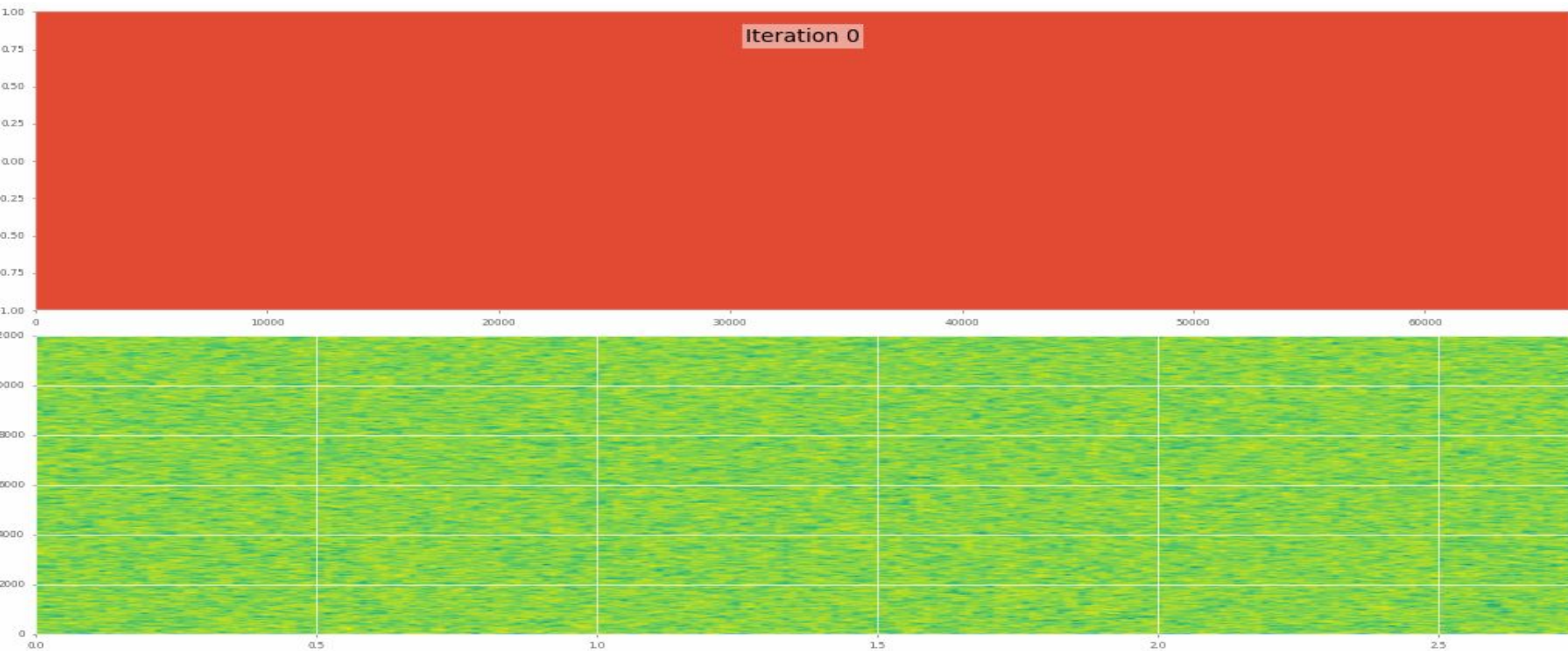Irish Setter

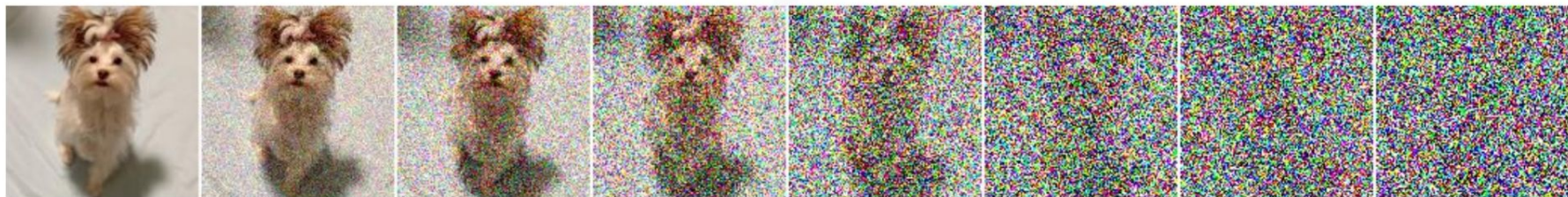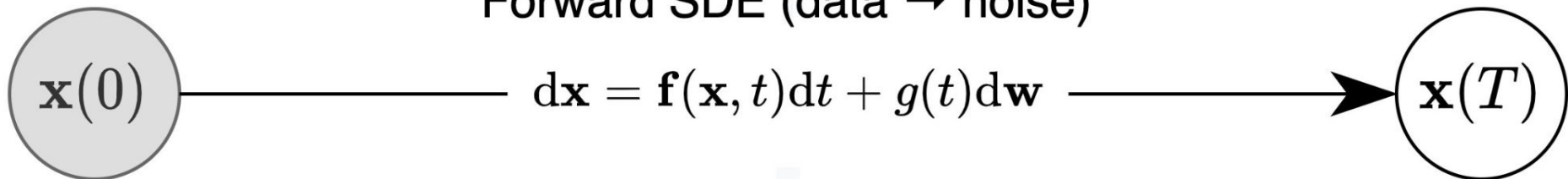# Denoising Diffusion Based Image Super resolution

Motivation for this work

How DDpm's work

Forward SDE (data → noise)

$$\mathrm{d}\mathbf{x} = \mathbf{f}(\mathbf{x}, t)\mathrm{d}t + g(t)\mathrm{d}\mathbf{w}$$

$\mathbf{x}(0)$ → $\mathbf{x}(T)$

score function

