CycleGAN for MR-CT Synthesis Project

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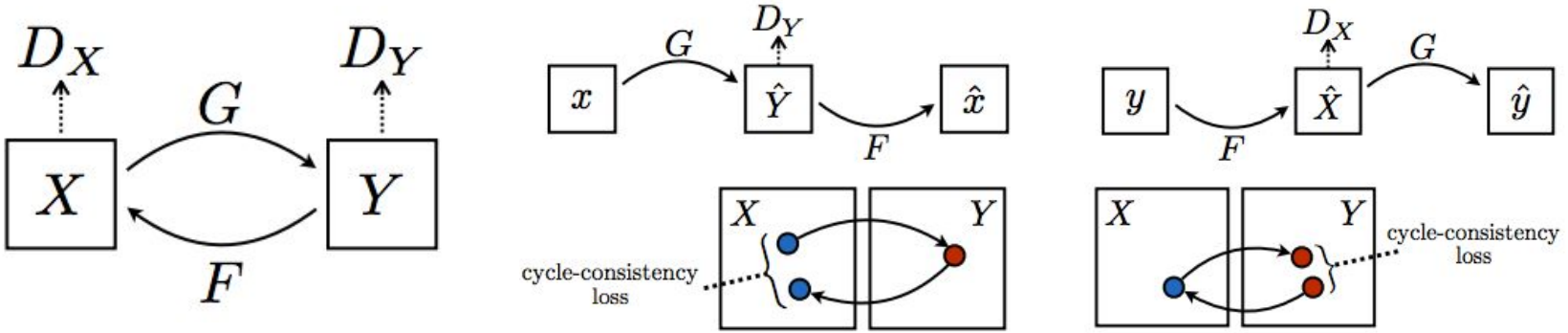
CycleGAN Implements Unpaired Image-to-Image Translation

Generator $G : X \rightarrow Y$, associated discriminator D_Y
Generator $F : Y \rightarrow X$, associated discriminator D_X

