Sharif University of Technology

Medical Signal Processing LAB

Assignment 07

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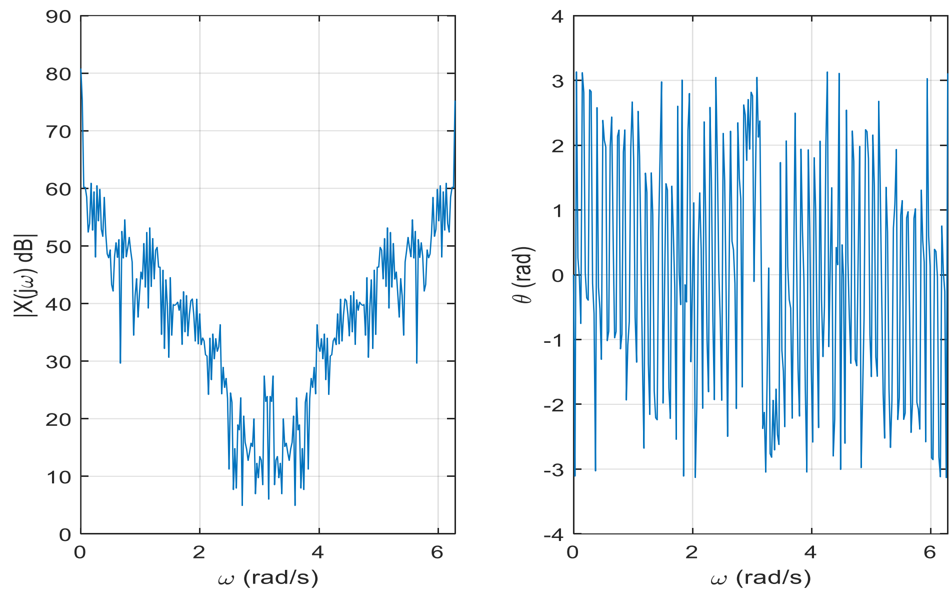
Contents

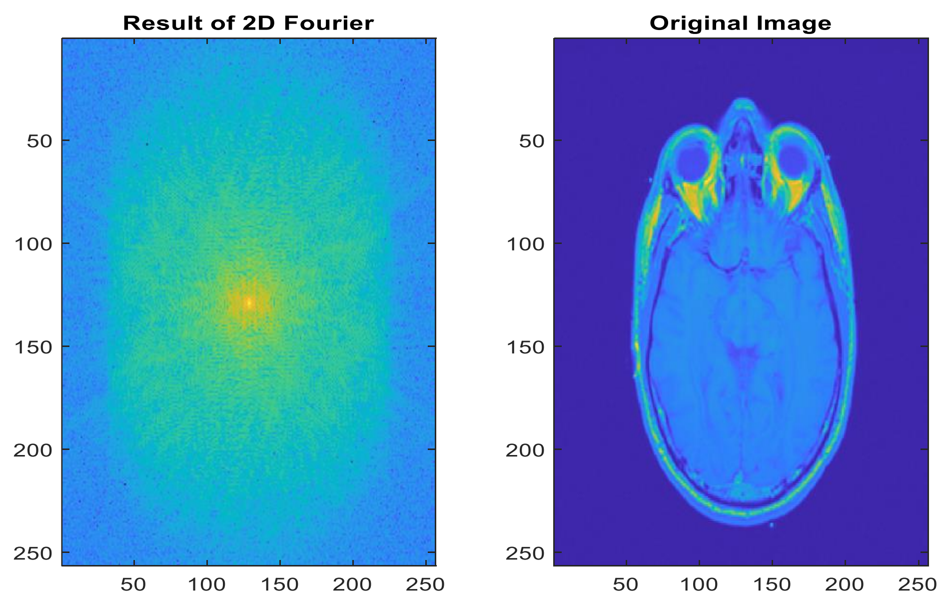
Section 1.

Here’s the result for the fft of the given row of the image.



As you can see, this figure gives us the insight about the signal from the 128th row of the image and as you can see, the DC components of the signal is dominant versus the high frequency ones.

