CS663 Assignment 5 Question 3 Report

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1 Overview

In this question, we have filtered a image which was corrupted by low frequency noise. The basic of code implementation and the final results obtained are mentioned.

2 Algorithm implementation

In the first section of the MATLAB code, the Fourier transform of the given image is calculated using inbuilt function. The image for the log magnitude of the Fourier transform is obtained.

In the second part using the log magnitude of FT of original image, the frequency components that contribute to the image noise are identified using some manually tuned parameters. These points are stored in order to use them for the design of the ideal notch filter.

The points in R-radius of the noise frequencies identified in the previous section are set to zero in the filtered FT as we are implementing a ideal notch filter. Other points remain unchanged. When we take the IFT of the filtered FT, we will get the filtered image.

Finally, the noise image is also shown separately which is the IFT corresponding to the noise frequency points in the original image FT.

3 Results

3.1 Fourier transform

The log magnitude of the Fourier transform for the original image is shown in the figure 1. The corresponding original image with the low frequency noise pattern is shown in figure 2.

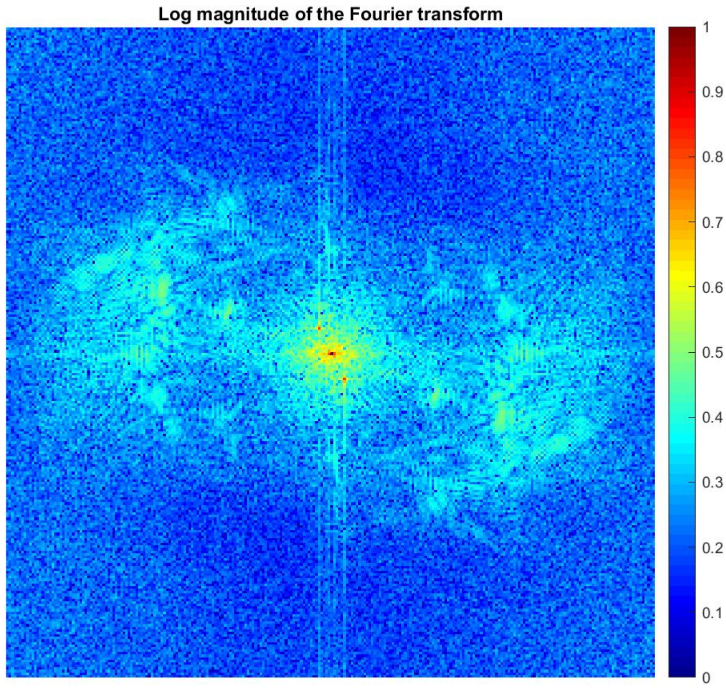

Figure 1: Log magnitude of FT of original image

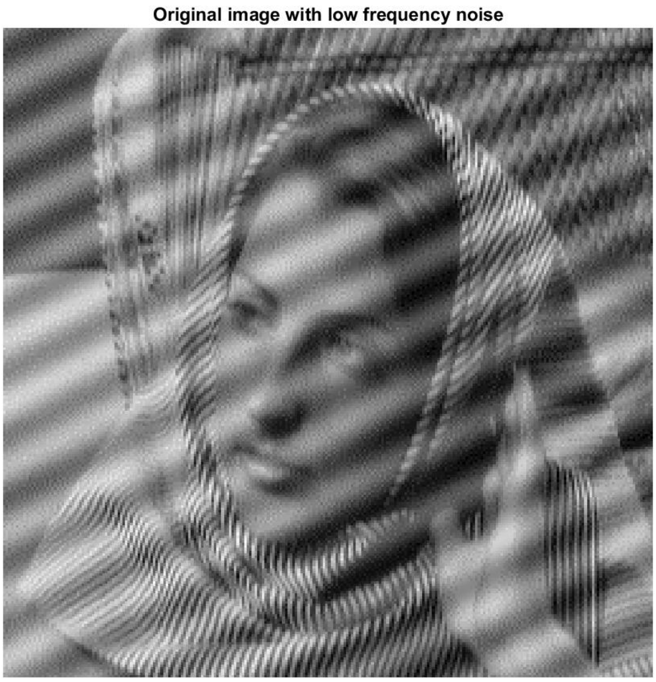

Figure 2: Original image with low frequency noise

In the original image, we can see that the image consists of noise in form of one or few sinosoids. From the FT, it is seen that the only high magnitude point at a frequency away from the centre is at point (134,139). Subtracting the centre i.e. 129, we get the noise to be at the spatial frequency (5,10).

