Digital Image Processing

Assignment 2

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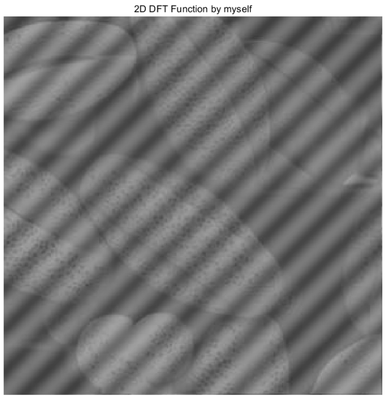
Problem 1

(a) (1) The formula and code is as Fig. 1 shown. (2) As Fig. 2 shown, it is the output of reconstructed image by the 2D inverse DFT function, which is implemented by myself.

$$f(x,y) = \frac{1}{MN}\sum_{u=0}^{M-1}\sum_{v=0}^{N-1} F(u,v)e^{j2\pi}(\frac{ux}{M}+\frac{vy}{N})$$

```
for x=1:m
    for y=1:n
        for u=1:m
            for v=1:n
                I2(x,y)=I2(x,y)+double(I(u,v))*exp(2*pi*i*(u*x/m+v*y/n))/(m*n);
            end
        end
    end
end
```

Figure 1: The formula and code of 2D inverse DFT.



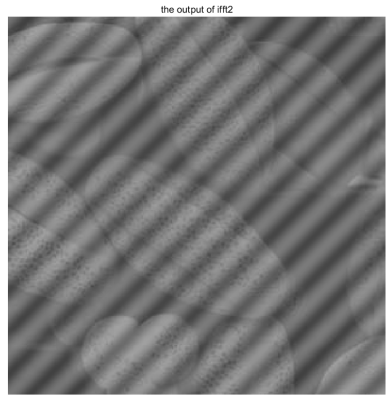


Figure 2: The results of Q1a. Left image is the output of my function. Right one is the output of ifft2.

(2) L_2 distance to $ifft2$ output is 5.7195 by $norm(img_1 - img_2, 2)$.

(b) (1) The result as Fig. 3 shown.

(2) The first image is the result of original F data.mat. The second one is reconstructed by original F data. Then The third picture is the spectrogram of the adjusted Fourier change. The last one is the reconstructed image based on the spectrogram without noise.

(2) I just found the origial data had the noise pixel at $(166, 166)$, then recalculate this pixel with the mean of its surrounding pixels.

