A GREAT AND IMPORTANT CHALLENGE: THE SYNTHESIS OF THE MEDICAL IMAGE

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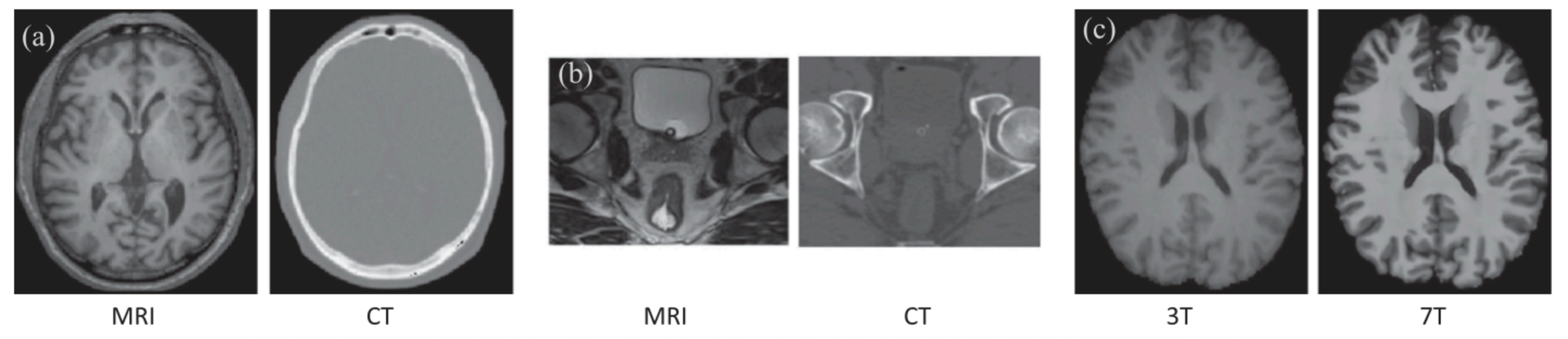
ABSTRACT

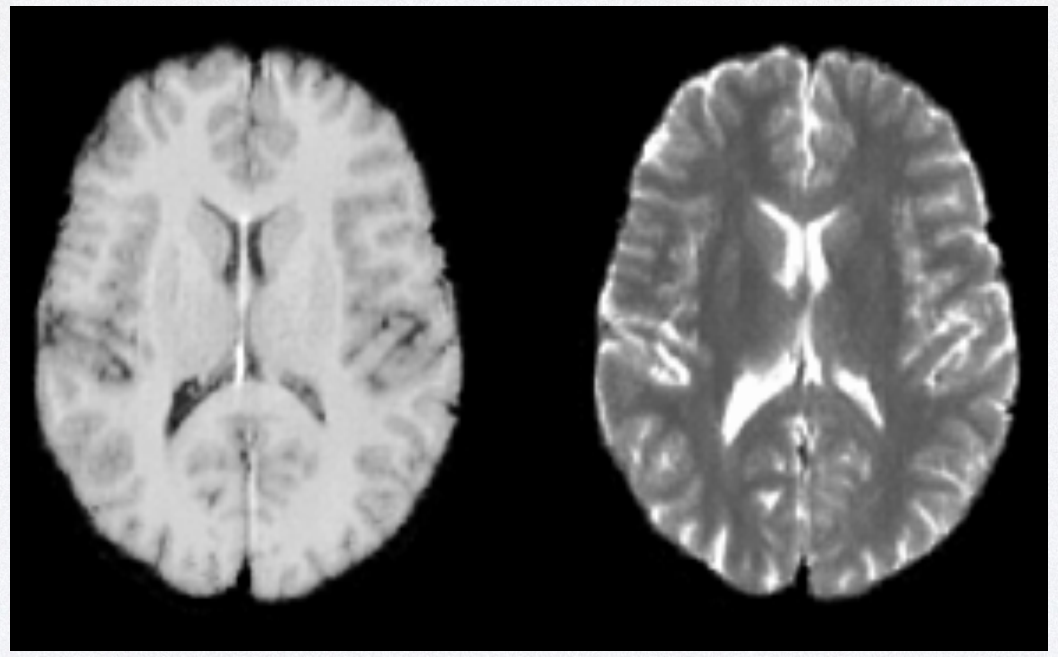
Our work is based on an article by Dong Nie et al. entitled "Medical Image Synthesis with Deep Convolutional Adversarial Networks" which deals with the use of a Generative Adversarial Network (GAN) for the synthesis of medical images from MRI. In particular, the above-mentioned network was trained using the BraTS'20 dataset, i.e. Multimodal Brain Tumor Segmentation Challenge 2020. Specifically, we used T1ce (Contrast Enhanced) and T2 images to perform T2 image synthesis from T1ce images.

