

Tomographic Medical Image Reconstruction with Deep Learning

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Claims

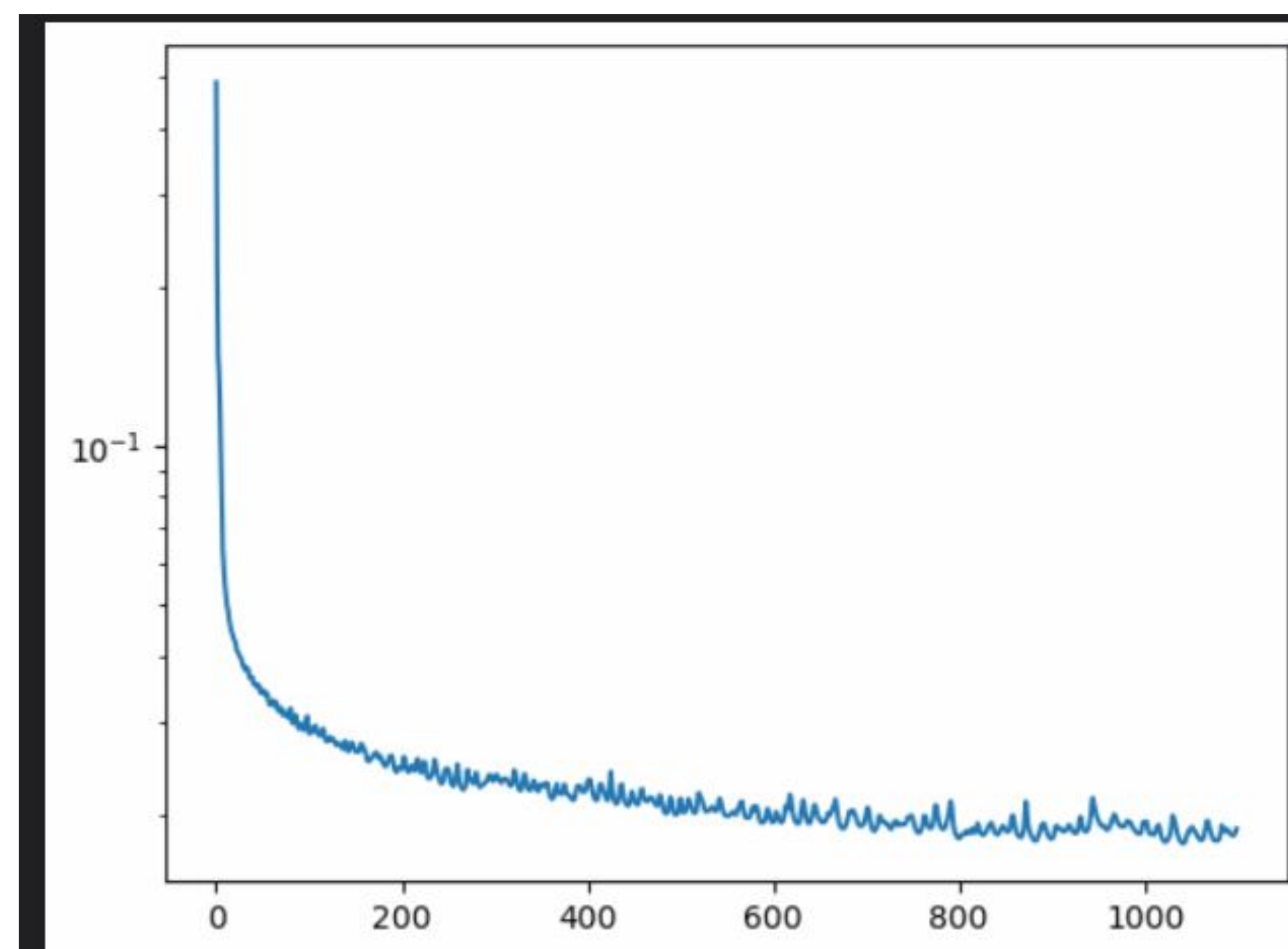
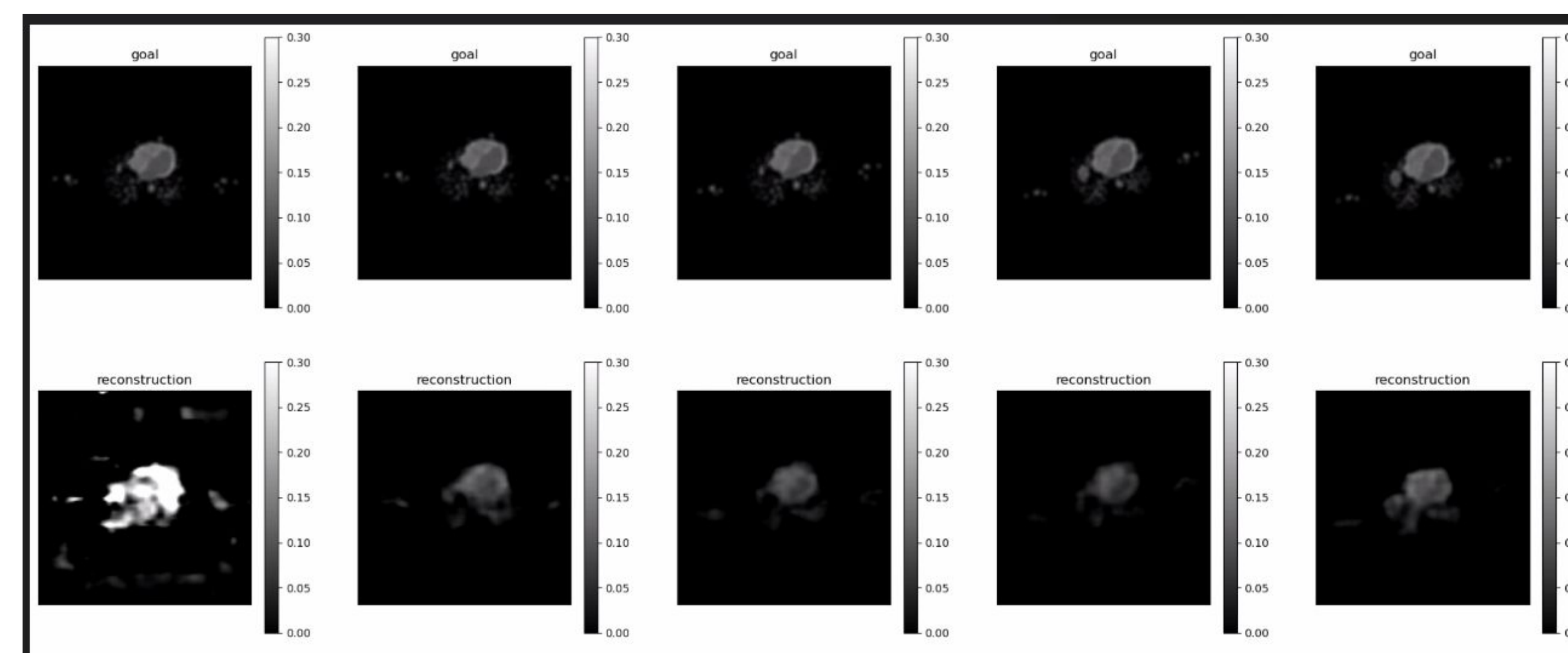
