Topographic Medical Image Reconstruction with Deep Learning Milestone 2

Asher Burrell, Christopher Hinton, Ty Mercer

Task Matrix

Task	Completion	Asher	Chris	Ty	To do
Learn how to use Open-GATE simulation	100%	33%	33%	33%	
Learn Pytorch syntax (secondary)	100%	33%	33%	33%	
Get sinogram generation pipeline working	100%	0%	0%	100%	Finish generating all SPECT data

Task Matrix (Task 1)

- Over the course of the month, we were able to set up sessions with Dr. Mitra’s lab members to show us the Open-Gate software.
- During the sessions:
  - We were able to learn about the entire pipeline for the sinogram generation.
  - Each member was able to get hands-on experience with the simulation software.
- We were able to successfully upload scripts into some of the data folders that are used by the Open-Gate software.

Task Matrix (Task 2)

- During a lab session, we were introduced to the code for the machine-learning model.
- All of us were able to learn the basics of PyTorch, either through classes at Florida Tech or through prior machine learning experience.
- Also, all of us understand the structure and code for the PyTorch model.

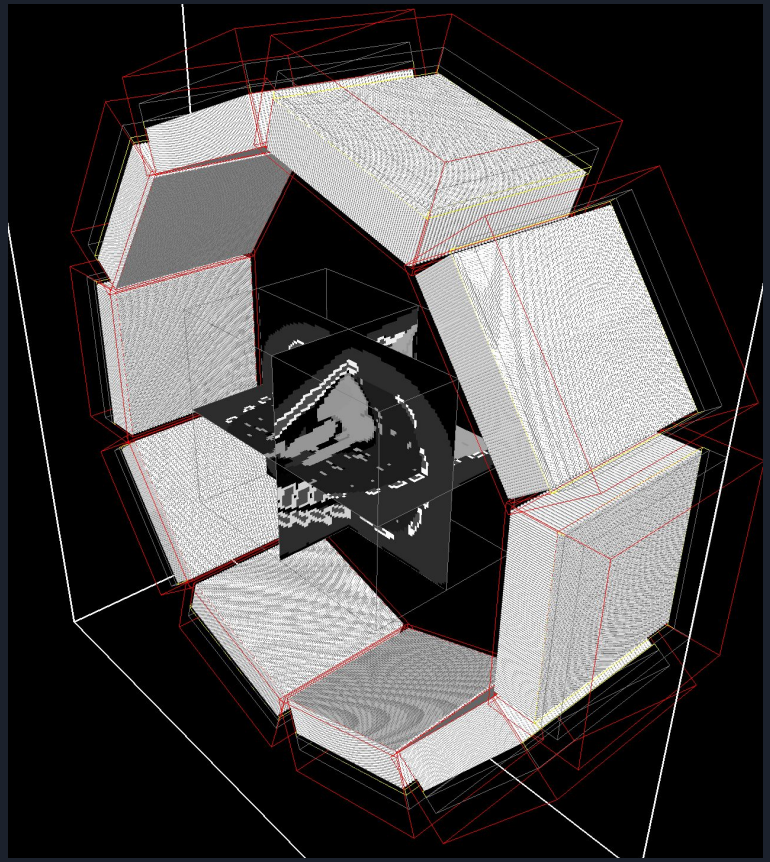
Task Matrix (Task 3)

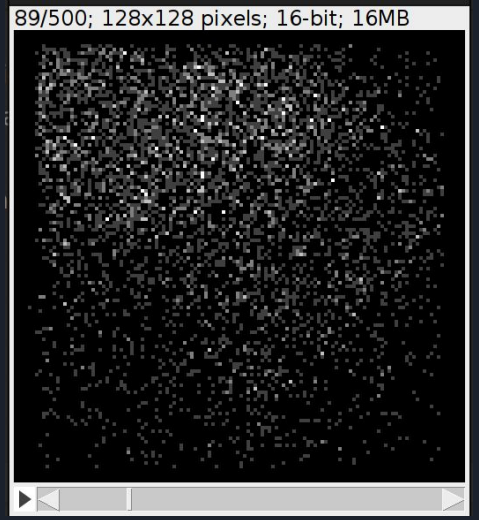
- We were able to successfully set up a Python script to generate the sinograms. This task was accomplished by Ty Mercer.
- This script is currently running in the lab and is produced 5 sinograms every 2 ½ days.
- Due to obstacles experienced during the semester, we have not generated as many sinograms currently as we had originally planned.

Obstacles during Milestone 2

- There were a few difficulties with replacing the old Powershell script that was used in the lab before with our new Python script, however, these were quickly resolved after a meeting with Tommy.
- Due to the hurricane and fall break, we had to delay the deployment and running of the script by a week and a half.
- There were some issues where the parameter file was previously configured to track only the heart (and not other organs.
- The parameter file did not set IDs to distinguish between the left heart region and right heart region.
- Ty was able to resolve these issues, but as a result, we do not have as many sinograms generated at this time as we originally intended.

Open GATE Simulation





Open GATE Simulation

- Simulate SPECT medical imaging process
- Takes about 12 hours per sinogram
- We need at least 1,000 sinograms to train our AI
- Working on speed optimizations and possible cloud computing solutions

Process Overview

1. Get statistical tracer data from medical images - Working
2. Fill XCAT phantoms using this data - Working
3. Simulate medical imaging process using these XCATs - Working
4. Generate enough sinogram data to train an AI model - Current bottleneck, need to speed up process
5. Train the deep learning model on the data - Start in Milestone 3
6. Validate, Test, & Refine the AI - Future

Milestone 3 Task Matrix

Task	Asher	Chris	Ty
Generate 1,000 sinograms using the model pipeline	10%	10%	80%
Develop a new machine learning model to classify the generated sinograms	40%	40%	20%
Train and tune the PyTorch AED model to start reconstructing the sinograms based on the data we have currently	35%	35%	30%
Figure out how to run OpenGate on a multithreading program.	33%	33%	33%

Milestone 3 (Task 1)

Generate 1,000 sinograms using the model pipeline

- This was originally supposed to be completed by Milestone 2, however, due to the hurricane and some technical difficulties outside our control, it has been pushed back to Milestone 3.
- To accomplish this task, we will have Ty run his Python script that generates five sinograms every 2 and a half days.

Milestone 3 (Task 2)

Develop a new machine learning model to classify the generated sinograms

- Although we do not have all of our data generated as of now, we will still continue to create a new machine-learning model that accomplishes our goal of classifying and reconstructing the sinograms.
- All three of our members will be contributing to this task.

Milestone 3 (Task 3)

Train and tune the PyTorch AED model to start classifying the sinograms based on the data we have currently

- To get around our issue of having a lack of data, we will mainly experiment with few-shot learning methods in the beginning using modified forms of AED models that already exist in the lab.
- As we acquire more data, we will be able to switch to a standard train/test procedure.

Milestone 3 (Task 4)

Figure out how to run OpenGate on a multithreading program

- In order to meet our deadline of producing 1000 sinograms, we will need to up the production process by using multiple cores or cloud computing resources.
- However, we will need to find out how to run OpenGATE from whatever servers we plan to use for the generation process.

Questions?