

Medical Image Processing

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Assignment 1
January 16, 2021

Instructions:

- All your code should be uploaded in a folder named as 'Code'.
- The report should be in a '.pdf' format with your roll number as the filename.
- In the case of computing-based questions, the pdf should clearly report the experimental settings, results/observations and a discussion/conclusions based on the results.
- Upload the code and report in a single .zip file which has the following naming format: r_An where r is your full roll no; n is the assignment number.

Outline: *In this assignment, you will implement various Reconstruction Algorithms without using any built-in packages and compare the results across.*

Question 1: Why does the Radon Transform of an image, $\mathcal{R}\{f(x,y)\}$, known as 'Sinogram'? Hint: Support your answer by deriving the sinogram corresponding to the object to be imaged.

Question 2: Implement Radon Transform and report the observations on the change in the sinogram as you vary the step size of θ and the 'number of detectors' or range of 'r'

Question 3A: Implement the following reconstruction algorithms and using a suitable metric, check the performance of these algorithms on: 1. Shepp-Logan Phantom 2. Nema sinogram and 3. Image of your choice.

- Back Projection
- Direct Fourier Reconstruction
- Filtered Back Project (FBP)

Question 3B: Make changes to following hyper parameters and report the effect:

- Different interpolation methods is K-space
- Different filter functions for FBP
- Change number of views and detectors
- Noisy Shepp-Logan Phantom

[Note]

1. Shepp-Logan phantom is a standard test image created by Larry Shepp and Benjamin F. Logan for their 1974 paper [1]. It serves as the model of a human head in the development and testing of image reconstruction algorithms. The phantom image is already made available in both Python and Matlab

2. *NEMA is a physical phantom provided by the National Electrical Manufacturers Association (NEMA). It is specifically used to test PET reconstruction. The details on how to download NEMA sinogram is given in [Nema.zip](#)*

References

- [1] Lawrence A Shepp and Benjamin F Logan, “The fourier reconstruction of a head section,” *IEEE Transactions on nuclear science*, vol. 21, pp. 21–43, 1974.