$\mathbf{x}(0)$ ← $$\mathrm{d}\mathbf{x} = \left[\mathbf{f}(\mathbf{x}, t) - g^2(t)\boxed{\nabla_{\mathbf{x}} \log p_t(\mathbf{x})}\right]\mathrm{d}t + g(t)\mathrm{d}\bar{\mathbf{w}}$$ ← $\mathbf{x}(T)$
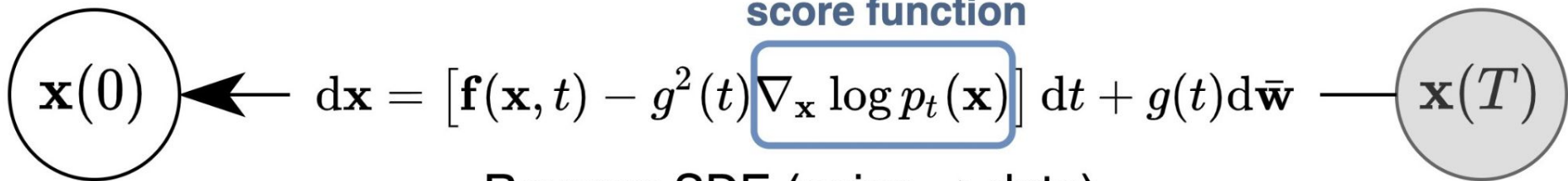
Reverse SDE (noise → data)

How DDpm's work

DDPM VS Gans

Confusion Rates on 16x16 → 128x128 face images.

- FSRGAN: 8.5%
- PULSE: 33.7%
- Regression: 15.3%
- SR3 (ours): 47.4%

Confusion Rates on 64x64 → 256x256 natural images.

