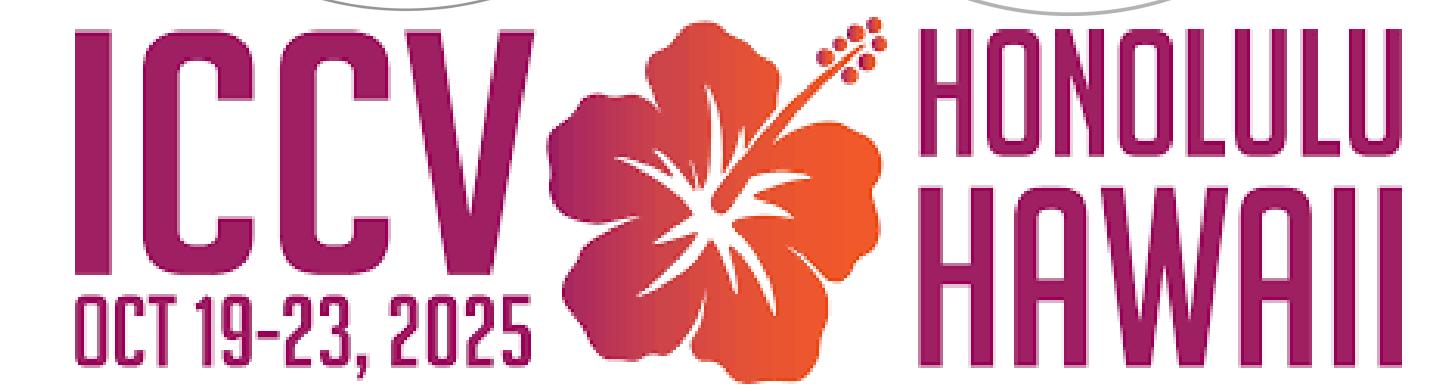


One-Step Specular Highlight Removal with Adapted Diffusion Models

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Problem & Motivation

Goal: Removing specular highlights from the surfaces of the objects.

