

Medical Imaging System Homework

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When considering image quality I use

Reconstruction Error:

I_o : Original Image

I_b : Backprojected Image

$$\sum_i^h \sum_j^w |I_b(i,j) - I_o(i,j)|$$

When considering efficiency I use

cputime

<https://ww2.mathworks.cn/help/matlab/ref/cputime.html?requestedDomain=cn>

Settings:

Image size = 512 * 512

1. Call radon and iradon functions

Projections: 0 degree to 180 degrees with 3 degree of increment



Reconstruction Error (assume grayscale within [0, 255]):

$$\text{filtered backprojection} = 1.6602 \times 10^7$$

$$\text{unfiltered backprojection} = 1.3634 \times 10^7$$

Cpu_time = 0.6200 (Seconds)

Projections: 0 degree to 180 degrees with 0.3 degree of increment



Reconstruction Error (assume grayscale within [0, 255]):

$$\text{filtered backprojection} = 3.1358 \times 10^6$$

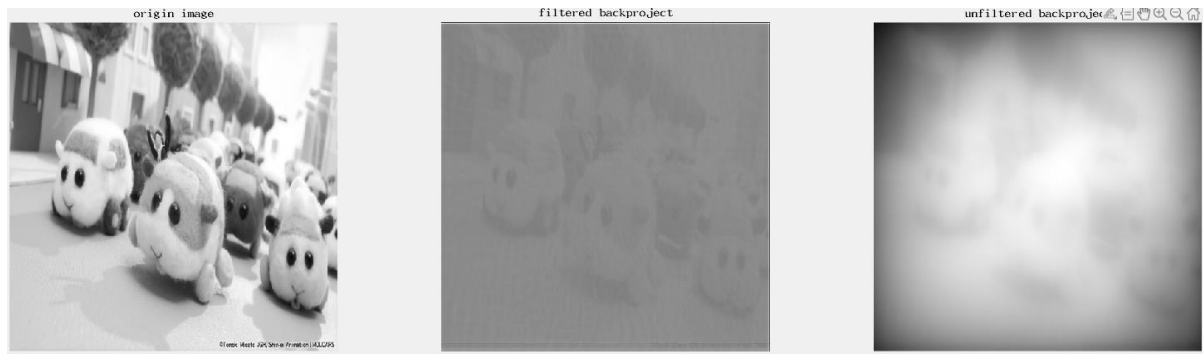
$$\text{unfiltered backprojection} = 1.3934 \times 10^7$$

Cpu_time = 3.7900(Seconds)

2. Implement radon and iradon myself

2.1 Implement Ram-Lak filter in frequency domain

Projections: 0 degree to 180 degrees with 3 degree of increment



Reconstruction Error (assume grayscale within $[0, 255]$):

$$\text{filtered backprojection} = 1.6080 \times 10^7$$

$$\text{unfiltered backprojection} = 1.3653 \times 10^7$$

Cpu_time = 1.0100 (Seconds)

Projections: 0 degree to 180 degrees with 0.3 degree of increment



Reconstruction Error (assume grayscale within $[0, 255]$):

$$\text{filtered backprojection} = 6.2760 \times 10^6$$

$$\text{unfiltered backprojection} = 1.4017 \times 10^7$$

Cpu_time = 7.5100 (Seconds)

2.2 Implement Ram-Lak filter in spatial domain

Projections: 0 degree to 180 degrees with 3 degree of increment



Reconstruction Error (assume grayscale within $[0, 255]$):

$$\text{filtered backprojection} = 1.6443 \times 10^7$$

$$\text{unfiltered backprojection} = 1.3653 \times 10^7$$

Cpu_time = 1.0500 (Seconds)

Projections: 0 degree to 180 degrees with 0.3 degree of increment



Reconstruction Error (assume grayscale within $[0, 255]$):

$$\text{filtered backprojection} = 5.2764 \times 10^6$$

$$\text{unfiltered backprojection} = 1.4017 \times 10^7$$

Cpu_time = 8.3800 (Seconds)

Discussions:

3.1 Compare and discuss two sets of simulation parameters.

從上面三組實驗中可以看出，投影角度越多(increament 值越小)，重建回來影像品質越好

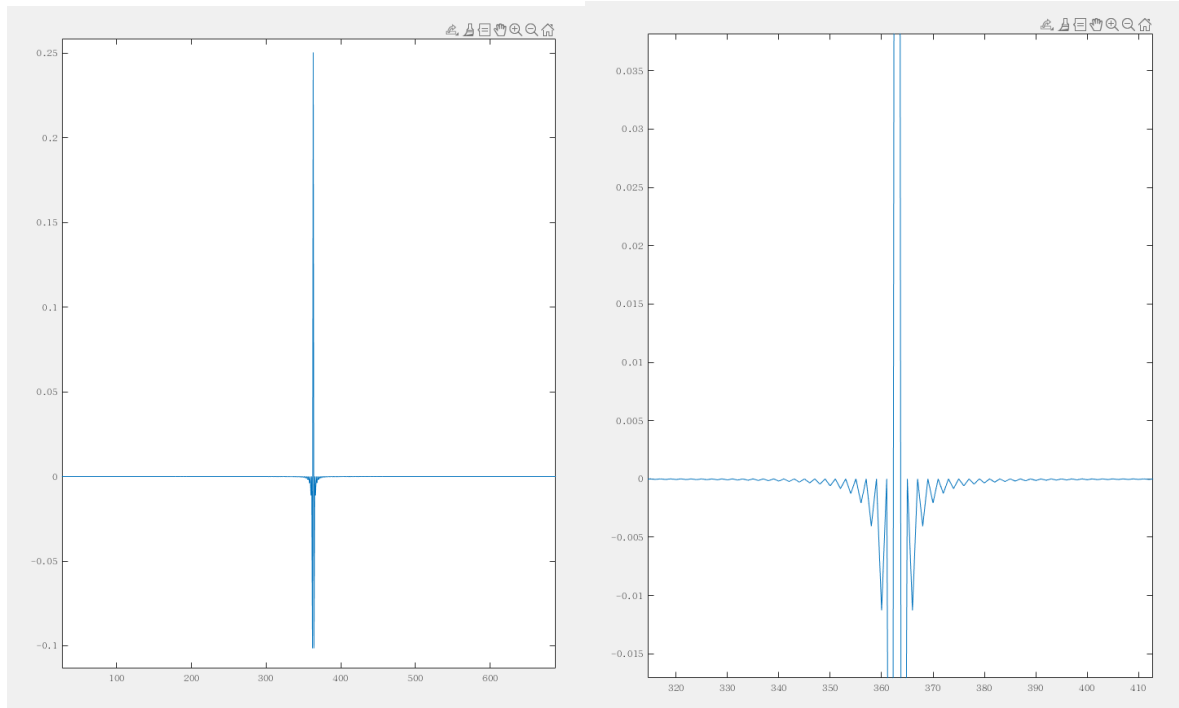
3.2 Compare and discuss back-projection and filtered back-projection results.

未做 filter，則重建回來的影像較模糊（低頻訊號較多）

3.3 Compare and discuss Matlab functions and your implementation regarding image quality and efficiency

從 reconstrucion error 以及 cpu time 可看出，在效率上以及影像品質上 matlab 官方的 radon 和 iradon 都較為出色。

Ram-Lak filter in Spatial Domain



Ram-Lak filter in Frequency Domain