- Regression: 13.4%
- SR3 (ours): 39.0%
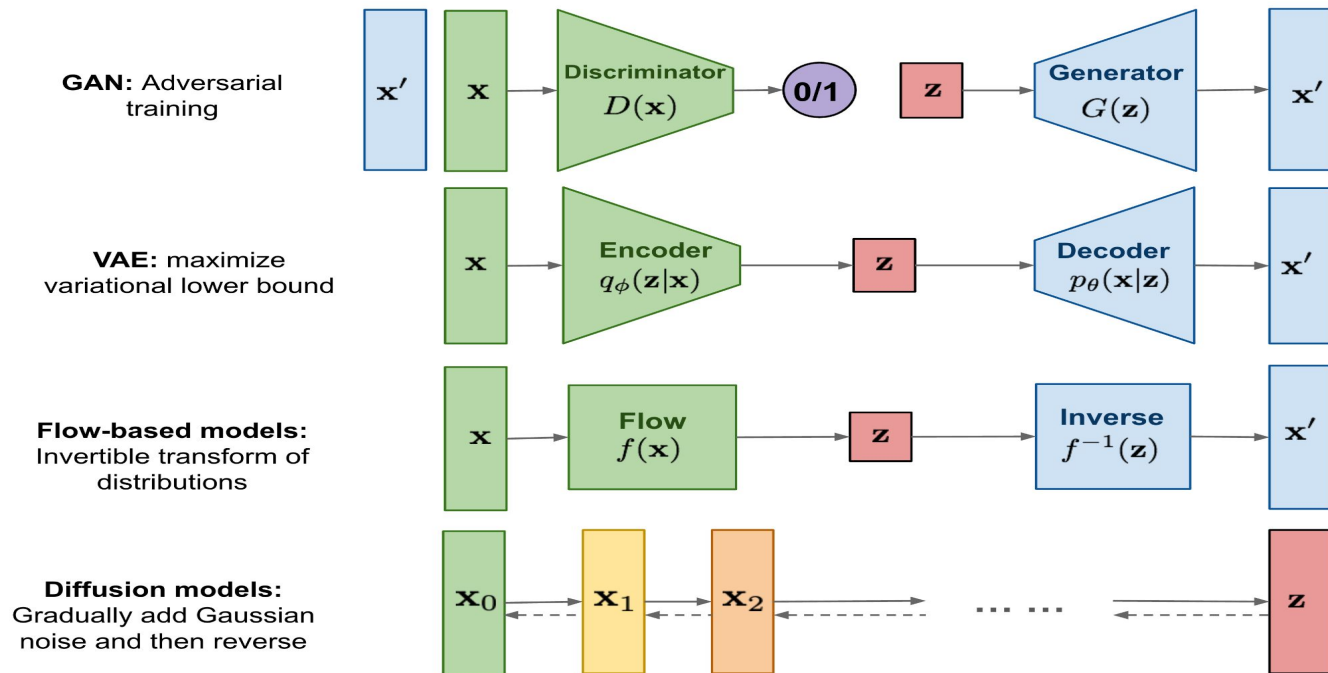
DDPM VS GANS

FID –Fréchet inception distance

Lower the better

Model	FID vs train	FID vs validation	IS
32×32 resolution			
CDM (ours)	1.11	1.99	26.01 ± 0.59
64×64 resolution			
BigGAN-deep, by (Dhariwal and Nichol, 2021)	4.06		
Improved DDPM (Nichol and Dhariwal, 2021)	2.92		
ADM (Dhariwal and Nichol, 2021)	2.07		
CDM (ours)	**1.48**	2.48	67.95 ± 1.97
128×128 resolution			
BigGAN-deep (Brock et al., 2019)	5.7		124.5
BigGAN-deep, max IS (Brock et al., 2019)	25		**253**
LOGAN (Wu et al., 2019)	**3.36**		148.2
ADM (Dhariwal and Nichol, 2021)	5.91		
CDM (ours)	3.52	3.76	128.80 ± 2.51
256×256 resolution			
BigGAN-deep (Brock et al., 2019)	6.9		171.4
BigGAN-deep, max IS (Brock et al., 2019)	27		**317**
VQ-VAE-2 (Razavi et al., 2019)	31.11		
Improved DDPM (Nichol and Dhariwal, 2021)	12.26		
SR3 (Saharia et al., 2021)	11.30		
ADM (Dhariwal and Nichol, 2021)	10.94		100.98
ADM+upsampling (Dhariwal and Nichol, 2021)	7.49		127.49
CDM (ours)	**4.88**	4.63	158.71 ± 2.26

(a) Class-conditional ImageNet sample quality results for classifier guidance-free methods

Model	Top-1 Accuracy	Top-5 Accuracy
128×128 resolution		
Real	68.82%	88.79%
BigGAN-deep (Brock et al., 2019)	40.64%	64.44%
HAM (De Fauw et al., 2019)	54.05%	77.33%
CDM (ours)	**59.84%**	**81.79%**
256×256 resolution		
Real	73.09%	91.47%
BigGAN-deep (Brock et al., 2019)	42.65%	65.92%
VQ-VAE-2 (Razavi et al., 2019)	54.83%	77.59%
CDM (ours)	**63.02%**	**84.06%**

(b) Classification Accuracy Score (CAS) results

DDPM VS GANS

FID score (256x256 resolution).

