

Medical Imaging

IST 2022-2023

Lab 2

Consider the formation using a 1st generation scanner of a CT image of the modified Shepp-Logan phantom, which approximately models X-ray attenuation in a human head.

Note: for this lab you will need the [scikit-image](#) processing toolbox.

1. Generate the modified Shepp-Logan phantom using `shepp_logan_phantom`. Use the function `rescale` to get a 256x256 dimension.
2. Simulate the sinogram obtained by collecting projections covering $[0;180[^\circ$ in steps of 1° (using `radon`), and the associated reconstructed image using filtered backprojection (using `iradon`).
3. Repeat the simulation in 2., but now covering $[0;90[^\circ$ and $[0;360[^\circ$, in steps of 1° . Determine what the minimum angle coverage should be, in theory.
4. Repeat the simulation in 2., covering $[0;180[^\circ$, but now in steps of 5° . Observe the effects on the sinogram and the reconstructed image.
5. Repeat the simulation in 2., by adding noise to the projection data, considering a maximum sinogram intensity of 255 (using the `random.poisson` function of the `numpy` library; note that values need to be converted to `uint8` type (8-bit unsigned integers) prior to applying this function).
6. Repeat the simulation in 5., by now considering half of the original tube voltage. Compare with 5.
7. Repeat the simulation in 6., by replacing the original Ram-Lak filter by modified filters (available in `iradon`), and explain the results as a function of their different frequency responses.