A Study on GAN Using Capsule Network

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1. Introduction

Recently, image processing using CNN has been intensively studied. GAN (Generative Adversarial Network) [1] is one of them. There are a lot of GAN using CNN like DCGAN [2]. However, CNN has the defect that the relational information between features of the image may be lost. Capsule Network [3], proposed in 2017, overcomes the defect of CNN. Therefore, we assume that GAN using Capsule Network generates better quality images. In this study, we propose Capsule GAN, which incorporates Capsule Network into the Discriminator and the Generator of GAN.

2. Capsule Network

Capsule Network is based CNN. By changing the input of each neuron from a scalar to a vector, it can keep the relational information between features of the image [4]. Capsule Network processes an image while keeping the relational information. It outputs DigitCaps layer as the output layer. DigitCaps layer has 16 dimensions vectors that have features of the image. The number of vectors is the classification class. The length of vectors represents the probability of the classification.

3. Proposed Method

The structure of proposed Capsule GAN is shown in Fig. 1. Capsule Network is incorporated into the Discriminator like a CNN. DigitCaps layer from the discriminator is multiplied by latent variables. They are regarded as the input of the Generator.
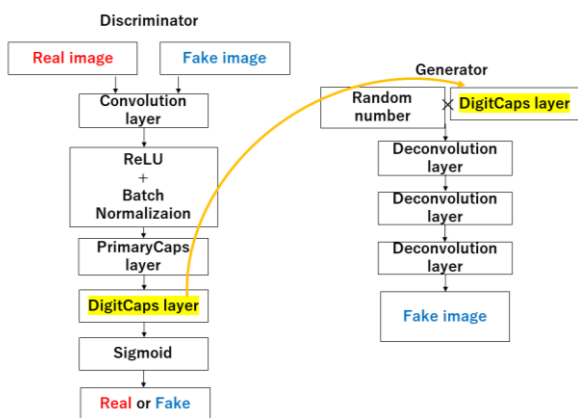

Fig. 1　A structure of Capsule GAN

4. Experiment

We conducted an experiment using 60000 images from MNIST [5]. Iteration is 50000. The result is shown in Fig. 2.

Fig. 2　Generated images

We also conducted an experiment by DCGAN and calculated Inception Score [6]. The result is shown in Tab.1. From Table 1, Inception Score of Capsule GAN is 0.05 larger than one of DCGAN.

Table 1　Inception Score

Process	Inception Score
Capsule GAN	2.37
DCGAN	2.32

5. Conclusion

In this study, Capsule GAN is proposed. By the experiment, Capsule GAN shows better performance than DCGAN.

6. References

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