Model	FID
ADM	7.49
BigGAN-deep	6.90
CDM (ours)	4.88
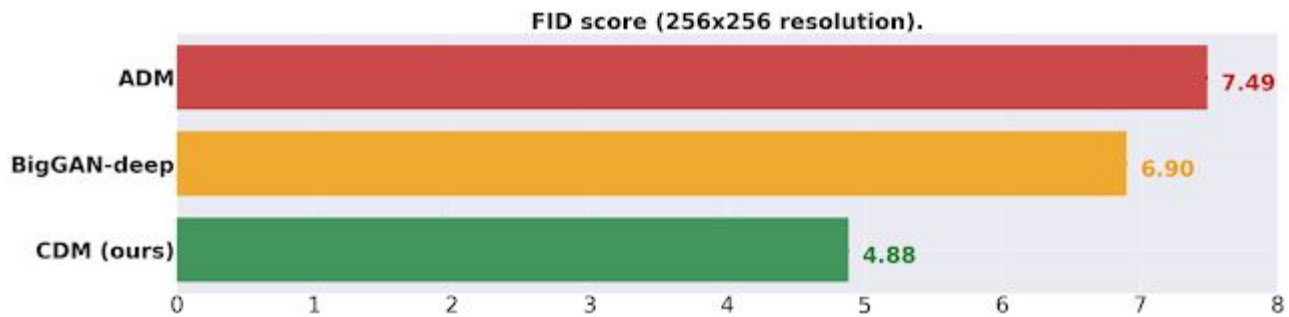
Effective Super Resolution

Slide 1. SR3

Slide 2. ESR-GAN

Slide 3. PULSE

SR3 (ours)   Reference
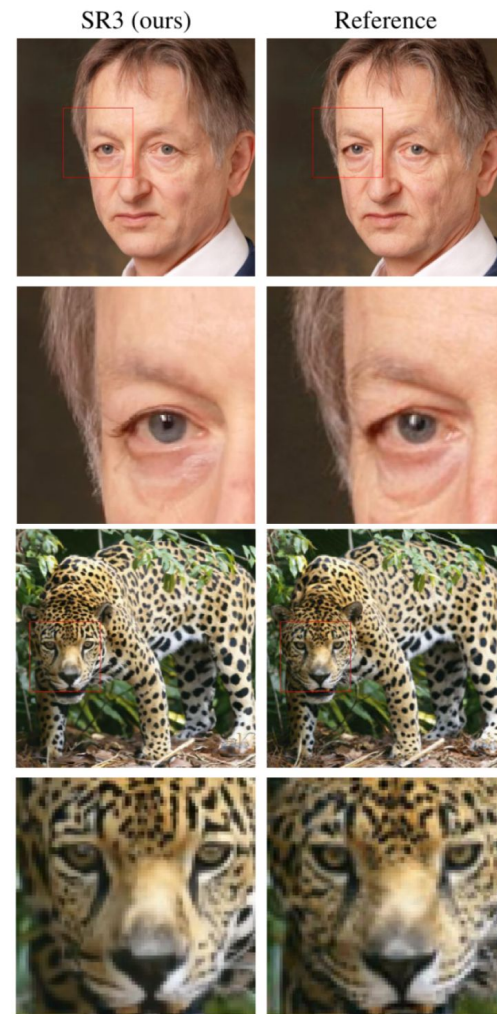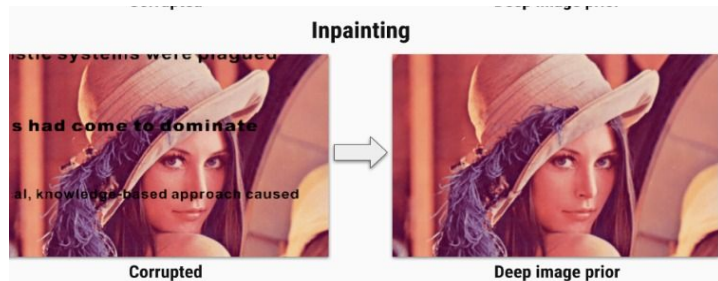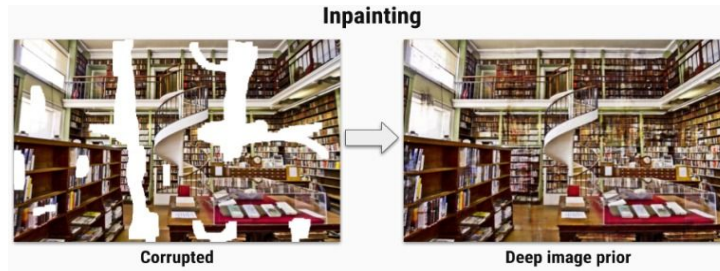
ESR-GAN : Geoffrey Hilton