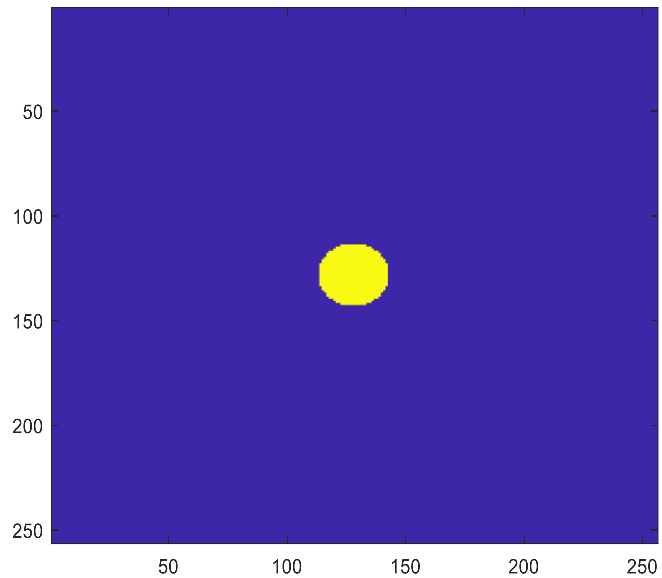
Also, the 2D Fourier transform of the image is shown in the following figure.



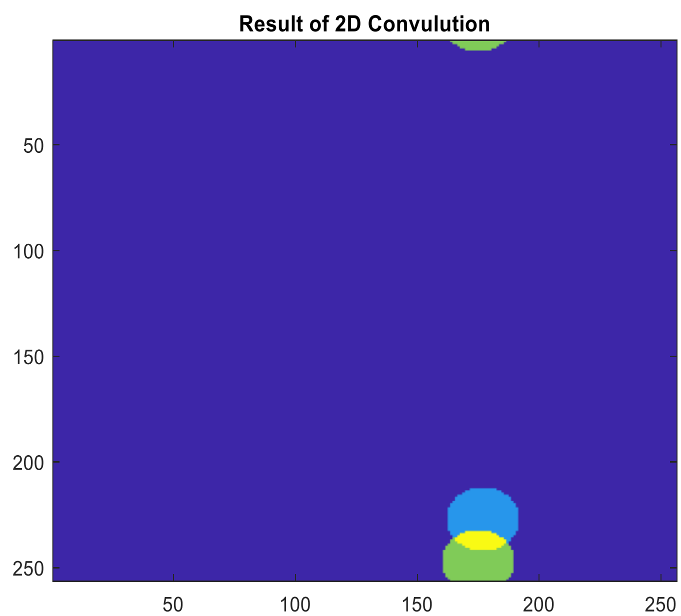
As you can see, the edges of the picture are visible in the 2D Fourier plot. Also, you can see the variations amplitude in different frequencies in different directions as well. As you can see, the image’s frequency contents are mostly located in low frequencies in both directions.

Section 2.

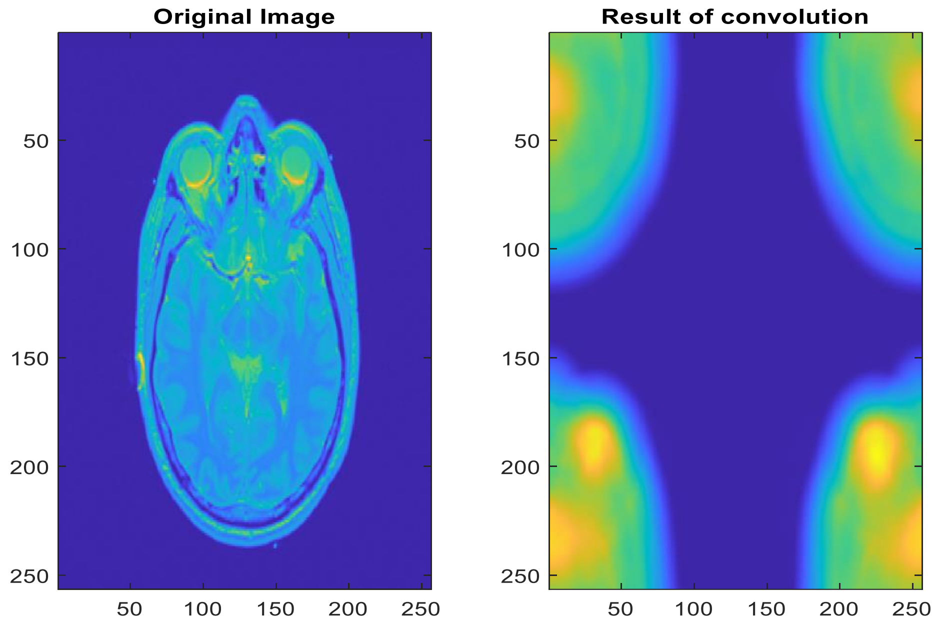
Here’s the original kernel.



