

Digital Image Processing, 2024 Spring
Homework 3

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Due 23:59 (CST), May. 20, 2024

Problem 1: CT reconstruction

The filtered back projection is applied with the following steps:

1. Compute the 1-D Fourier transform of each projection.
2. Multiply each 1-D Fourier transform by the ramp filter which has been multiplied by a Hamming window.
3. Then obtain the inverse 1-D Fourier transform of each resulting filtered projection.
4. For each projection, we replicate it, rotate it, and sum them together to obtain the reconstructed result.

The Hamming window is defined as:

$$w(n) = 0.54 + 0.46 \cos\left(\frac{2\pi n}{N-1}\right), \quad n = 0, 1, \dots, N-1$$

where N is the number of samples in the projection.

The normalized reconstructed image is shown in Figure 1.

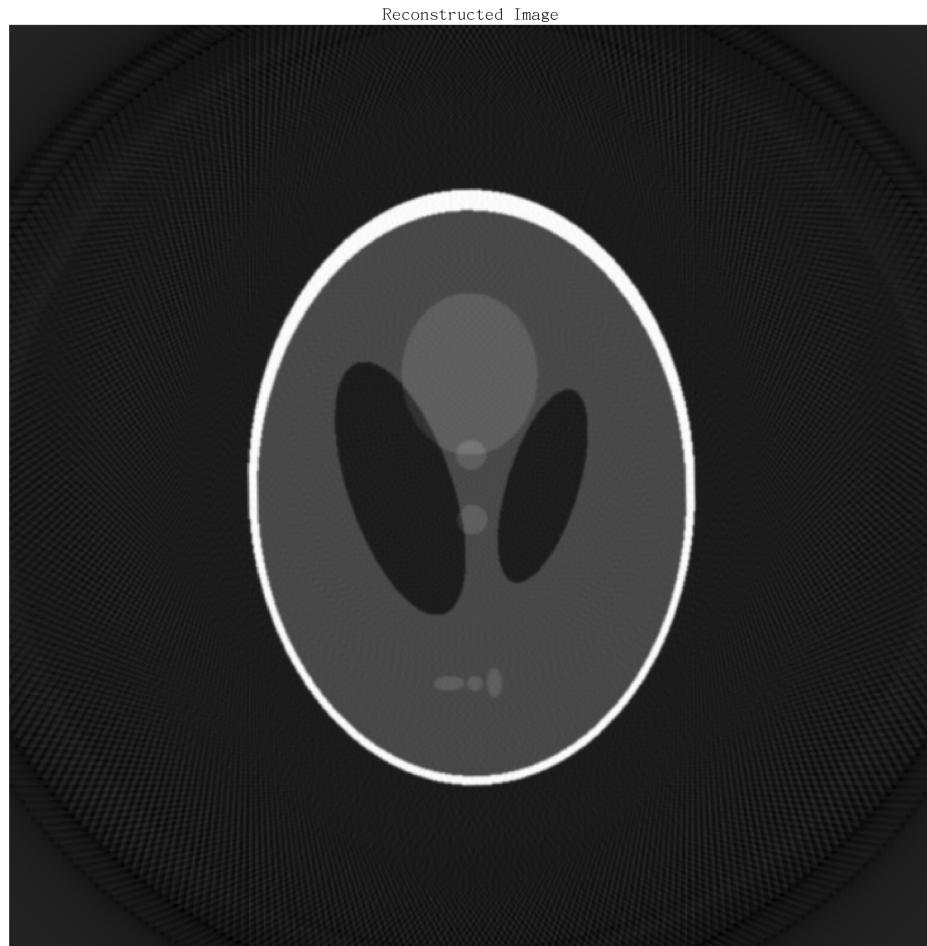


Figure 1. Reconstructed result of CT.

Problem 2: Threshold processing

(a) To make the foreground and background of the image more distinguishable, there are two ways to convert 3 channels of the image into gray level. i.e.

$$I_1 = \frac{1}{3}(R + B + G)$$

$$I_2 = 0.299 * R + 0.587 * B + 0.114 * G$$

The histogram of the intensity of the gray level and its correspondence foreground image is shown in Figure 2.