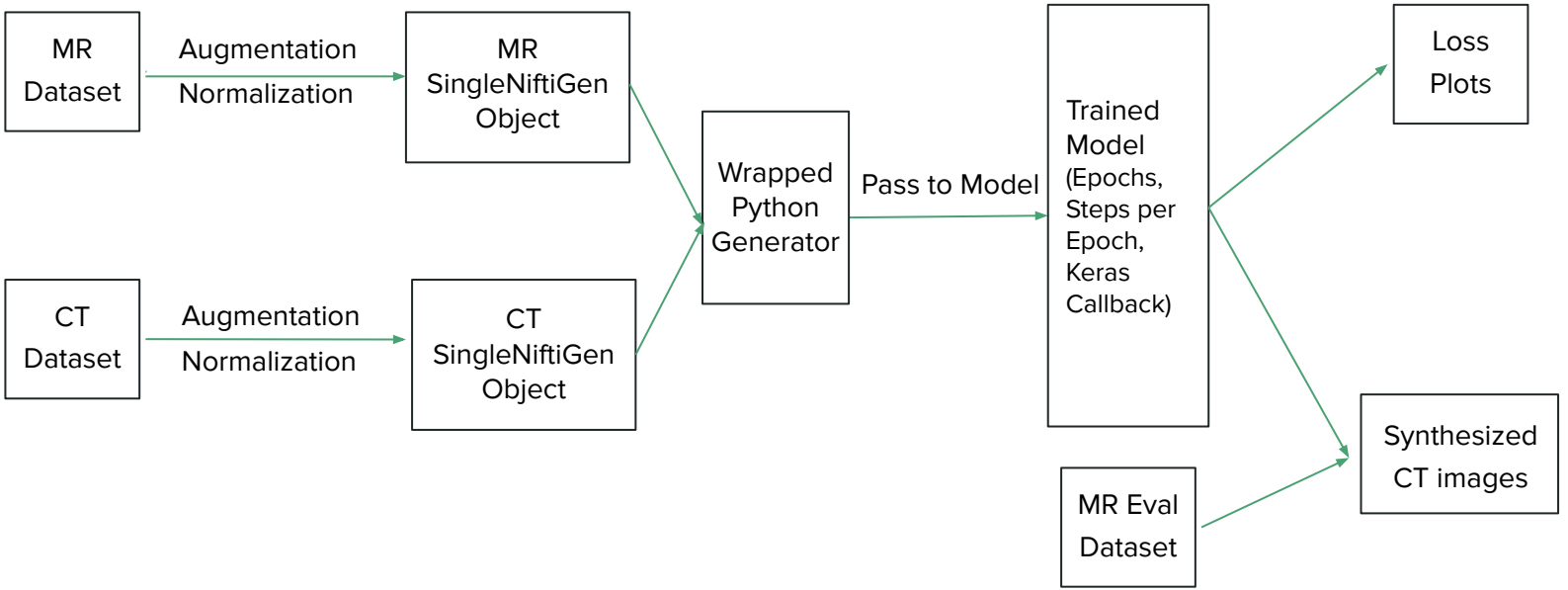


Challenge & Motivation for the Project

- CycleGAN has proven effective for MR -> CT synthesis for small datasets
- This project intends to implement CycleGAN with 10,000+ patient's worth of data
  - Several different scan types
- Unique challenges with such a large dataset

Keras Implementation

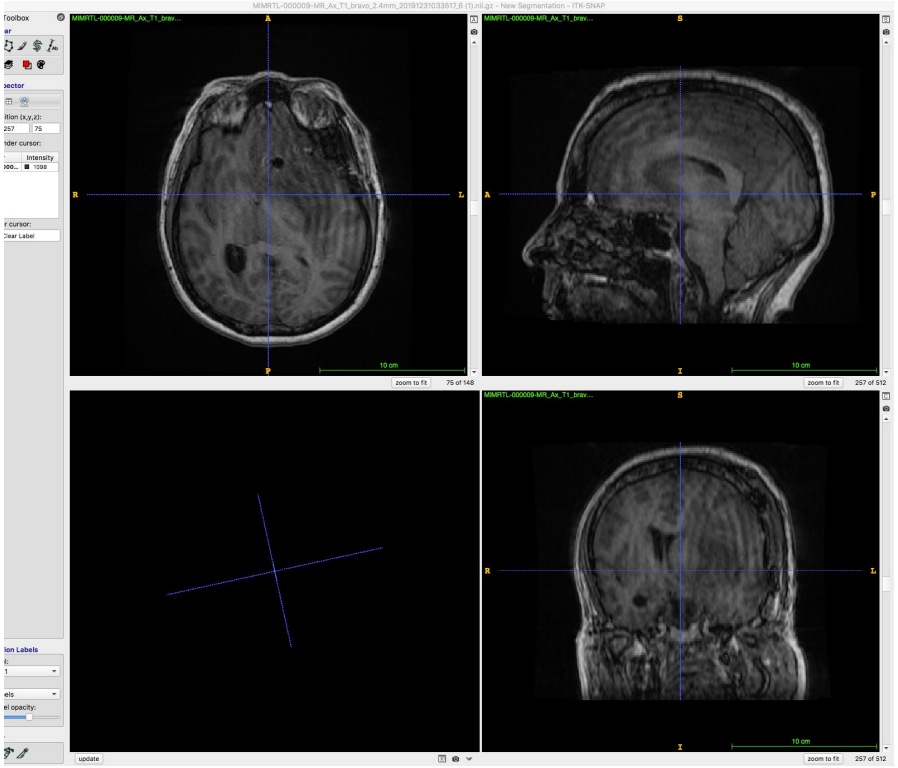
- Network architecture from: https://keras.io/examples/generative/cyclegan/
- Block diagram for model

