

Cardiac Reconstruction From Low-dosage SPECT Scans via Deep Learning

Test Plan

Team Members: Timothy Shane (tshane2022@my.fit.edu), Evan Gunderson (egunderson2022@my.fit.edu), Alexander Thomas (thomasa2022@my.fit.edu)

Faculty Advisor/Client: Dr. Debasis Mitra

Florida Institute of Technology

29 September 2025

1. Introduction

1.1. Purpose

The purpose of this document is to provide all tests that are to be run on the developed software for this senior design project.

2. Low Dose Sinogram Generation Tests

2.1. Verify dimensions of final sinogram are as should be (128x128x120)

Implementation:

Extract the dims field of the .mhd file using python and compare to The fixed dimensions for data generation (128x128x120) in this version

2.2. Generation should pass through each source XCAT in the inputs folder running 5 simulations for each initial XCAT

Implementation:

Verify that there are 5 times as many sinograms as XCAT files that went through the simulation

2.3. Produced sinograms should be stored per camera and then recombined labeled by date in their respective output folder

Implementation:

Verify existence using filenames according to the naming convention with the .raw extension after the simulation finished a run, then run the recombination script, then verify the existence of the output folder, then verify the existence of combined file using the naming convention

2.4. Ensure that the sinogram contains activity

Implementation:

Pixel intensity values should be non zero at some point in the sinogram

2.5. Sinograms should be visually inspected for quality

Implementation:

Target organs should be able to be accurately visually identified from the sinogram by someone who has some familiarity with the technology

3. Sub/super Resolution Tests

- 3.1. Sinograms can be augmented to take 1/4th resolution
Implementation:
Verify four sinograms are produced from every sinogram output by the simulation, then visually verify the contents of the sinograms to see the resolution
- 3.2. The stored sub resolution sinogram should be the same dimensionality as the source sinogram
Implementation:
Read the contents of the .mhd files for both sinograms and compare their dimension values
- 3.3. The sub resolution sinograms each take a different pixel for sub resolution from a 2x2 segment across the image
Implementation:
Compare the pixels for each sinogram to verify that no sinogram is identical to the others to ensure no replication has occurred.

4. Neural Network Tests

- 4.1. The neural network should accept a sinogram
Implementation:
The dimensions and data type of the input layer of the network should match the dimensions and data type specified in the sinogram header file
- 4.2. The neural network should output a reconstruction
Implementation:
The output layer should have dimensions that fit an XCAT and should have non zero values
- 4.3. Reconstruction should have a RMSE when compared to the ground truth of less than 0.003
Implementation:
Verify that RMSE when compared to ground truth is less than 0.03
- 4.4. Reconstruction should have a structural similarity index measure over 0.87
Implementation:
Verify that SSI is greater than 0.87
- 4.5. NN forward pass in .eval mode should run in under 0.004 second
Implementation:
Time the forward pass in .eval mode to verify that it runs in 0.004 seconds

- 4.6. When finished training the model file should be able to be loaded to resume training

Implementation:

Load model file and try resuming training

- 4.7. Target organs should be visually identifiable

Implementation:

Have team members familiar with anatomy identify the organs to verify that they can be identified