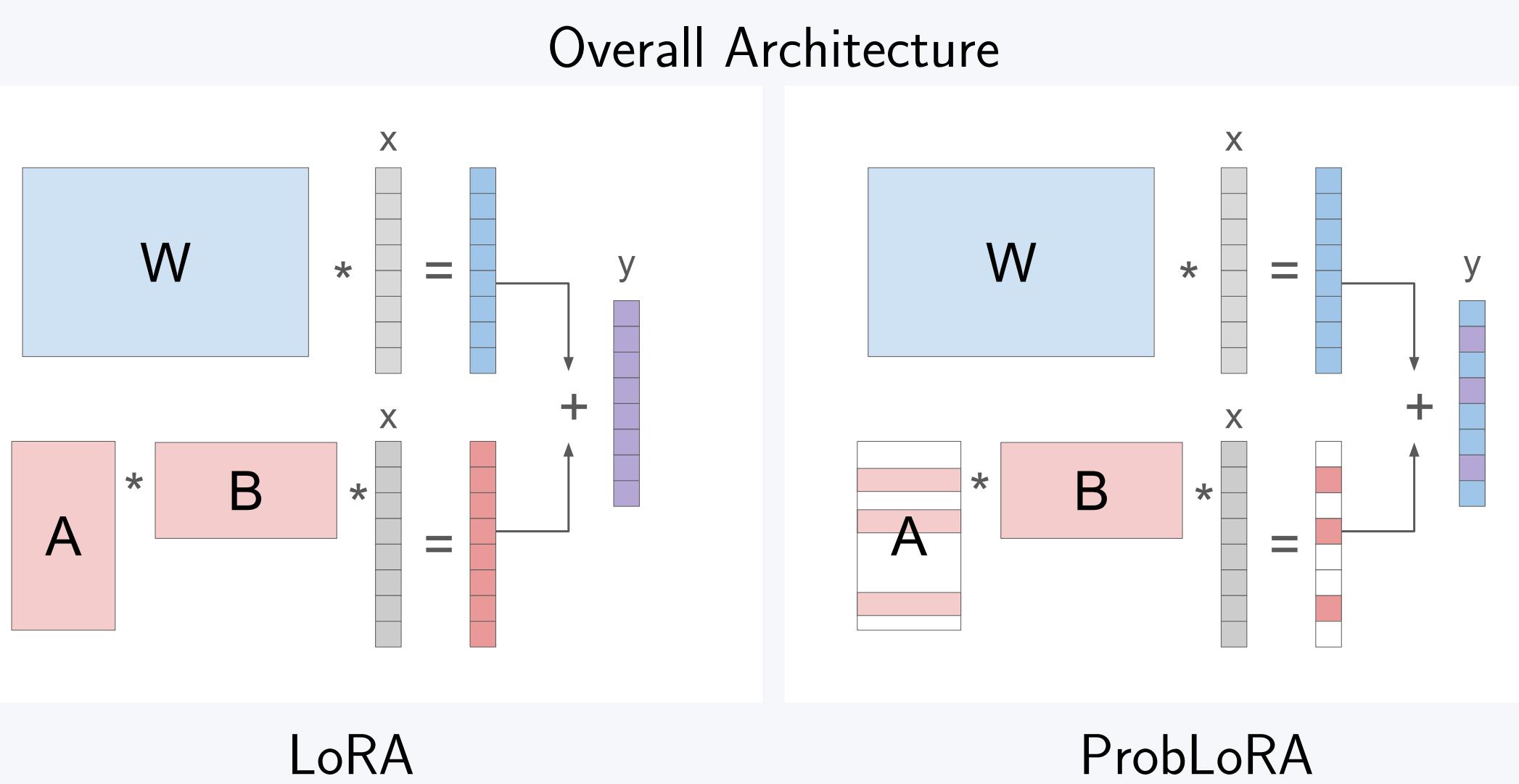
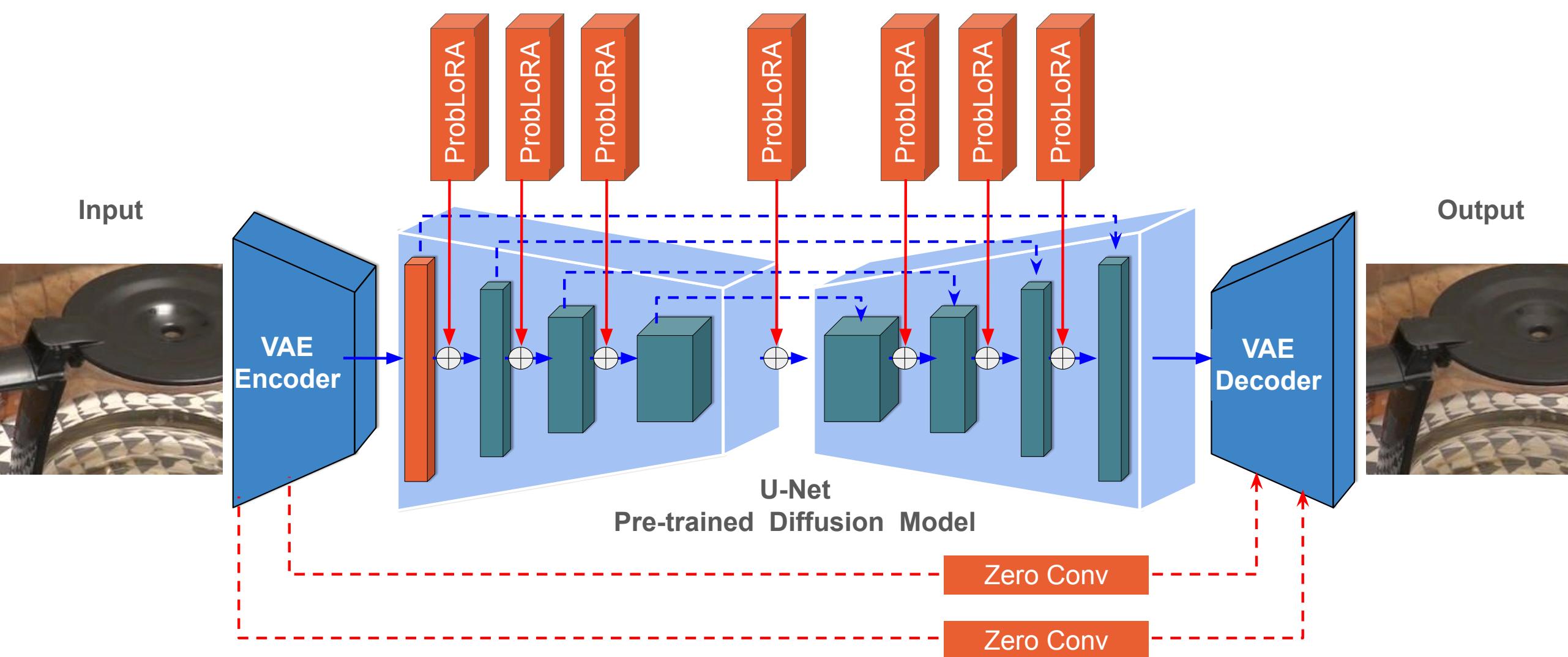
Challenge: Loyalty to the original surface color and texture

Opportunity: Utilizing Stable Diffusion Turbo (SD Turbo) with a new adaptation mechanism, improved efficiency and adaptability.

