Noise Robust Generative Adversarial Networks

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Background: Limitations of standard GANs

- In spite of noise, standard GANs mimic training images.

GAN: Goodfellow et al., NIPS 2014.
Proposal: Noise robust GANs (NR-GANs)

- We propose NR-GANs, which can learn a clean image generator, even when only noisy images are available for training.
Key idea I: Two-generator model

- Introduce a **two-generator model** consisting of **image** and **noise** generators

**Question:** How to generate an image and noise separately?
Key idea II: Distribution or transformation constraint

- Impose a distribution/transformation constraint on the noise generator

Distribution constraint:
\[ \epsilon \sim \mathcal{N}(0, I) \]
\[ \sigma \cdot \epsilon \sim \mathcal{N}(0, \text{diag}(\sigma)^2) \]

Transformation constraint:
\[ n = T(\hat{n}) \]
- Rotation
- Channel shuffle
- Color inversion

Reparameterization trick: Kingma & Welling, ICLR 2014.
Experiments

• Noise robust image generation

Signal-independent noise

- Additive Gaussian noise
- Brown Gaussian noise

Additive Gaussian noise
Brown Gaussian noise

Signal-dependent noise

- Multiplicative Gaussian noise
- Poisson noise

Multiplicative Gaussian noise
Poisson noise

Training images
GAN
NR-GAN

Training images
GAN
NR-GAN

• Application: Image denoising

generated noisy image

GN2GC

Generated clean image

LSUN dataset: Yu et al., 2015.
Thank you!

Our code and project page are available online.

**Code**

https://github.com/takuhirok/NR-GAN/

**Project page**

https://takuhirok.github.io/NR-GAN/