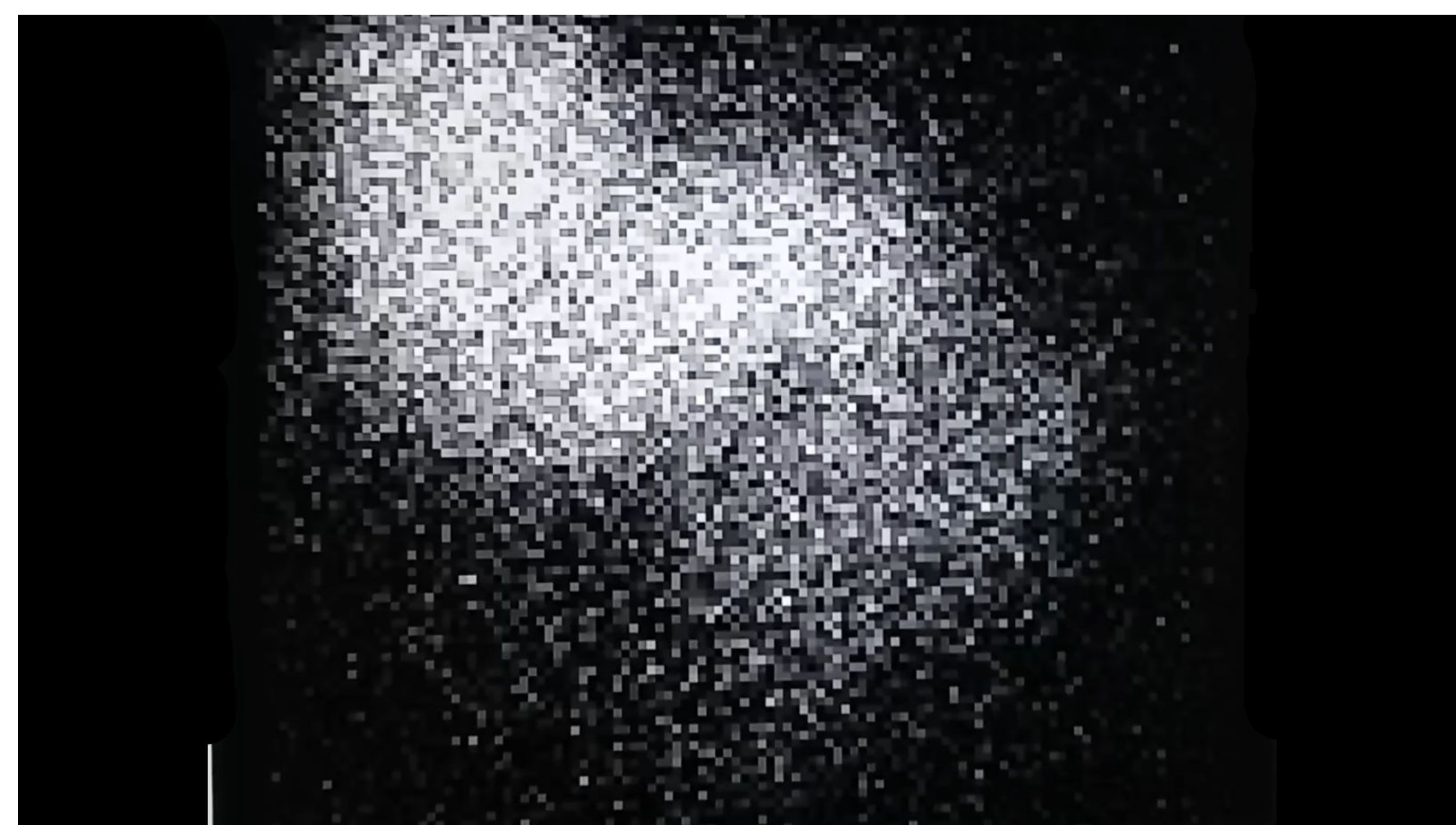
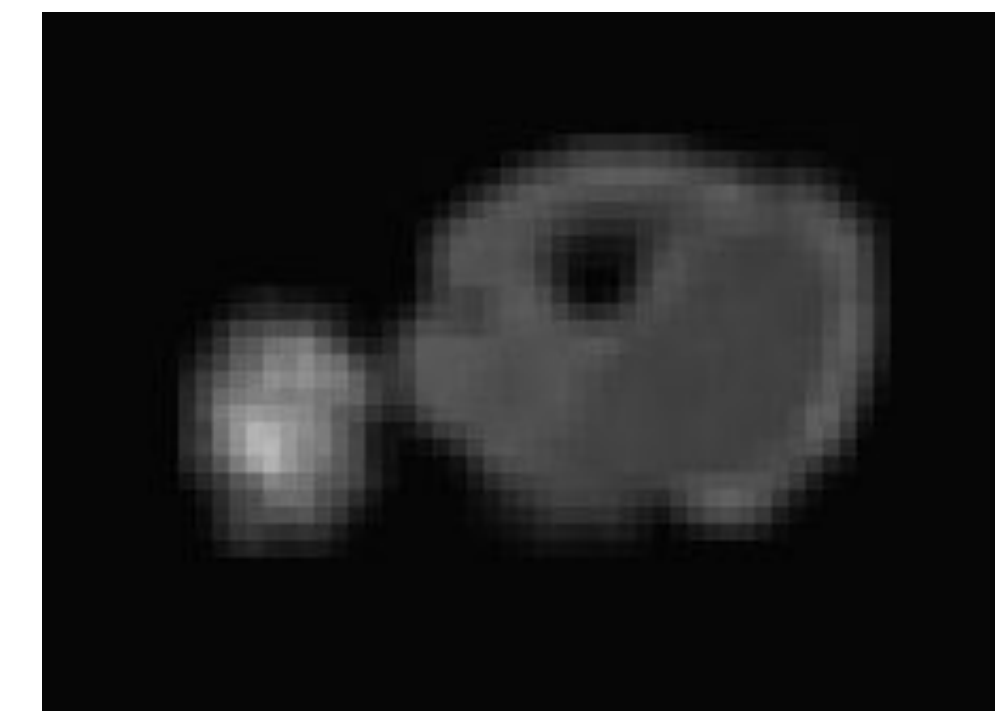
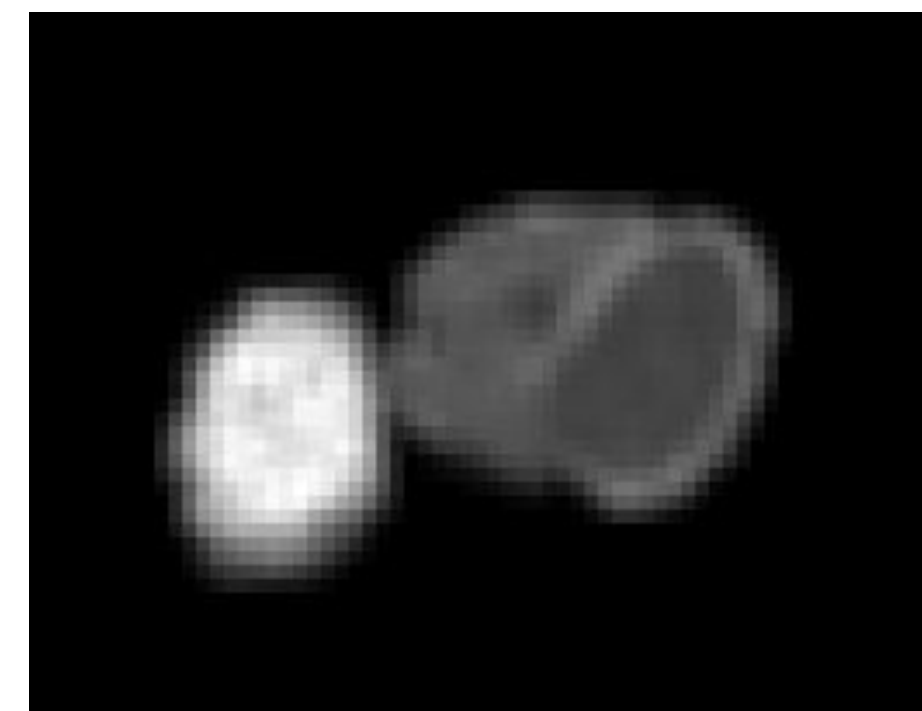
- Medical image reconstruction takes a while – about 5 minutes
- Synthetic SPECT medical data is hard to find
- Our project addresses these issues:
 - Generates large amounts of synthetic SPECT data
 - Uses AI to reconstruct SPECT data in milliseconds

