

# Denoising low dose Cone Beam CT image using GAN

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Code : <https://github.com/myosoo/DenoisingGAN>

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## 1 Introduction

### 1.1 Idea

CNN will be affected by the Architecture of Network when it gets complicated results. There are also limitations that can not increase the depth of the layer too much to get good results. Therefore, I try to solve this by using a generative adversarial network for noise images. The main concept of image denoising with GAN(Generative Adversarial Network) is as follows. Its aimed to make a generator network to denoise images by generating a noise free image while competing a discriminator on a ground truth reference to improve the generated image. Generator is the same as the existing method. The Generator uses the CNN framework, And this directly learn an end-to-end mapping from input noisy image to its corresponding ground truth. The discriminator compares this generated image with groundtruth to determine whether it is real or fake. Through this cycle the generator will grow further. Therefore, we can expect to obtain high quality denoised images.

### 1.2 Method

In this project, I used open source code at github. They are built a GAN based on ResNet structure. ResNet are the state of the art convolutional for very deep CNN. So they used skip connections and batch normalization for training time. In this experiment, arbitrary gaussian noise of different standard deviation was added to the training image. The training set consists of a total of 1000 gaussian noise images and the test set(my own images) is 6 images. These 6 test images are randomly selected from a total of 422 images of one person. And then, I added Gaussian noise of standard deviation of 0.2 to this images.

$$p_G(z) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(z-\mu)^2}{2\sigma^2}}$$

The loss function of this network is the addition of adversarial loss to existing euclidean norm and smooth loss. Adversarial Loss is for the generator to produce better output to fool the discriminator. I tried to denoising this image through the GAN. The results is as follow.