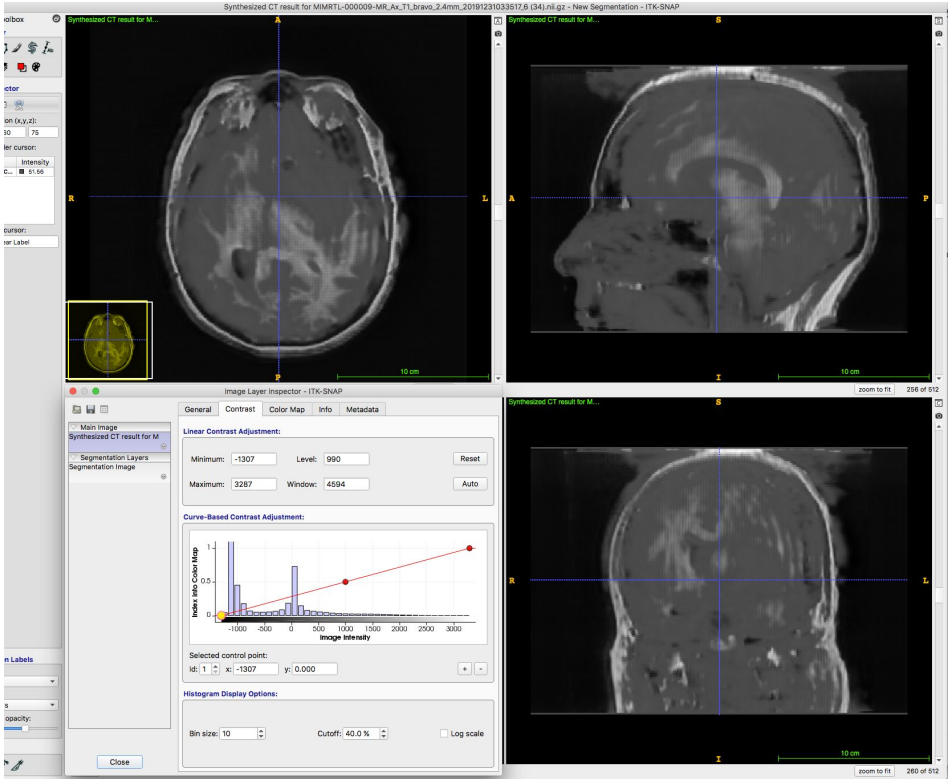


Results with Unpaired Data

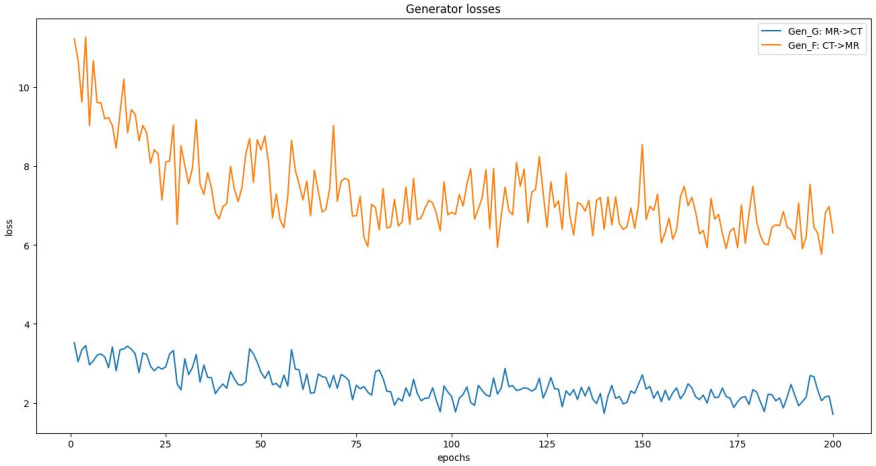
- Input data: 455 images each of CT and MR from t1_bravo scan type (subset of entire available dataset)
- Evaluation data: 5 t1_bravo MR images
- Augmentation: flips, rotations, scalings, shears, translations
- Normalization: offset and scale for correct HU for CT
- 200 epochs, 256 steps per epoch
- Somewhat varying voxel sizes across training images