SUMMARY

- Introduction to medical imaging and work purposes
- Dataset choice and its principles
- Network architecture
    - Supervised deep convolutional adversarial network
    - Loss functions
    - Auto-Context Model for refinement
- Experiments and results
- Final comparisons

INTRODUCTION TO MEDICAL IMAGING AND WORK PURPOSES



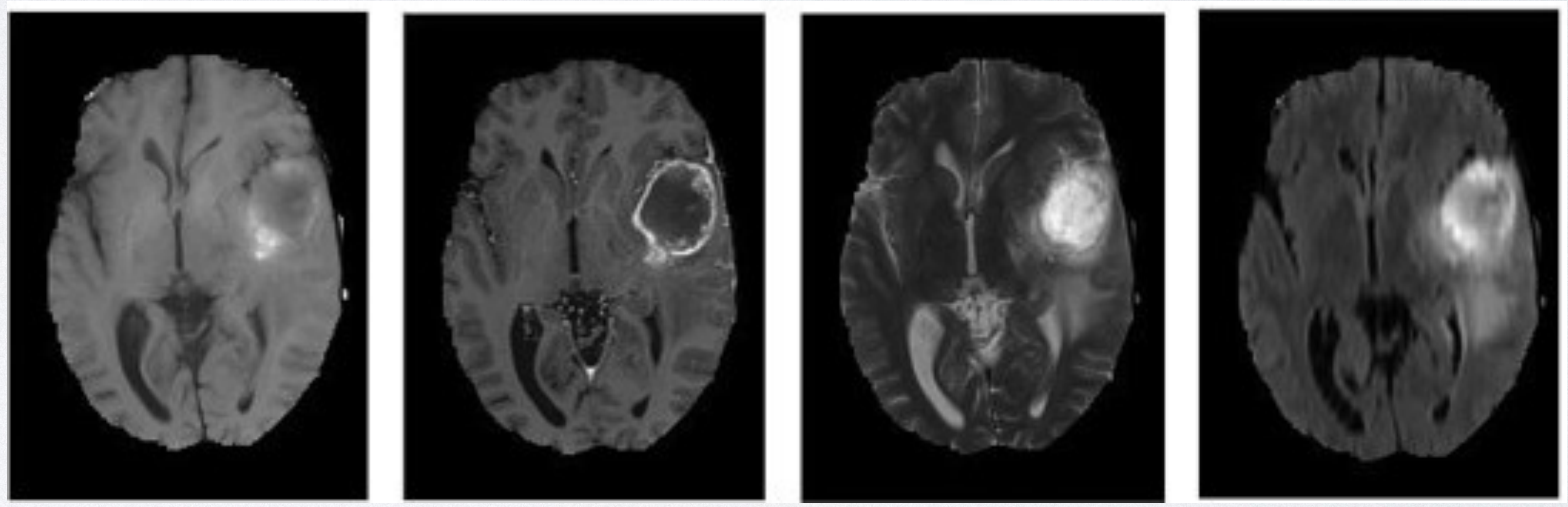


T1ce → T2