## 2 EXPERIMENT RESULTS

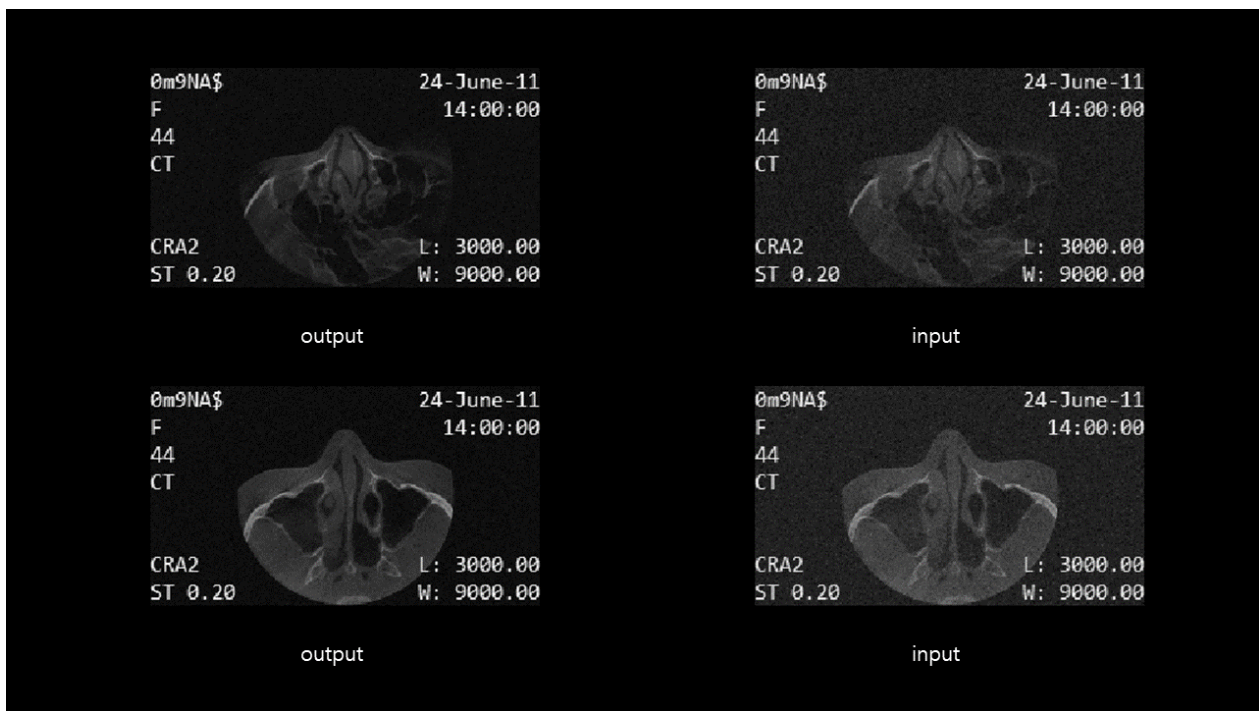


Figure 1: result1

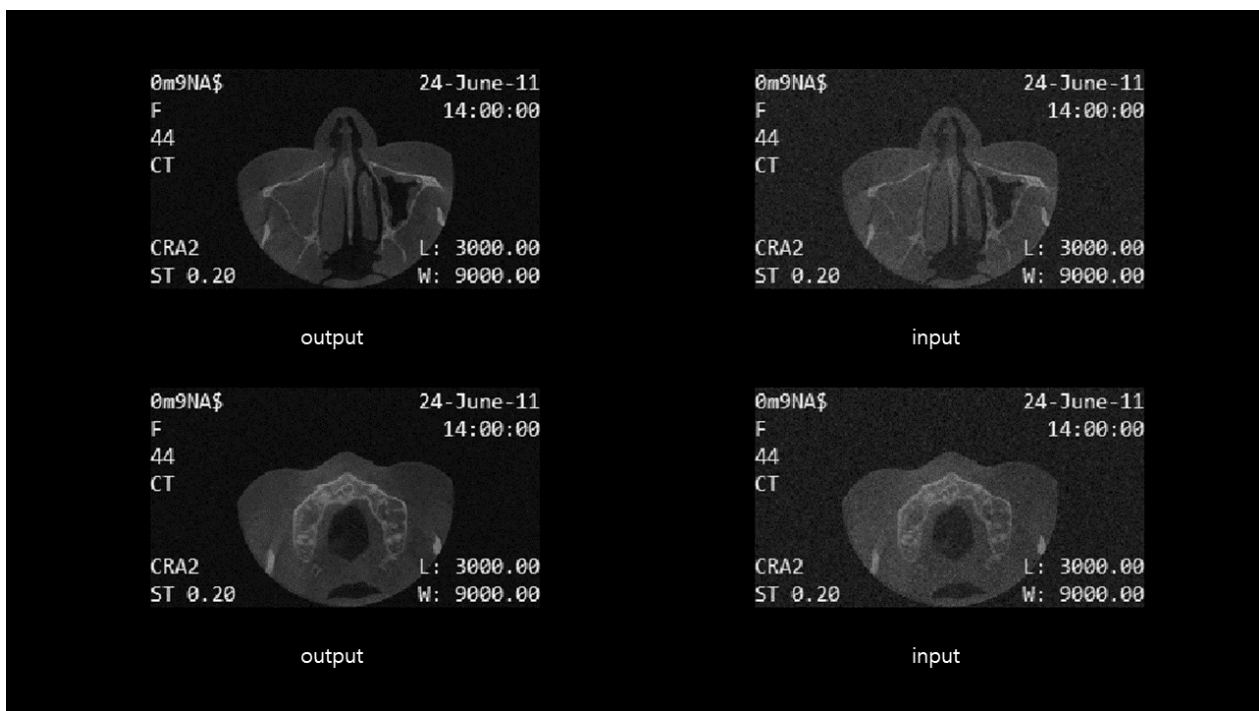


Figure 2: result2

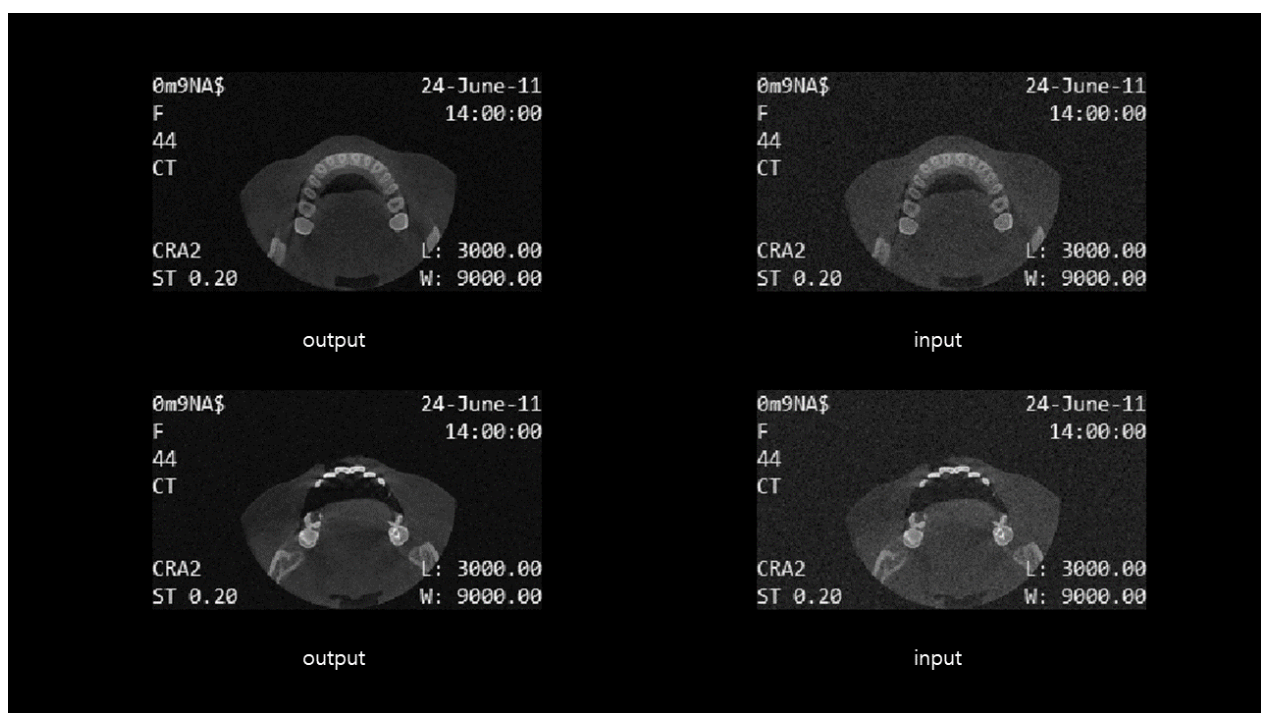


Figure 3: result3