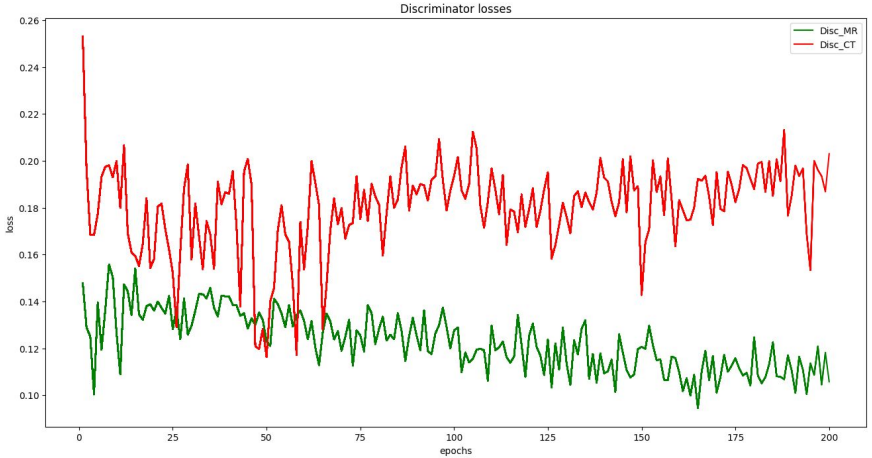
Results with Unpaired Data





Results with Unpaired Data

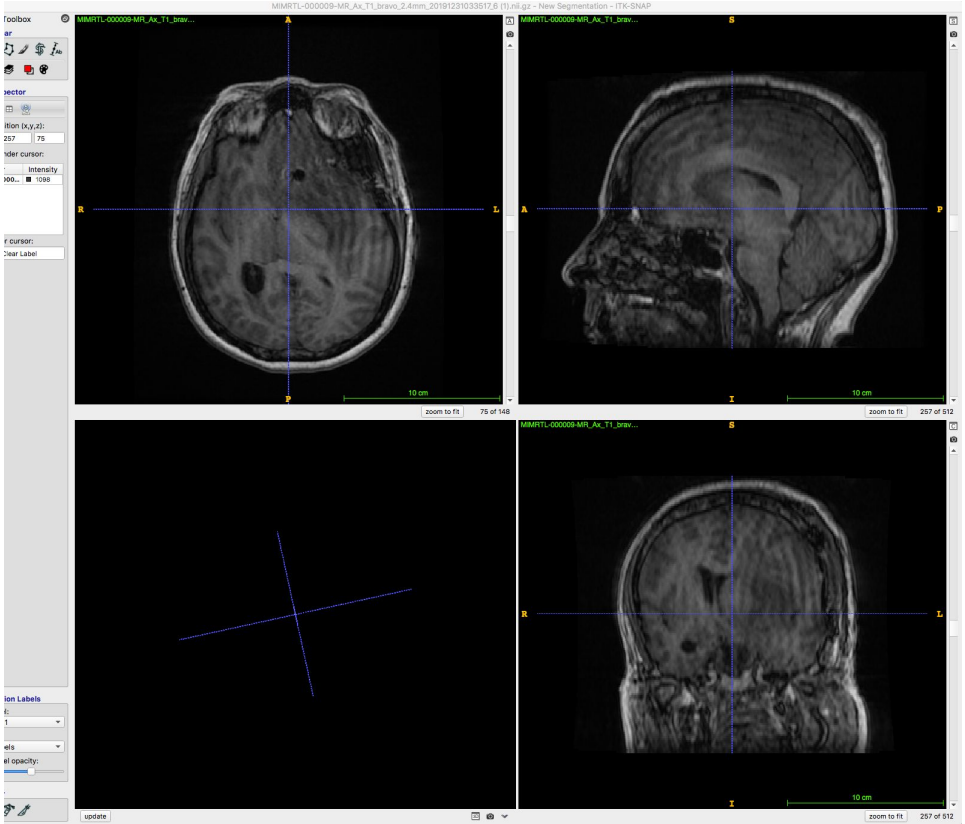


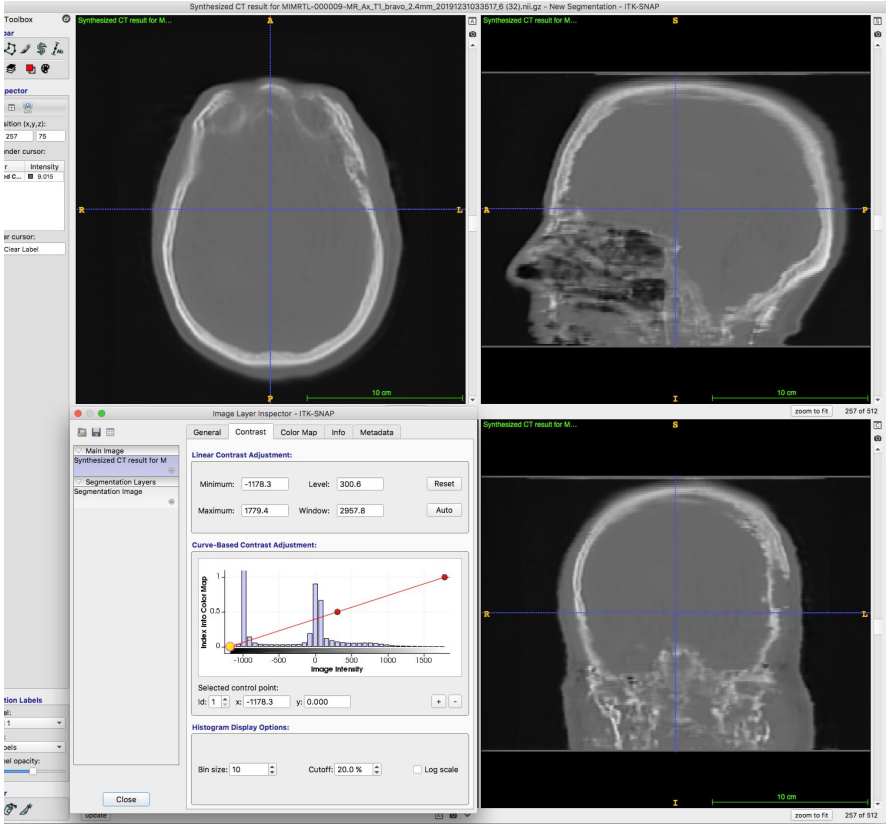


Sanity Check -- Results with Paired Data

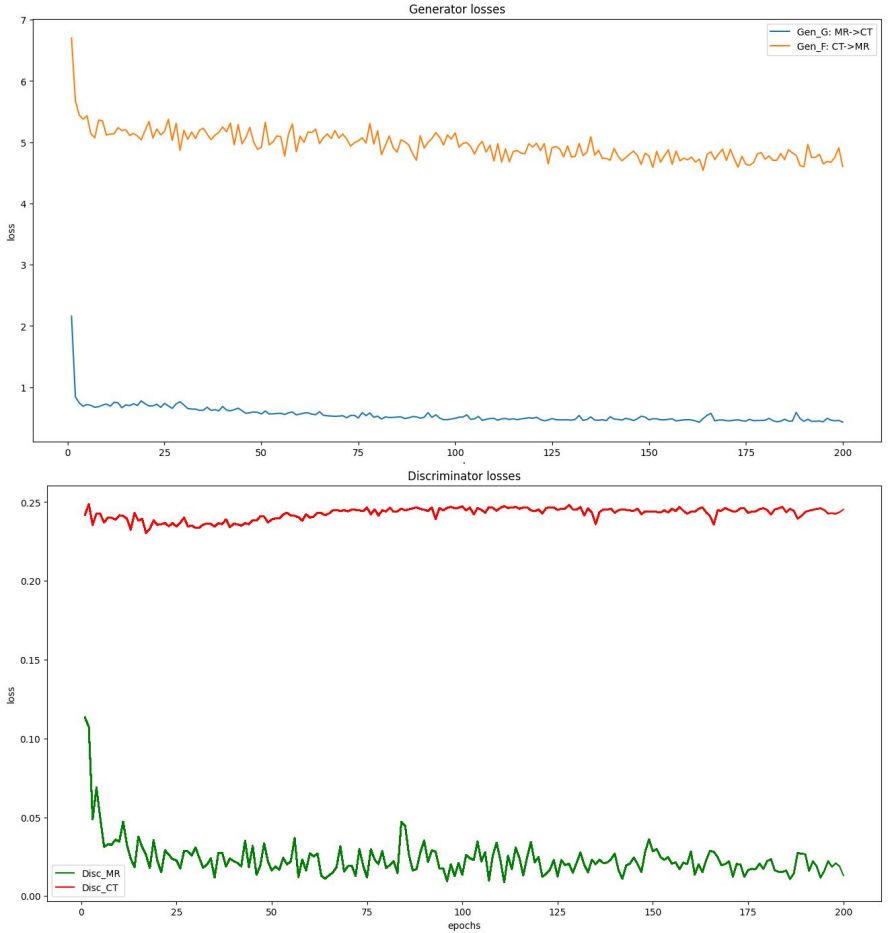
- Input data: 43 registered images each of CT and MR
- Evaluation data: 5 t1_bravo MR images
- Augmentation: flips, rotations, scalings, shears, translations
- Normalization: offset and scale for correct HU for CT
- 200 epochs, 256 steps per epoch

Sanity Check -- Results with Paired Data





Sanity Check -- Results with Paired Data



Discussion

- Registered/paired data vs. unregistered/unpaired data
- Voxel size normalization -- no success so far
  - Requires resampling: loss of data possibly detrimental to training
- Future directions towards understanding the dataset...

Thank you!