Now, the result of 2D convolution is:



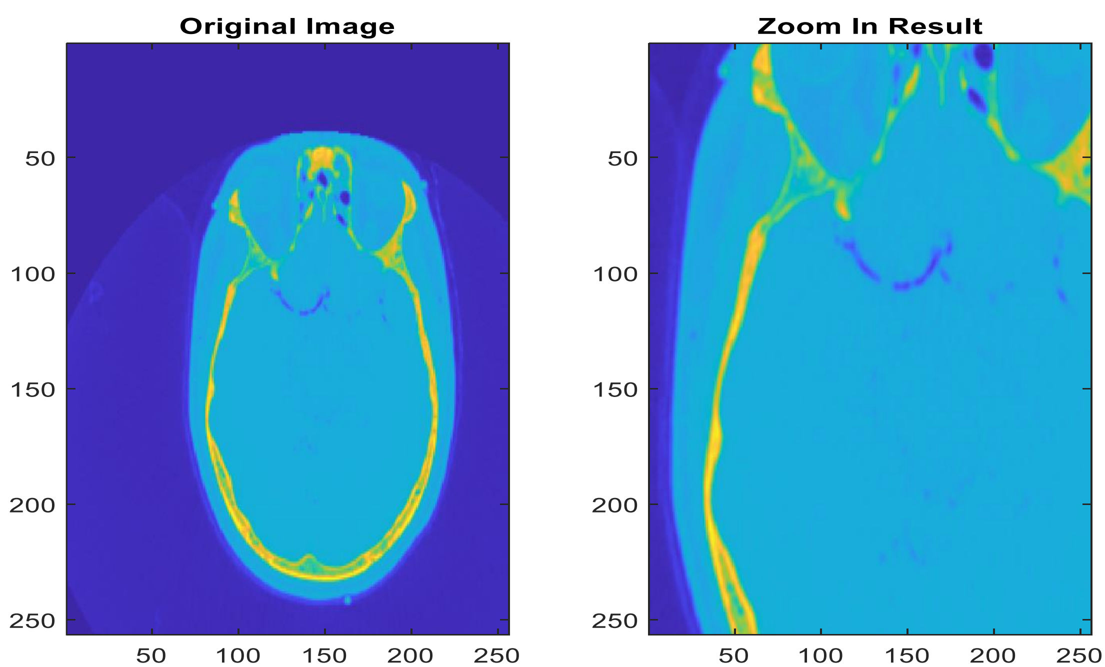
Now, the result of the convolution with the original kernel is shown in the following figure.



As you can see, the image is circularly shifted which is a result of the convolution with the given kernel. And the edges are obscured since the kernel acts as a lowpass filter image and hence the edges are obscured since they're part of the high-frequency components of the image.

Section 3.

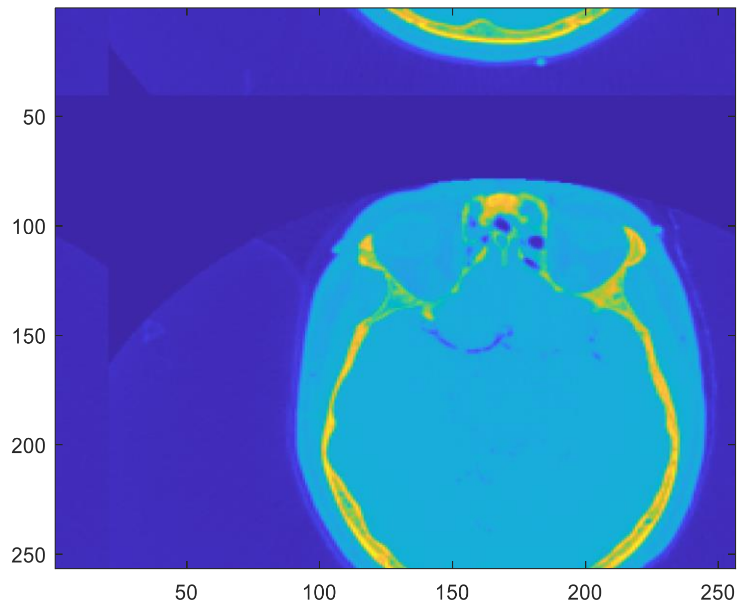
The result of this part is shown in the following figure.



