter and the resulting image.

-1	0	1
-2	0	2
-1	0	1

(Hint: MATLAB functions you might need: *fft2*, *ifft2*, *fftshift*, *abs*, *real*, *imag*, ...)