

Assignment: Filtered Back-projection

Due Friday, September 20, 2019 at 11:59 pm

Complete the deliverables listed below and upload to Canvas.

Please upload each file separately (i.e., don't compress them or make a .zip file)

- Matlab m-file with code to answer the following questions
- A report (saved as a pdf) of answers and figures (if necessary) to support your answer
- Make sure each plot/figure has a title, labeled axes, and is displayed in the correct aspect ratio.

For all of these images the image and voxel dimensions are saved within a structure.

For example:

`image_01.im` is the image array

`image_01.dim(1)` is the y-dimension (in mm)

`image_01.dim(2)` is the x-dimension (in mm)

`image_01.dim(3)` is the z-dimension (in mm)

(1) Explain the process of acquiring and reconstructing CT images and how we can use Matlab to simulate that (5 pts)

(2) Plot a line profile of image_01 (5 pts)

- a. What does this profile tell us?

(3) Create functions from the scripts we wrote in-class (10 pts)

- a. Create a back projection function that returns an unfiltered backprojection when you provide it with (1) an image, (2) and a list of angles
 - i. `recon = backproject(image, 1D array of angles);`
- b. Create a function that reconstructs the images using a filtered reconstruction with the ram lak filter
 - i. `[recon_filt] = backproject_filt(image, 1D array of angles);`

(4) Calculate line profiles and then reconstruct image_01, using the functions your created (15 pts)

- a. Using 3, 10, 30, 180 evenly spaced back projections
 - i. Provide images of both the filtered and unfiltered approach
- b. Why is filtering needed?
- c. Explain how increasing the number of projections improves the image quality. Can you think of any limitations you might have when doing this in humans?

(5) Calculate line profiles and then reconstruct image_02 (15 pts)

- a. Use the `iradon` and `radon` functions to reconstruct these images

To create line profiles call

`[line_profiles] = radon(image, angles);`

To reconstruct the image use

`recon = iradon(line_profiles, del_theta, sy, 'linear');`

where `del_theta` is the spacing between angles.

- b. Using 3, 90, 180, 270, 1000 evenly spaced back projections, reconstruct the image
- c. What can an image like this tell us about the performance of a CT scanner?