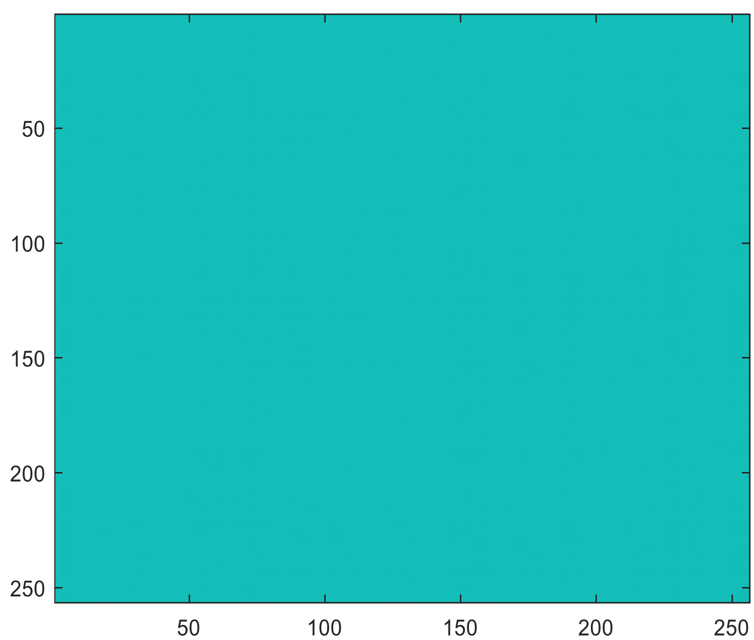
Section 4.

Part 1.

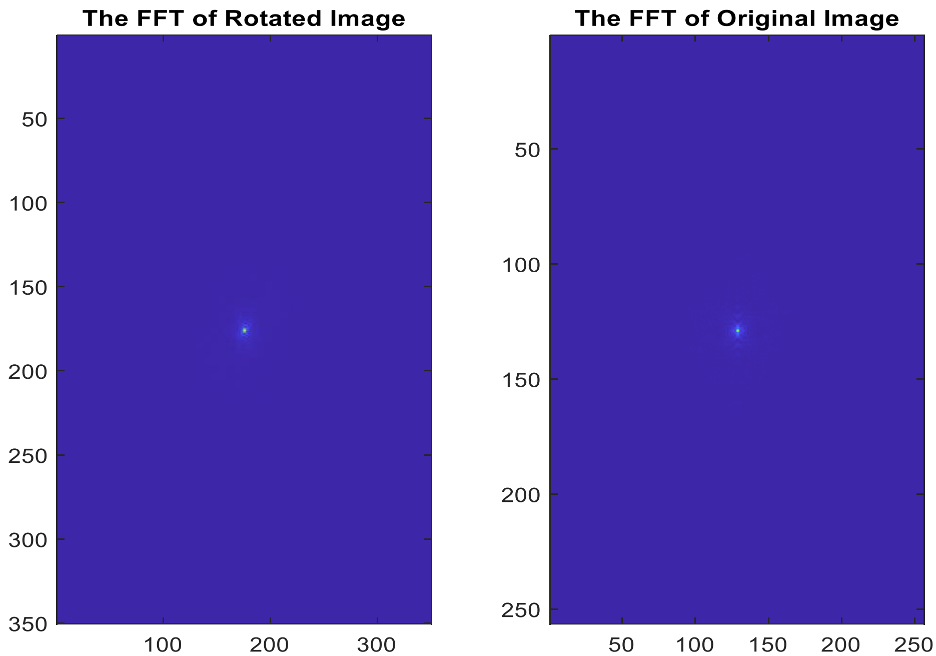
The result of the shifting of image is shown in the following figure.