3.1.1 Frequency of noise patterns

From the FT of the original image, we can infer that the noise frequency is of (5,10). This point is marked in the below figure 3:

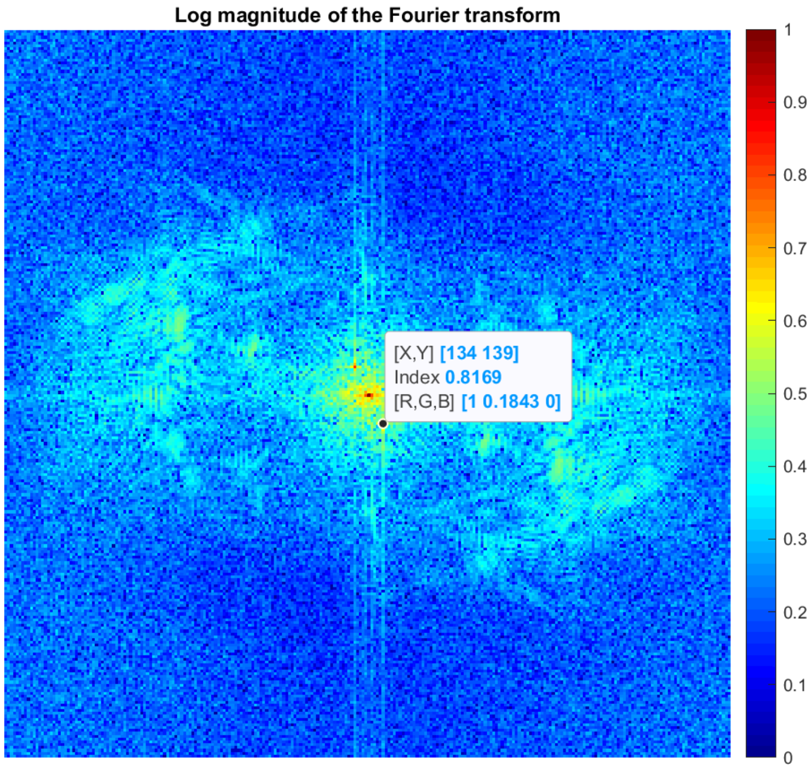

Figure 3: Marked noise frequency

Due to the symmetry, there is also another impulse like point at (-5,-10). Taking these two points only, if we construct a FT and take its IFT, we will get the noise pattern only. This noise patter in shown in figure 4.

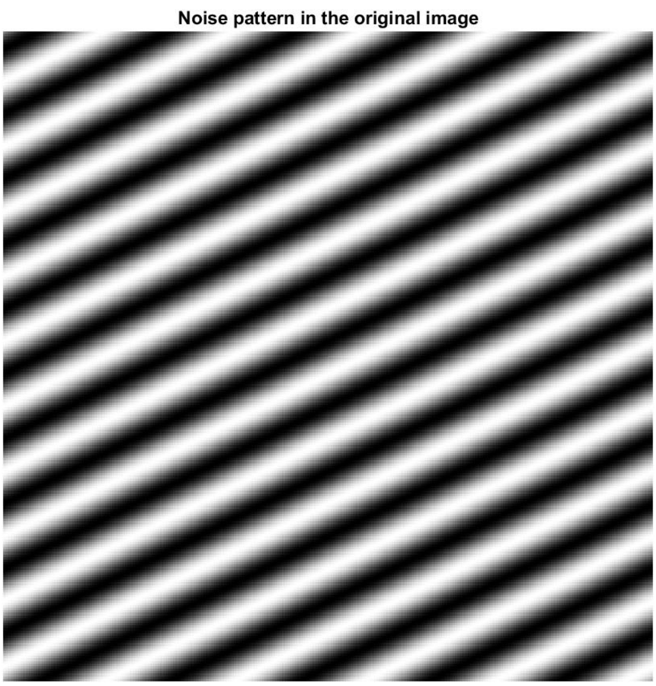

Figure 4: Noise pattern in original image

3.2 Ideal notch filter

Finally, we design an ideal notch filter which is centred around the point (124,119) and (134,139). Thus we reject the noise frequencies component and set it to zero. Thus the FT of our filtered image will be a product between the notch filter response and the original FT. The result is shown in below figure 5:

