Biomedical Image Investigation: Fall 2024

Homework 4

Due: **10/7 PM 14:10**

Use the axial image of human brain in homework 1.

(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 on 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.

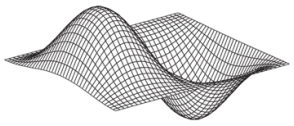
(c) Design a low-pass Gaussian filter as introduced in class and apply it to the given data. Show your results (i.e., the low-pass filtered images) with $D_0 = 20$ and 40 points.

(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) Perform filtering in the frequency domain. The spatial filter of the Sobel mask is provided below on the left. Display its corresponding perspective plot in the frequency domain (as the plot shown on the right) and show the resulting image.

(Hint: The Sobel mask exhibits odd symmetry in this case)

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



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