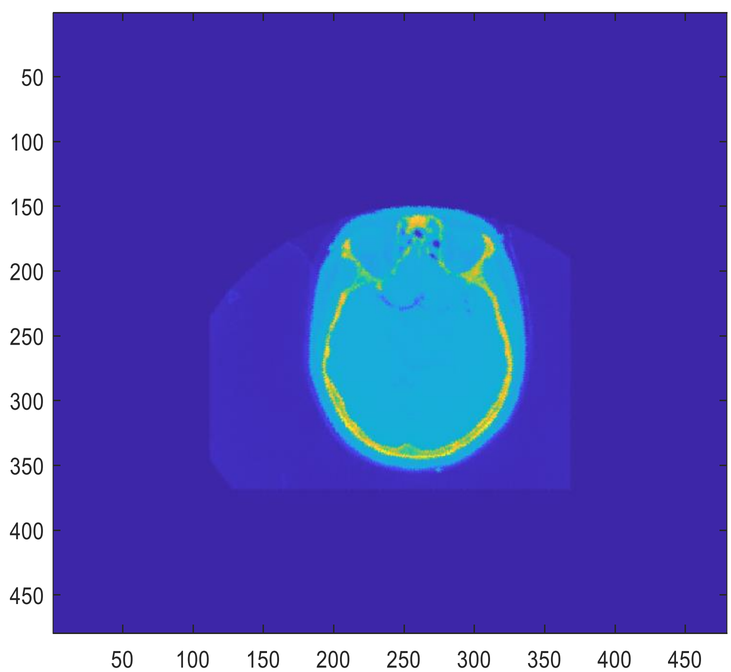
Here's the kernel in the Fourier domain



Part 2.

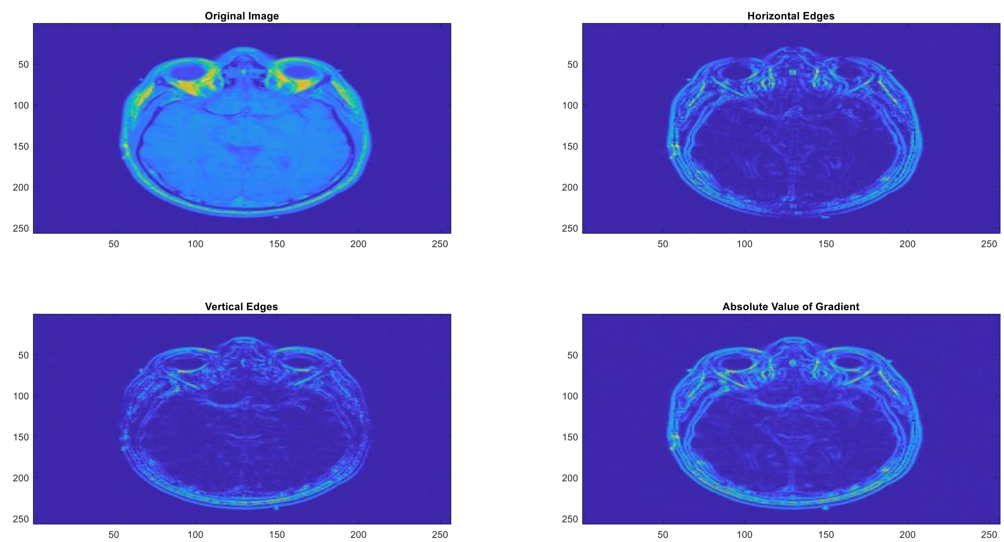


As you can see, the FFT of the image is rotated as well in the rotated image as well. Using rotation of the Fourier version of image, we can obtain the original image as follows.



Section 5.

The result for this part is shown in the following figure.



As you can see, both vertical and horizontal edges maps are lacking some details in the middle whereas the absolute value of gradient shows the complete edge map of original image.

Section 6.