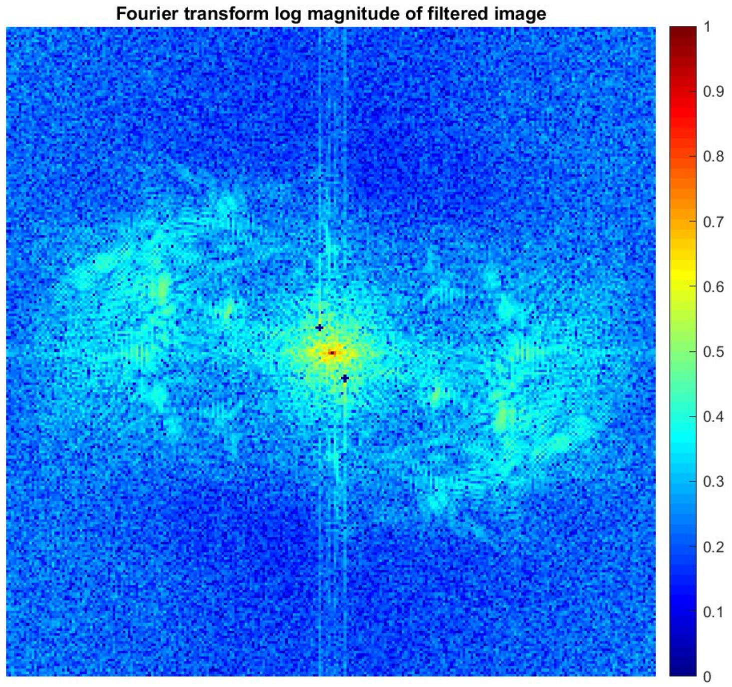

Figure 5: Log magnitude FT of the notch filtered image

Thus we have eliminated the frequency that was contributing to the noise. The radius of the notch filter can be tuned manually in the code. The best result we have obtained is for R = 1 is shown below in figure 6.

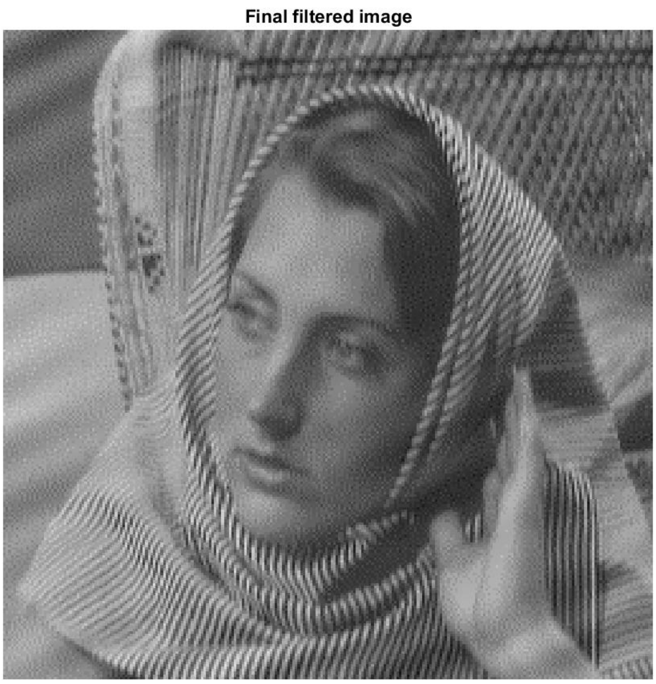

Figure 6: Final filtered image