PULSE : GEOFFREY HILTON

THIS RESEARCH GOING FORWARD

- Re-creating corrupted images
- DDPM ensures that the image will closely resemble the true image

Inpainting

Corrupted — Deep image prior

Inpainting

Corrupted — Deep image prior

Real world implications of this work

r/photoshop · Posted by u/seanbrockest 4 years ago

Trying to use a Super Resolution tutorial on some 360 panorama photos, but the camera doesn't map the images the same each time.

So i'm trying to create a super resolution photo from a static scene. The technique is described here.

https://petapixel.com/2015/02/21/a-practical-guide-to-creating-superresolution-photos-with-photoshop/

The purpose of this is to use these 360 panoramas in a V.R. tour. For VR, resolution is very important, but my 360 camera only outputs photos of 5660*2830. My plan is to use this super resolution trick to get a much bigger image.

The problem is the 360 camera. I set it up in my bedroom and took 14 pictures 2 seconds apart. The images are the same, but the camera processed them slightly differently every time.

https://drive.google.com/drive/folders/1DVx3GGQXk_VWeto4NcIlXcSNsFXR0305?usp=sharing

Download a few or all of these images to follow along (you only need like 3 to see what i'm meaning, but feel free to nab all 14 if your internet allows, 67 megs total)

Open them in a photo viewer that allows you to scrub left and right to switch photos. If they were uniformly off center, I could deal with that. But it's like it mapped each image in 3 zones. I'm not sure how to correct for that before I center them.

I'm about ready to scrap the project. I expect the images to have blurry areas due to the way that 360 cameras process the images, but this is a little too "random", and since the mis-alignments are "zoned" so to speak, i'm not sure how I can get them to line up (the tutorial above makes use of auto align)

Any ideas?

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New comments cannot be posted and votes cannot be cast

chain83 · 4y
Expert user 👍

I wouldn't expect a superresolution technique to fix this.

A 360-camera is indeed very practical to take 360-degree images as you can get it all done with a single click and have the camera handle the rest.

But as you have noticed you are limited by the camera resolution. And yeah, when viewing that 360 image in VR you quickly realise that you need really high resolution for a sharp result as you are really just looking at a tiny section of the total image at any time - stretched accross 110 degrees of your field of view... :(

Since you are capturing a static scene, perhaps you could use a regular camera to take the individual exposures and stitch them into the final 360x180 degree panorama. Then you could get crazy high resolution easily enough, although it would require more manual work to capture/stitch/process.

⬆ 1 ⬇   Give Award   Share   Report   Save   ⚠ Tip

References

- https://lilianweng.github.io/lil-log/2021/07/11/diffusion-models.html
- https://yang-song.github.io/blog/2021/score/
- https://iterative-refinement.github.io/ [Image Super-Resolution via Iterative Refinement]
- https://cascaded-diffusion.github.io/ [Cascaded Diffusion Models for High Fidelity Image Generation]

Thank You