CSE377 HW8: CT Image Reconstruction (10 pts)

Due April 27 2023, 11:59PM, submitted via Brightspace

Part 1: Using the forward projection to generate the CT signals (sinogram). Starter-codes are provided.

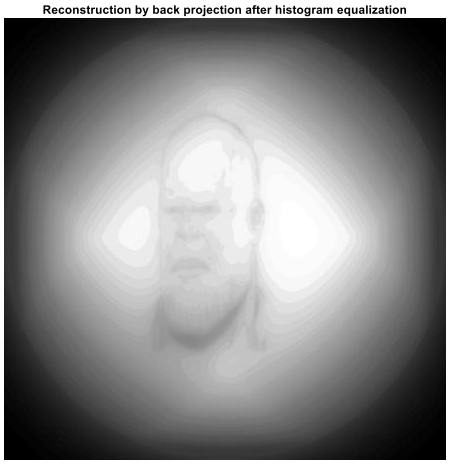
For example, the following is an 800 x 800 image and its sinogram 800 x 180 for 180 viewing angles (i.e., the x-ray source rotates around the head every 1 degree clockwise from 0 degree to 180 degree).

Part 2: Using the backward projection to reconstruct the CT image from the sinogram. (2pts)

For example, the following is the reconstructed example, which is very blurred and with low-contrast.

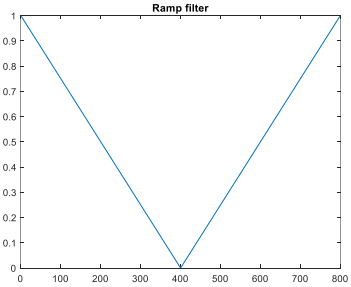
Part 3: Histogram equalization. (1pt)

Applying the histogram equalization to the above reconstruction, you will get a better visualization as below.



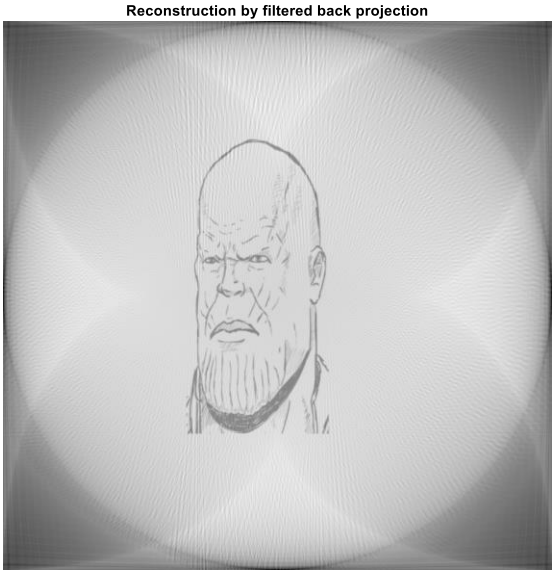
Part 4: Frequency filtering. (3pts)

Applying ramp filtering (a high-pass filtering) onto each column of the sinogram in the frequency domain to attenuate the low-frequency components. For example, the following (left) is an example of ramp filter, after applying it to the sinogram in part 1, you will get a filtered sinogram (right in the following).



Part 5: Filtered back projection. (2pts)

Performing the back projection on the filtered sinogram, you will get the following reconstructed CT image, which is much sharper.



Part 6: Imagine some of the x-ray detectors are out of order, so some rows of the original sinogram are black (i.e., with zero values). Performing the filtered back projection on the damaged sinogram, what will you find? (1pt)

Part 7: Imagine some view angles of the x-ray sources are out of order, so some columns of the original sinogram are black (i.e., with zero values). Performing the filtered back projection on the damaged sinogram, what will you find? (1pt)

Upload your codes with enough comments in Jupyter notebook or .m/.py codes with a brief report to Brightspace by the due date & time.