Tools Used

- ImageJ – 3D Image Viewer
- ITK-Snap – Image Segmentation Tool
- XCAT – eXtended CARDiac Torso human body phantom, created by Dr. Segars of Duke University
- XCAT+ – Synthetic SPECT images
- OpenGATE – Physics Simulator
- Convolutional Neural Network in PyTorch – AI library in Python

System Features

- Data Generator
 - Takes in parameters for a 3D human body image, and statistics from real patient data
 - Outputs the following:
 - 3D human body image (XCAT phantom)
 - Realistic SPECT 3D medical image (XCAT+ phantom)
 - Synthetic raw 3D SPECT data (Artificial sinogram)
- Reconstruction AI
 - Trained on XCAT+ phantom and raw 3D SPECT data from Data Generator
 - Learned to reconstruct artificial SPECT data
 - Experiments with real data



Implementation

- Data generator was largely written in Python
 - Fully automated modular design to call shell commands and other Python programs
- AI was coded with PyTorch, and tested/trained in AI Panther (high-performance computing cluster at FIT)
 - AI details go here
- Both were modified/refactored from existing code in the lab

Evaluation

- How does our data look?
 - Input data: 128x128x120 angles
 - Output data: 128x128x64 3D image
- Does the AI work?
 - AI can reconstruct synthetic data with 98% accuracy.
 - Unfortunately, reconstruction similarity on real data is only 60%.

Limitations and Future Work

- Currently, our training is on one GPU which limits how fast we can train. The next group will introduce distributed training to speed up times
- The next group will also try to increase accuracy on real data..

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