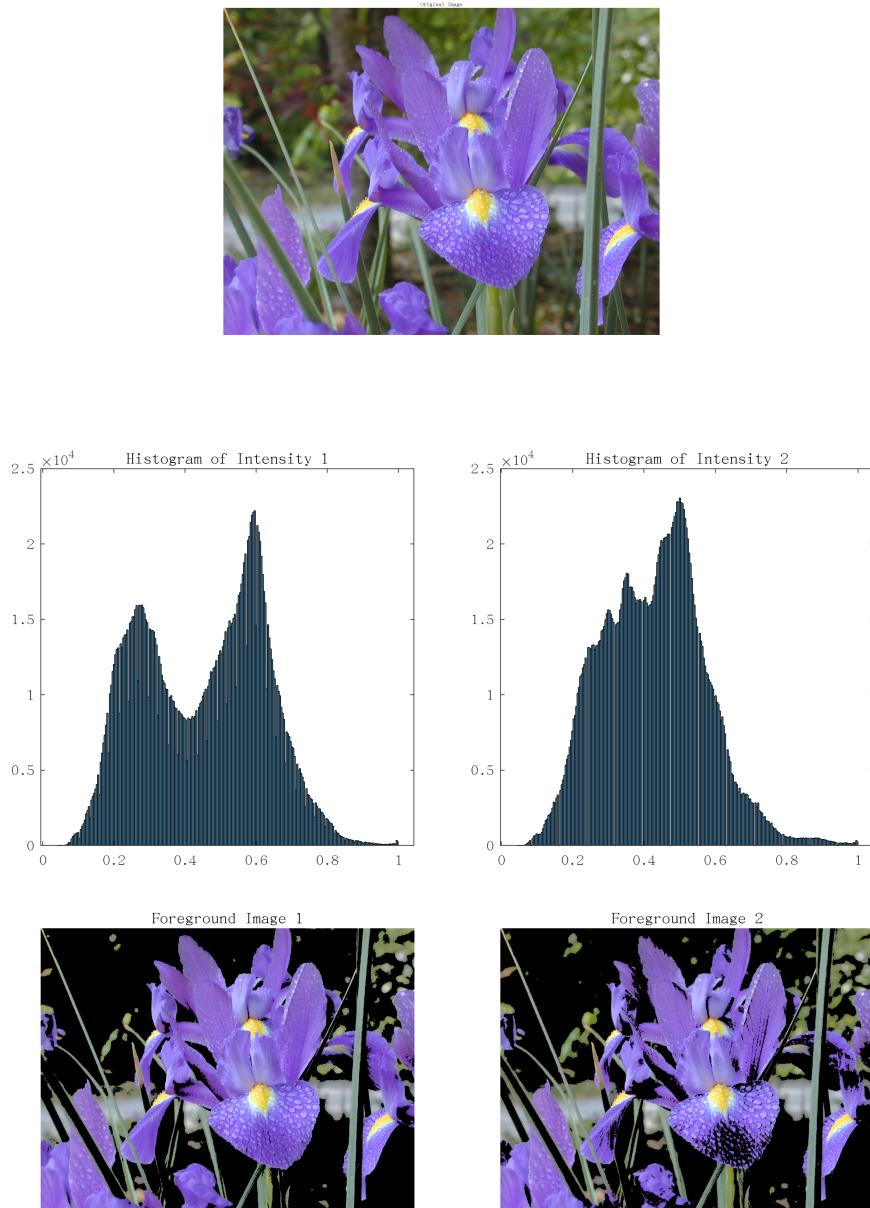


Figure 2. Basic global thresholding

(b) The result of Region Splitting and Merging with the minimum four-quadrant size limit of $4 * 4$ and $8 * 8$ is shown in Figure 3.

The first line is the result of $4 * 4$ and the second line is the result of $8 * 8$.

