Digital Image Processing (1121)

Homework #2 (DUE: 2023.10.25)

(Please note that you have to upload your source codes (and a brief description about your codes or algorithms, optional) to the server before the deadline. Please check the course website for more details.)

* Bonus: to design a GUI or integrate all these functions to the one you constructed in HW#1 is strongly encouraged.

1. Enhancement Using Spatial Filters

pirate_a   pirate_b

(a) Download the images 'pirate_a.raw' and 'pirate_b.raw' as shown above (512x512, 256 grayscale). Apply a 3x3 averaging mask to both of the images and make a comparison according to your result.

(b) Repeat (a), but apply a 3x3 median filter rather than the averaging mask to both of the images. Again, compare these two resultant images and give your explanation.

(c) Choose the best-improved image you can obtain from (a) and (b), and apply the Laplacian mask to this image. Display the filtered result and compare it with the original image.

2. The white bars in the test pattern shown below (BarTest.tif) are 7 pixels wide and 210 pixels high. The separation between bars is 17 pixels. Please apply the following filters to this image and show the results:

(a) A 7x7 arithmetic mean filter?

(b) A 3x3 arithmetic mean filter?

(c) A 7x7 median filter?

(d) A 3x3 median filter?
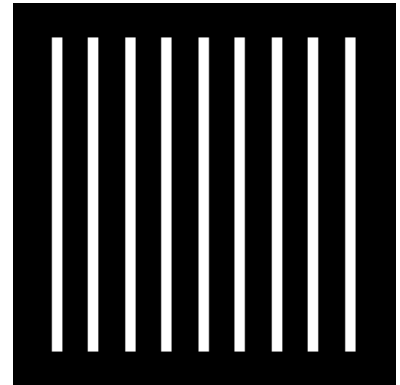
3. "Lenna" is a famous example of digital image processing. In order to have a further understanding of it, please do the following steps:

(a) Obtain the 2D-FFT of the image "Lenna.tif", and display the spectrum image of $\log|F(u,v)|$.

(b) Magnitude and Phase images: Do 2D-FFT to obtain the magnitude and phase of the image. Display its "magnitude-only image" and "phase-only image" by applying inverse 2D FFT.

4. Consider the image below (DIP_image.tif). The image was processed by the following steps:

(1) multiplying the image by $(-1)^{x+y}$;

(2) computing the DFT;

(3) taking the complex conjugate of the transform;

(4) computing the inverse DFT;

(5) multiplying the real part of the result by $(-1)^{x+y}$.

(a) What would the processed image look like? Show the processed images from each step.

(b) Explain mathematically why it appears as it does.