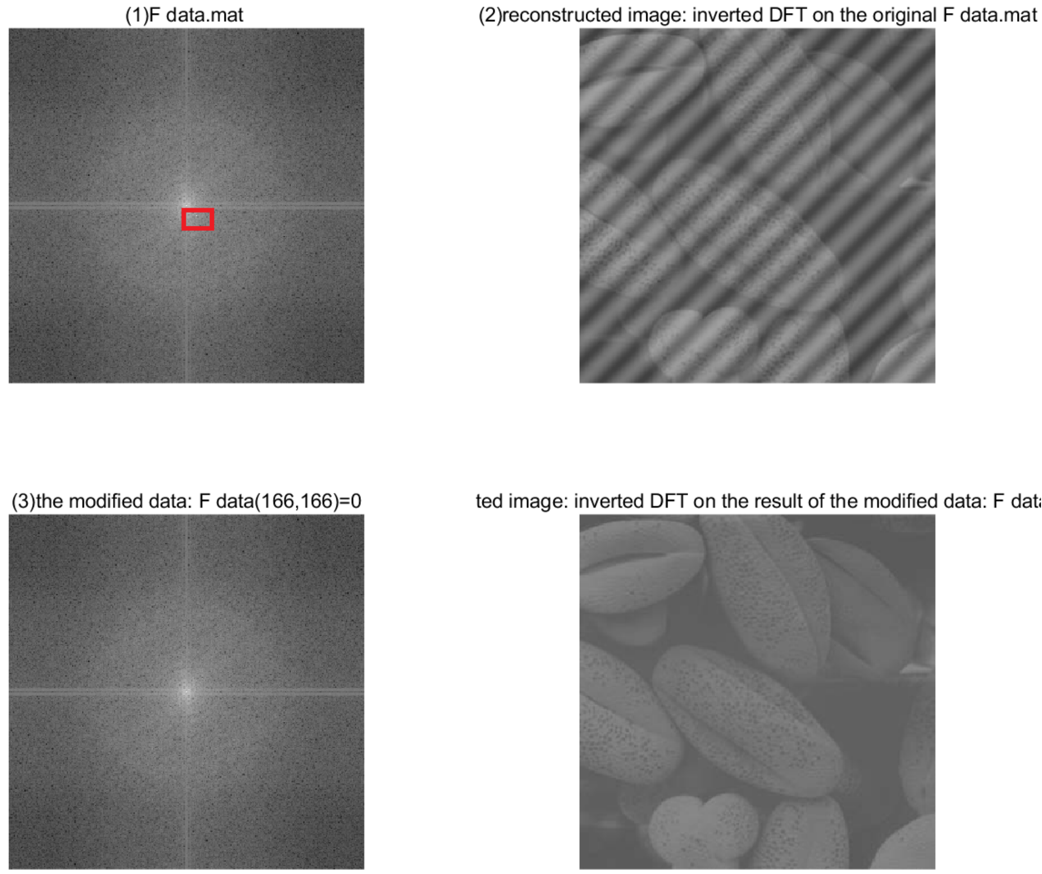


Figure 3: The results of q1.b

(c) (1) The results as Fig. 4 shown.

(2) The homomorphic filter with $\gamma_H = 0.4$, $\gamma_L = 0.35$, $D_0 = 10$, and $c = 0.25$.

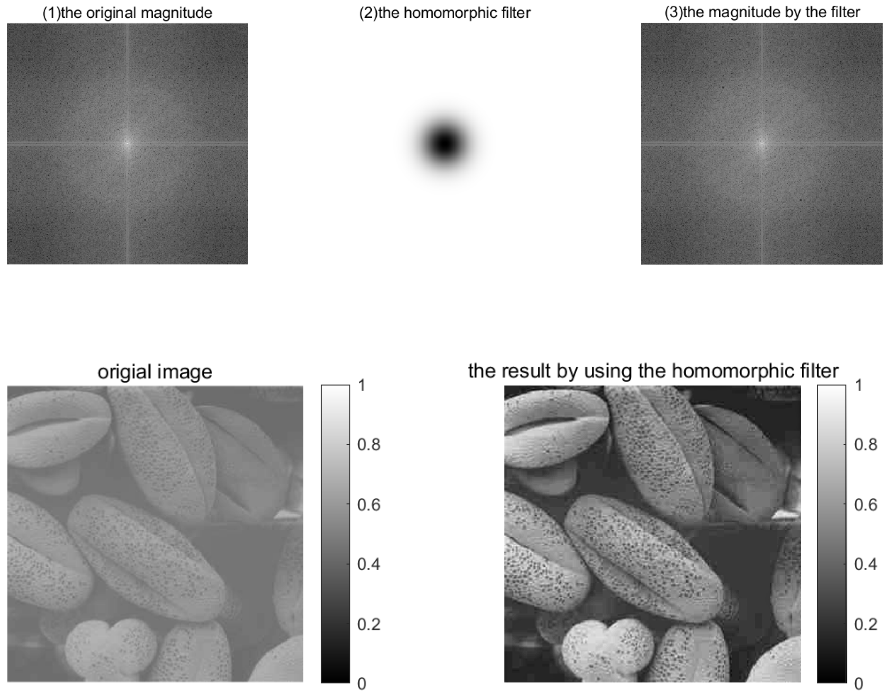


Figure 4: The results of q1.c

Problem 2

(a) Algorithm: Radon transform obtains a projection matrix, calculates the one-dimensional Fourier transform of the projection, multiplies a transfer function, carries out the inverse Fourier transform, and finally integrates all the one-dimensional inverse transforms.

(b) As Fig. 5 shown, they are the results of FBP. The raw data and filters used to generate the image are shown in the image's title. Compared with the original image, the third one is the best one.

