

## Stable training of noise-to-image GANs using an image-to-image GAN as initialization

Generative adversarial networks (GANs) can be trained to generate realistic synthetic images, see for example <https://thispersondoesnotexist.com>. A GAN consists of a generator, which generates images, and a discriminator, which discriminates if a given image is real or fake. Both the generator and the discriminator are convolutional neural networks. GANs can broadly be divided into noise-to-image GANs (Karras et al., 2017), which are trained to convert a noise vector into a realistic image, and image-to-image GANs, which are trained to convert one type of image into another type of image (e.g. winter images to summer images). Noise-to-image GANs are generally harder to train, compared to image-to-image GANs, since finding a mapping from a noise vector to a low-dimensional manifold of realistic images is a very hard problem. In medical imaging, the number of training images is also rather limited, compared to the field of computer vision. However, several types of images from each subject are often available in medical imaging. Since image-to-image GANs, e.g. CycleGAN (Zhu et al., 2017), are easier to train, an idea is to first train a CycleGAN to convert between two types of medical images (e.g. T1- and T2-weighted MR images, see Figure 1), and then use the obtained generator weights as a starting point for training a noise-to-image GAN to generate completely new T1-weighted MR images.

### Project objectives

Investigate if first training an image-to-image GAN can serve as a good starting point for training a noise-to-image GAN, instead of training a noise-to-image GAN from scratch

Investigate if the proposed training approach works well both in 2D and in 3D

### Requirements

Courses in machine learning, especially convolutional neural networks

Course in Python programming

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### References

Karras, T., Aila, T., Laine, S. and Lehtinen, J., 2017. Progressive growing of GANs for improved quality, stability, and variation. *arXiv preprint arXiv:1710.10196*.

Zhu, J.Y., Park, T., Isola, P. and Efros, A.A., 2017. Unpaired image-to-image translation using cycle-consistent adversarial networks. In *Proceedings of the IEEE international conference on computer vision* (pp. 2223-2232).

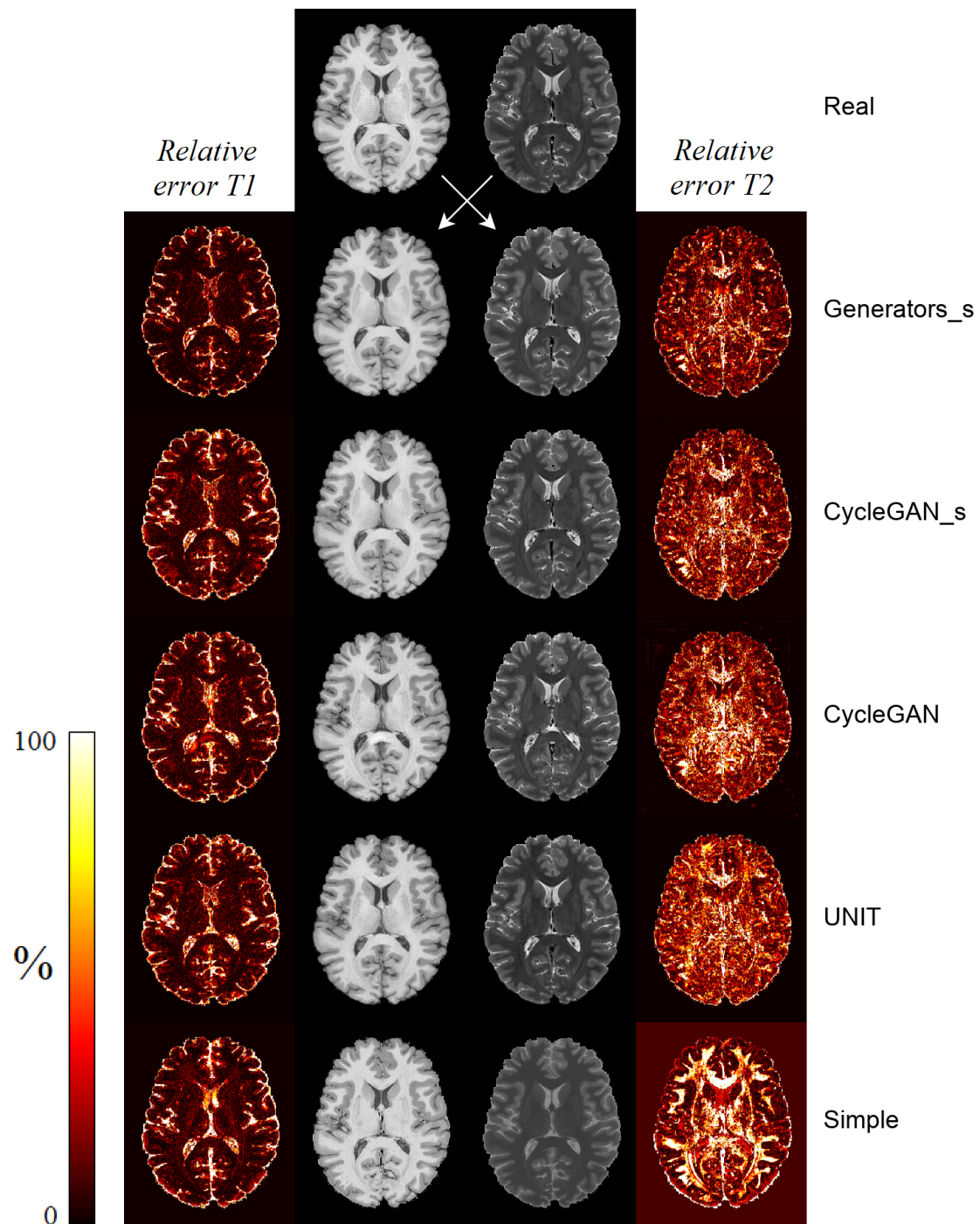


Figure 1. Comparison of different image-to-image GANs for converting between T1- and T2-weighted MR images. Can the T2-to-T1 generator in a trained CycleGAN be a good starting point for training a noise-to-image GAN to synthesize completely new T1-weighted images?