

Table 1: Comparison of the FID scores of various diffusion models trained on CIFAR-10.

Diffusion space	Model	FID ( $\downarrow$ )
Gaussian	DDPM [Ho et al., 2020]	3.17
	VP-EDM [Karras et al., 2022]	1.97
Gaussian+Blurring	Soft Diffusion [Daras et al., 2023]	3.86
	Blurring Diffusion [Hogeboom and Salimans, 2023]	3.17
Deterministic	Cold Diffusion (image reconstruction) [Bansal et al., 2022]	80.08 (deblurring) 8.92 (inpainting) 152.76 (super-resolution) 31.10 (desnowification)
	Inverse Heat Dispersion [Rissanen et al., 2023]	18.96
Categorical	D3PM Gauss+Logistic [Austin et al., 2021]	7.34
	$\tau$ LDR-10 [Campbell et al., 2022]	3.74
Count	JUMP [Chen and Zhou, 2023]	4.80
Range-bounded	Beta diffusion, optimized with -ELBO	5.20
	Beta diffusion, optimized with KLUB	3.56

Table 2: Comparison of the FIDs of KLUB and negative ELBO-optimized beta diffusion on CIFAR10 across various NFEs.

NFEs	-ELBO	KLUB
50	11.37	10.15
200	5.78	4.27
500	5.25	3.88
1000	5.20	3.56



Figure 10: Uncurated randomly-generated images by beta diffusion optimized with -ELBO and KLUB using NFEs=1000.