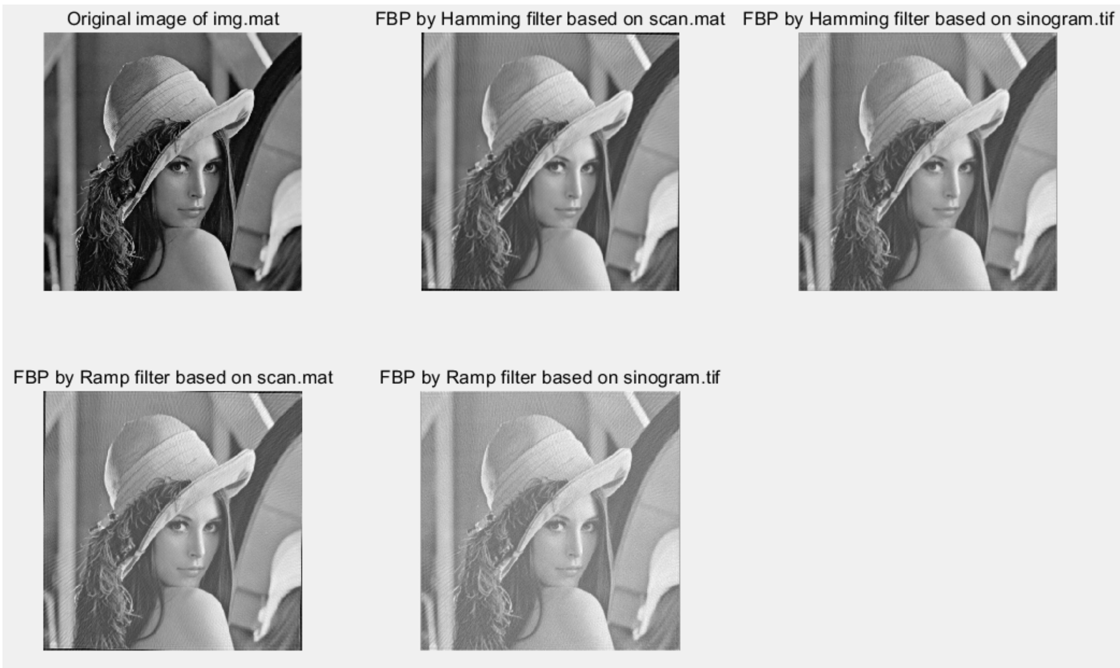


Figure 5: The results of FPB.

(c) The results of the level 3 decomposition is shown in Fig. 6.

Figure 6: The results of the level 3 decomposition.

Problem 3

(a&b) The result of the Q3.

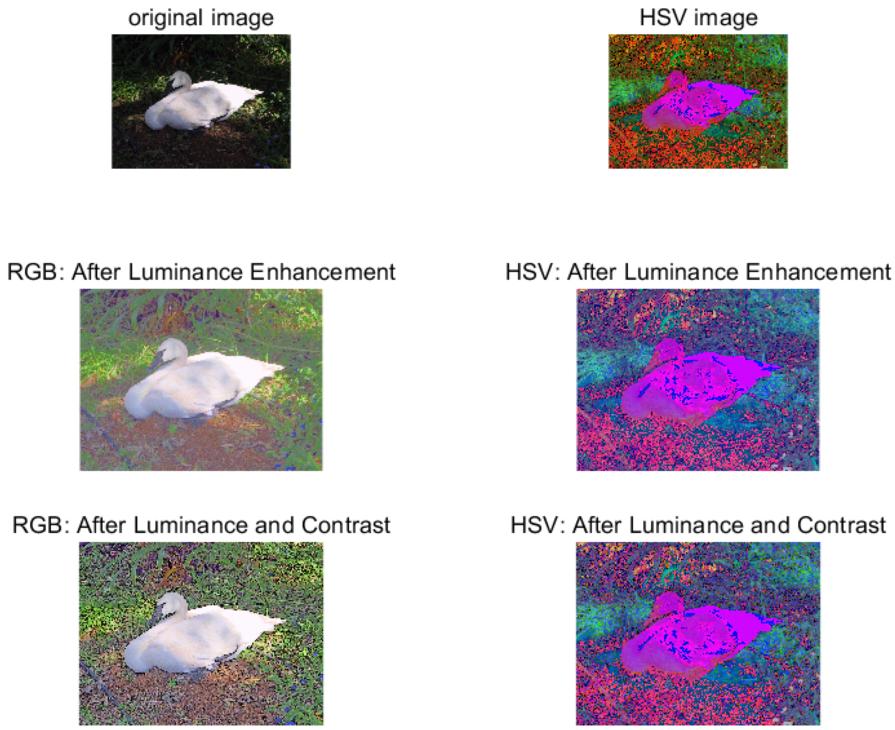


Figure 7: The results of Q3.