DATASET CHOICE AND ITS PRINCIPLES

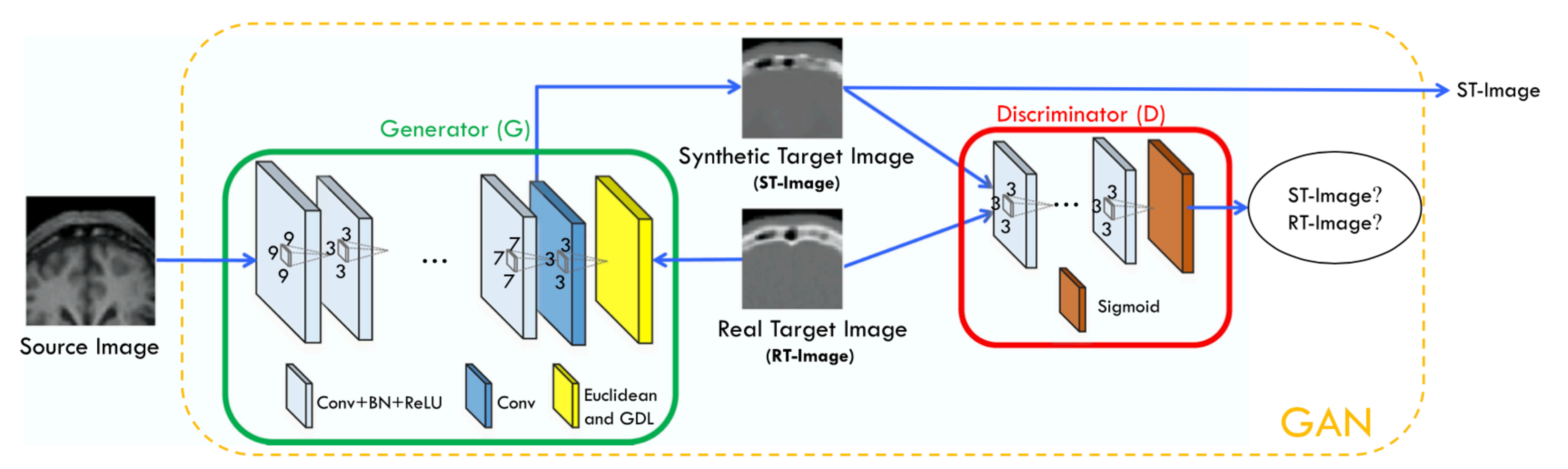
BraTS

MICCAI 2020 Lima PERU

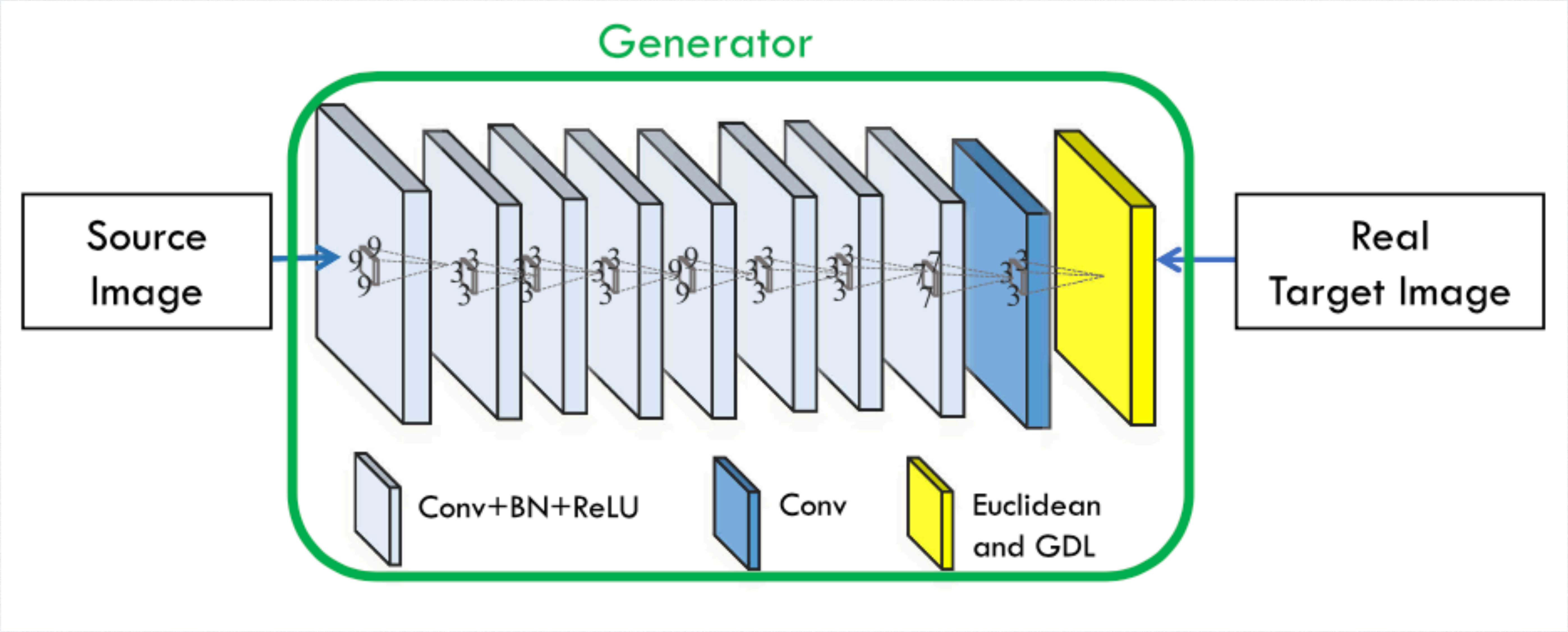


T1 T1ce T2 FLAIR

NETWORK ARCHITECTURE



SUPERVISED DEEP CONVOLUTIONAL ADVERSARIAL NETWORK

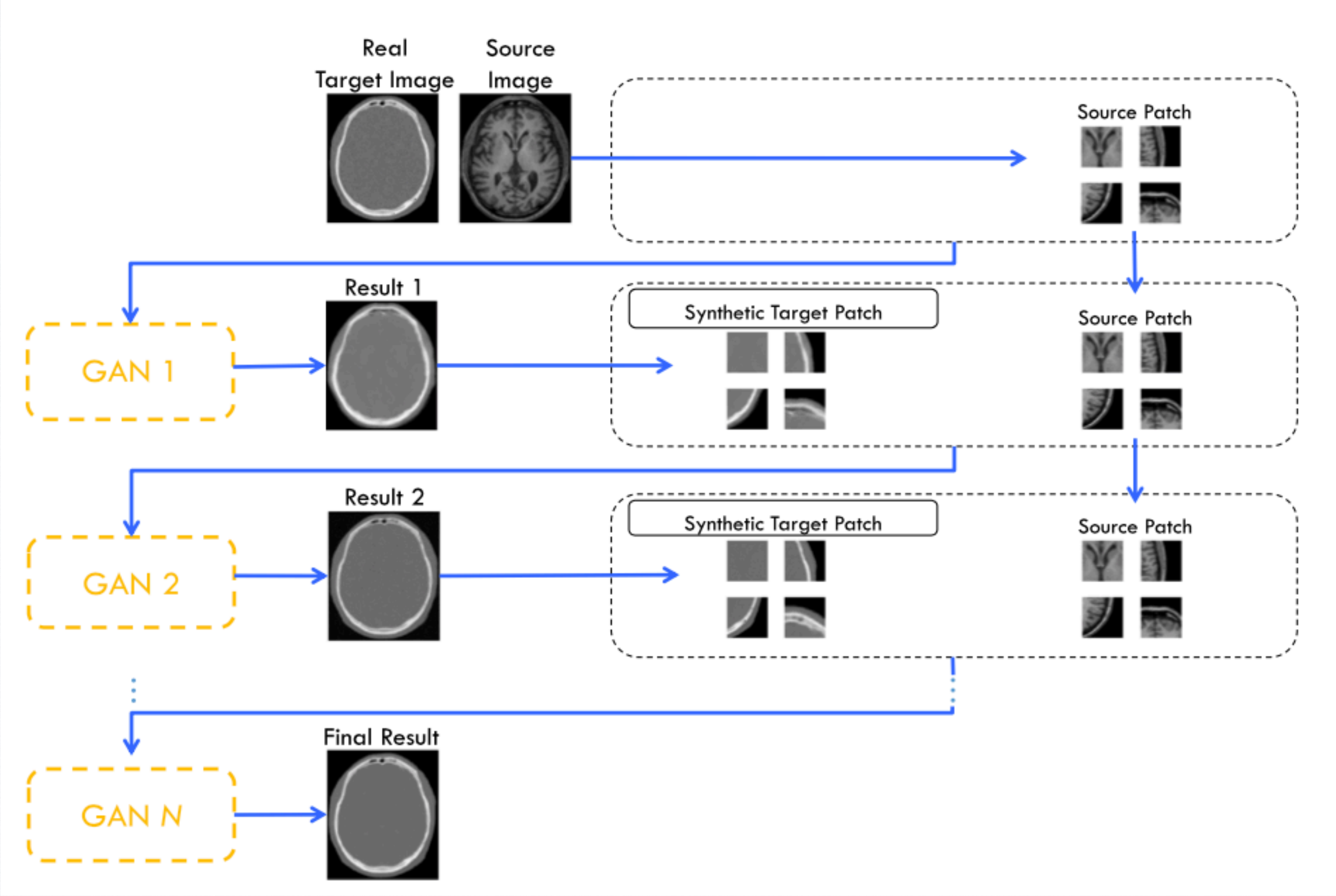


LOSS FUNCTIONS

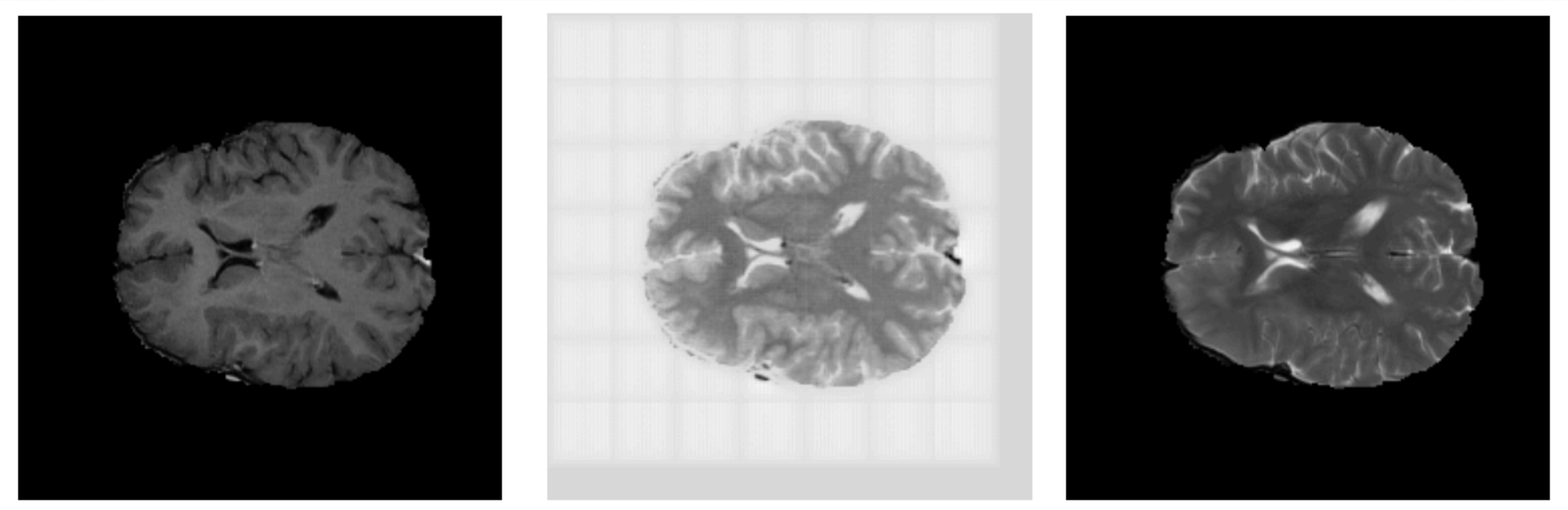
- Euclidean loss to train the model: $L_G(X, Y) = ||Y - G(X)||_2^2$