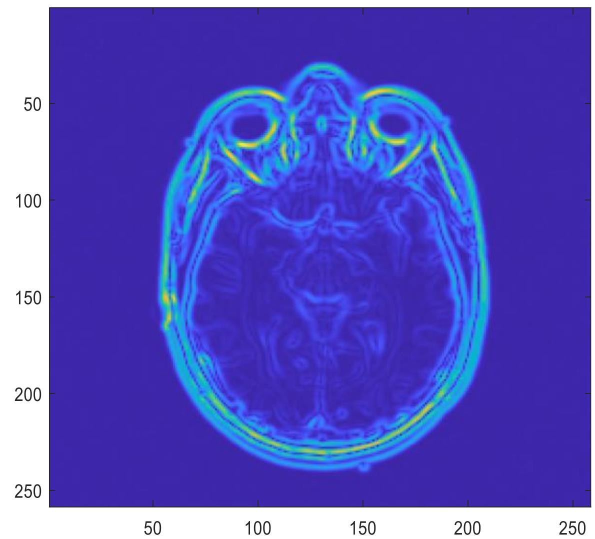
The Sobel edge detection method, apply a 3×3 kernel as follows to the image in both directions.

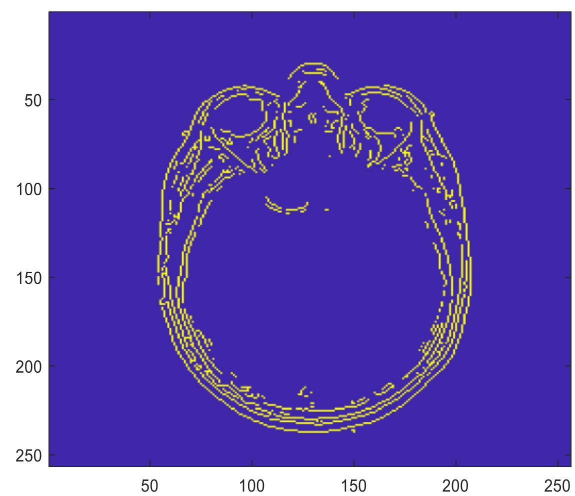
$$\mathbf{G}_x = \begin{bmatrix} +1 & 0 & -1 \\ +2 & 0 & -2 \\ +1 & 0 & -1 \end{bmatrix} * \mathbf{A}$$

$$\mathbf{G}_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * \mathbf{A}$$

Now, by finding the square root of the sum of square of the resulted images, we can find the edge map as follows. Note that the second result is by using proper thresholding using the built-in functions in MATLAB.

$$G_{abs} = \sqrt{G_x.* \, Gx + G_y.* \, G_y}$$

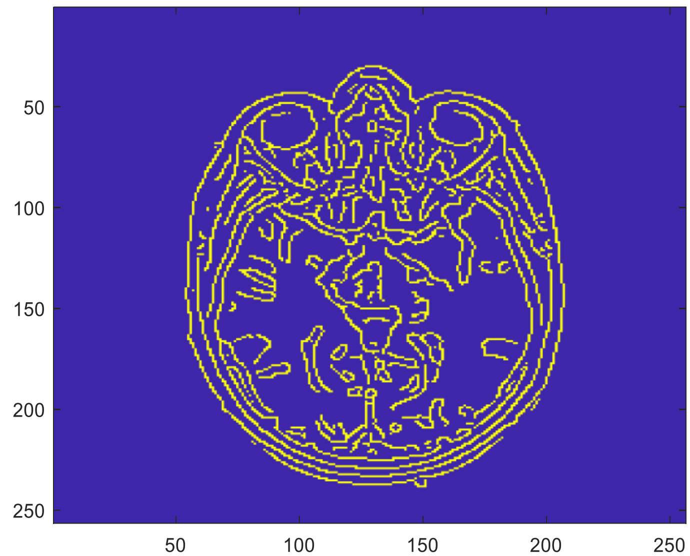




The Canny edge detector acts upon procedure which is:

1. Apply Gaussian filter to smooth the image in order to remove the noise
2. Find the intensity gradients of the image
3. Apply gradient magnitude thresholding or lower bound cut-off suppression to get rid of spurious response to edge detection
4. Apply double threshold to determine potential edges
5. Track edge by hysteresis: Finalize the detection of edges by suppressing all the other edges that are weak and not connected to strong edges.

Thus, by applying these steps on the given image using the built-in function of MATLAB, we derive the



following map.