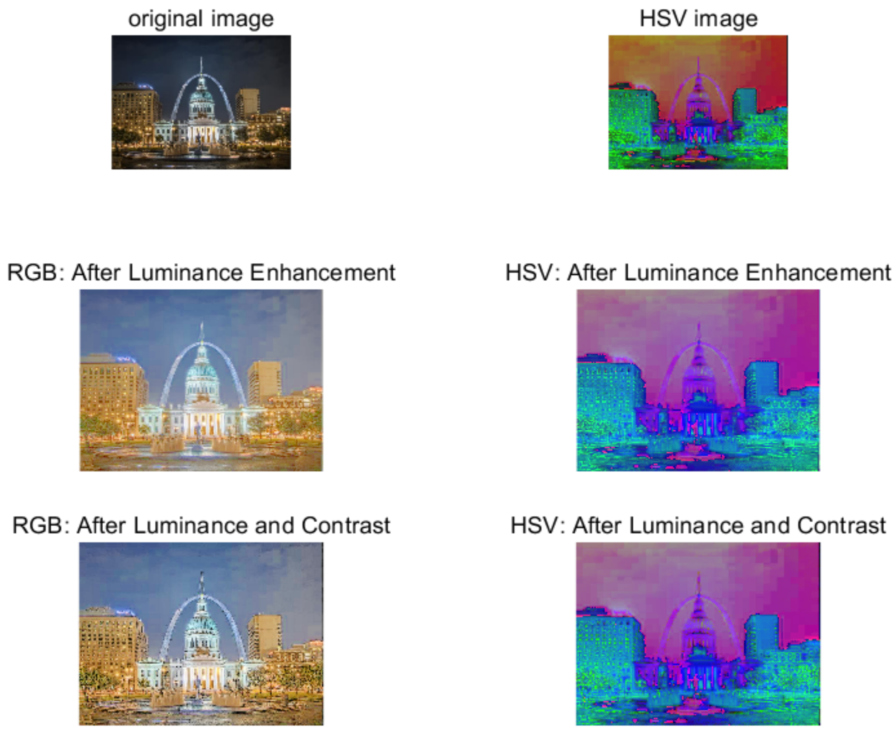


Figure 8: The results of Q3.

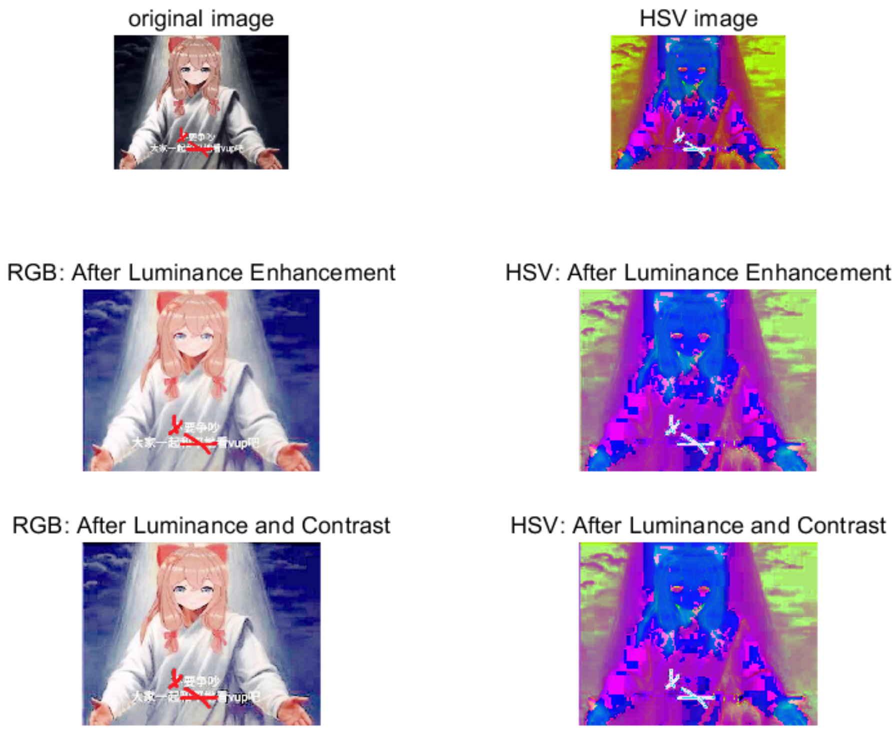


Figure 9: The results of Q3.

(bonus) (1) About Luminance Enhancement, we could calculate the parameter x based on *patch/local* rather than global's.

(2) About Contrast Enhancement, there are many noise in the final output image, may use de-noise method or use different methods (e.g. AINDANE, MSRCR, Histogram Equalization) for different images. There is no perfect way to enhance every image.