- Loss function for D and G: $L_D(X, Y) = L_{BCE}(D(Y), 1) + L_{BCE}(D(G(X)), 0)$
- Binary Cross Entropy: $L_{BCE}(\hat{Y}, Y) = -\sum_i Y_i log(\hat{Y}_i) + (1 - Y_i) log(1 - \hat{Y}_i)$
- Loss term to train G: $L_{G\_ADV} = \lambda_1 L_{ADV}(X) + \lambda_2 L_G(X, Y) + \lambda_3 L_{GDL}(Y, G(X))$
- Loss function to fool D: $L_{ADV}(X) = L_{BCE}(D(G(X)), 1)$
- Image Gradient Difference loss:

$$L_{GDL}(Y, \hat{Y}) = \left| |\nabla Y_x| - \left|\nabla \hat{Y}_x\right| \right|^2 + \left| |\nabla Y_y| - \left|\nabla \hat{Y}_y\right| \right|^2 + \left| |\nabla Y_z| - \left|\nabla \hat{Y}_z\right| \right|^2$$

AUTO-CONTEXT MODEL FOR REFINMENT



EXPERIMENTS AND RESULTS



T1ce T2 predicted T2 ground-truth

FINAL COMPARISONS

- Different datasets
- Different tasks
- No use of residual learning