Dialogues of Civilization 2018 - Biomedical Imaging
Homework 2

Due date: 5/29/2018

Please solve the following problems and email the solutions to *kercher.e@husky.neu.edu*.

1 Literature Review

Discuss with your group about potential project topics (*i.e.*, imaging techniques) that sound interesting to you. It's ok if we haven't yet covered them in lecture. Look up and review some research articles on the subject to help you formulate ideas for your project. Google Scholar and PubMed are good places to start. Once you have a few papers in mind, log in to the Northeastern Library website and search them for full access. (NU students, please help UAndes students with this process if needed).

Each person should review at least one paper and write a one page summary of the article to turn in. In your summary, include a brief background, methods, and any important results and conclusions from the paper. Also comment on the strengths and weaknesses of the paper; What did you like about it? What would you have done differently? Finally, discuss how this paper could help form your group project. Discuss these ideas with your group, keeping in mind that you may want to combine ideas from each paper for your final project. **To submit:** Each person should turn in their own one page summary plus a pdf of the research article.

Suggestions for project topics:

- Xray-CT
- MRI
- Ultrasound
- Optical Coherence Tomography
- Confocal/Fluorescence Microscopy
- Super-resolution Microscopy
- Endoscopy

- Hyperspectral Imaging
- Other...

2 X-Ray CT

This assignment asks you to use Matlab to simulate X-Ray computed tomography.

(a) First read about the `radon` and `iradon` functions in Matlab. Briefly explain how they work.

(b) Generate a $10 \times 10cm$ phantom with $100\mu m$ resolution and add the following 3 features at random places in the phantom. For clarity, make the interstitial regions of the phantom zero-valued. Plot an image of the phantom.

- Bone $\rightarrow$ A circle with radius $1.5cm$.
- Brain $\rightarrow$ A square with side length $2cm$.
- Adipose tissue $\rightarrow$ A right isosceles triangle with side length $2cm$.

Table 1: Absorption properties of tissue at $10keV$.

Tissue	Mass Attenuation $[cm^2/g]$	Density $[g/cm^2]$
Bone	28.52	2.90
Brain	5.41	0.99
Adipose	3.27	0.90

(c) Calculate 4 radon transforms from each side of the phantom. Reconstruct the image from the 4 measurements and display the image, how does it look?

(d) Now reconstruct the image using 8 equally-spaced measurements. How does the image look? Keep decreasing your angular resolution until your reconstruction is successful. Display 2 or 3 reconstructed images you produce along the way.

(e) Reduce your angular range to less than 360 degrees. What is the minimum angular range needed to reconstruct the image? Justify your results.

(f) Estimate the imaging time for each of images you produced in parts (d) and (e), assuming a measurement takes $10ms$. Organize your results in a table.