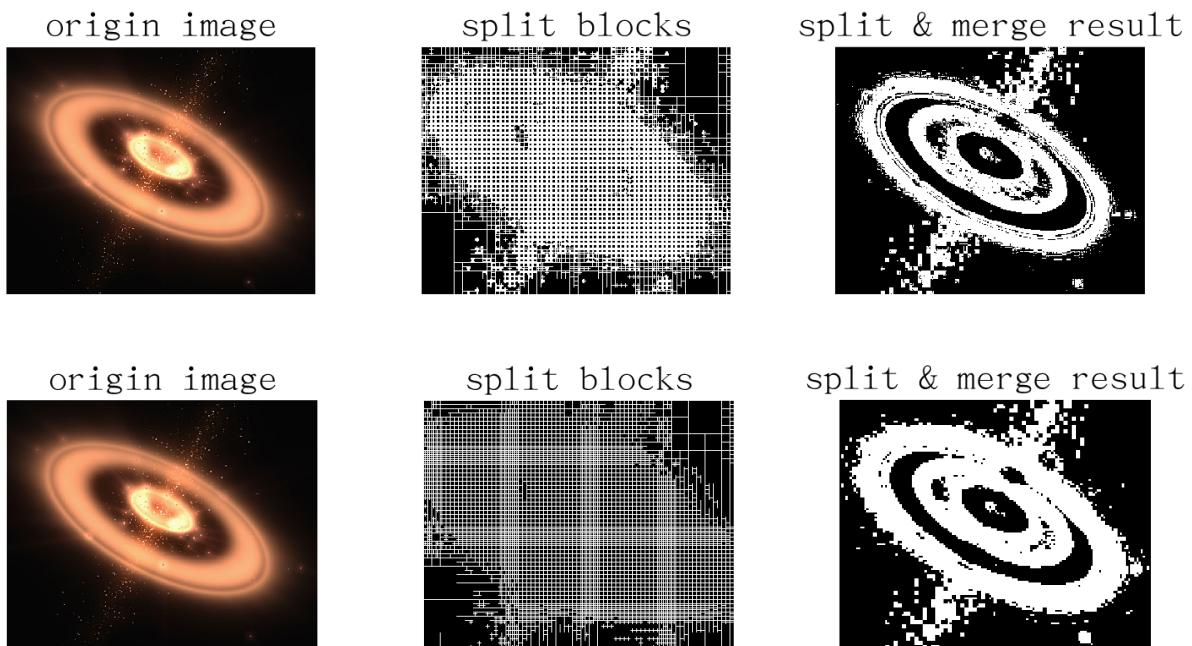


Figure 3. Region Splitting and Merging

Problem 3: Super pixel

We can apply the SLIC algorithm to the image to obtain super pixels.
The results of different number of super pixels are shown in Figure 4.

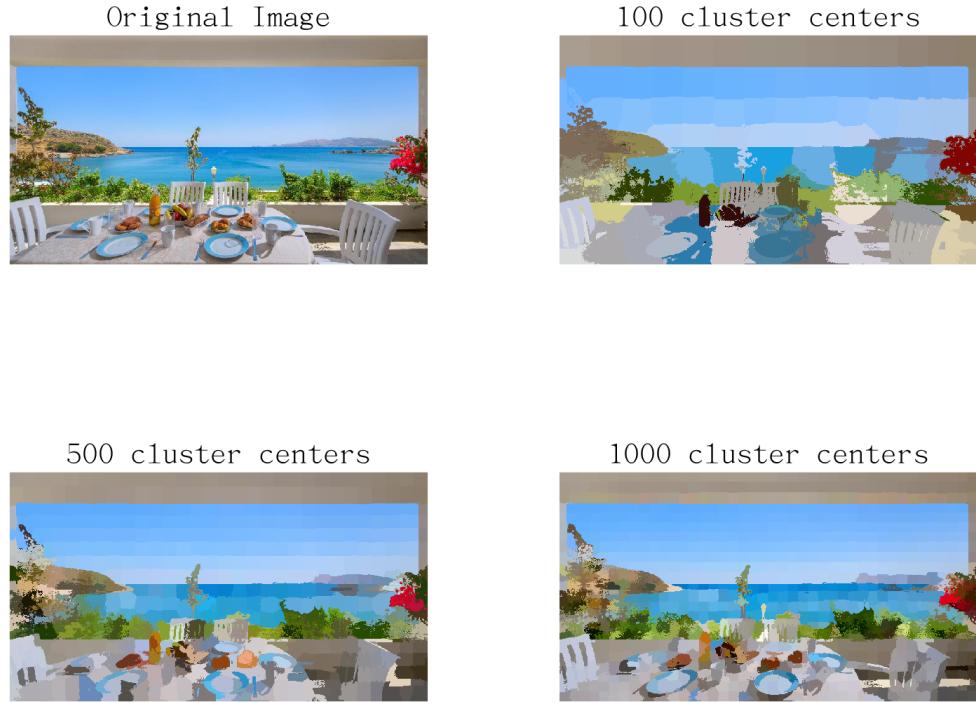


Figure 4. Results of different number of super pixels.