Key Contributions

1. One-step diffusion-based model for specular highlight removal
2. ProbLoRA, a novel modification of LoRA designed to adapt the diffusion model for specular highlight removal efficiently
3. State-of-the-art performance on specular highlight removal tasks

Architecture



Method Overview

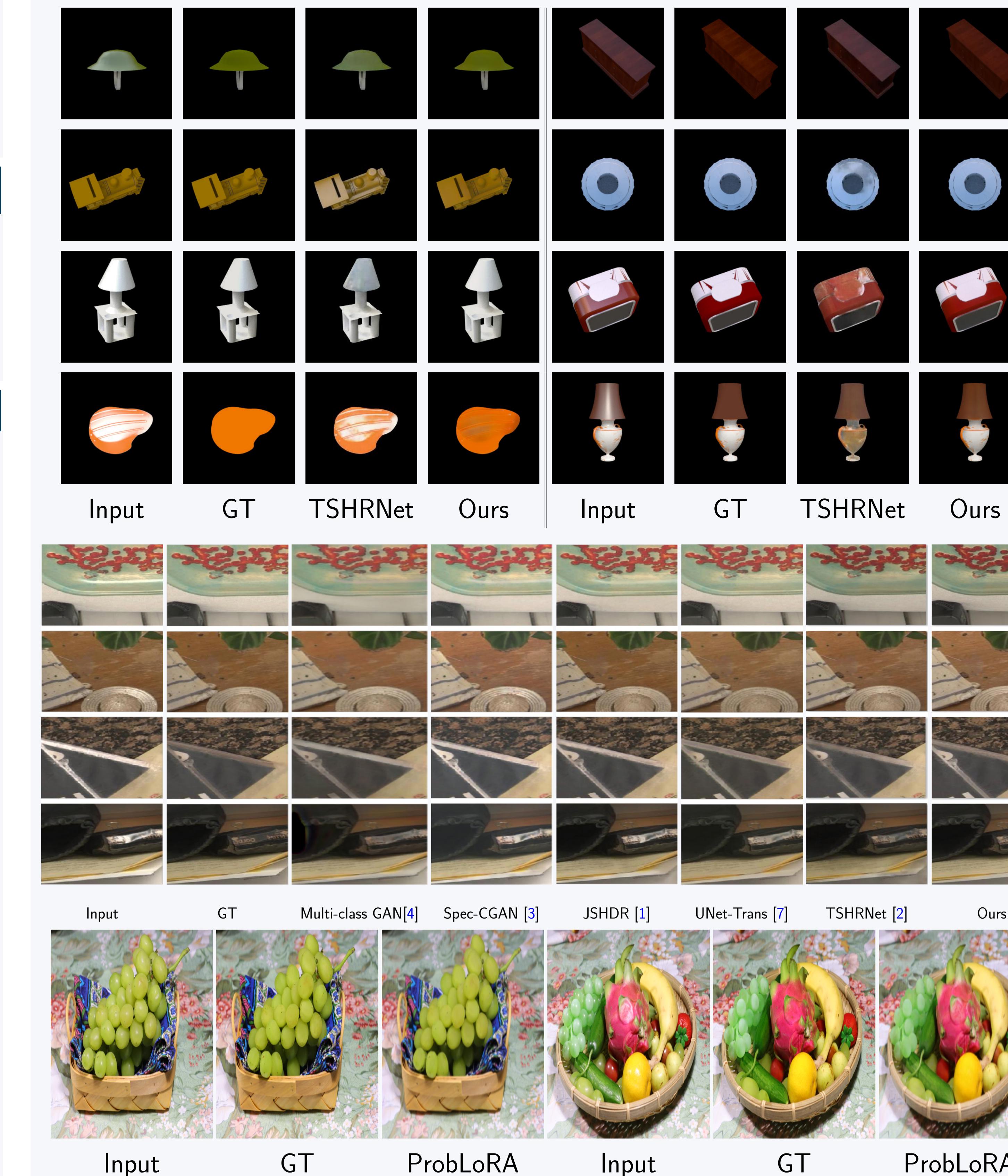
$$y = Wx + ABx \quad (1)$$

$$y_i = W_i x + p(a_i) a_i B x \quad (2)$$

$$p(a_i) = \frac{1}{1 + \exp(-\frac{M(a_i)}{\tau})} \quad (3)$$

$$M(a_i) = \max_{1 \leq k \leq r} \left\{ \frac{a_{ik}}{\sqrt{r}} \right\} - \frac{1}{r} \sum_{k=1}^r \frac{a_{ik}}{\sqrt{r}} \quad (4)$$

Qualitative Results



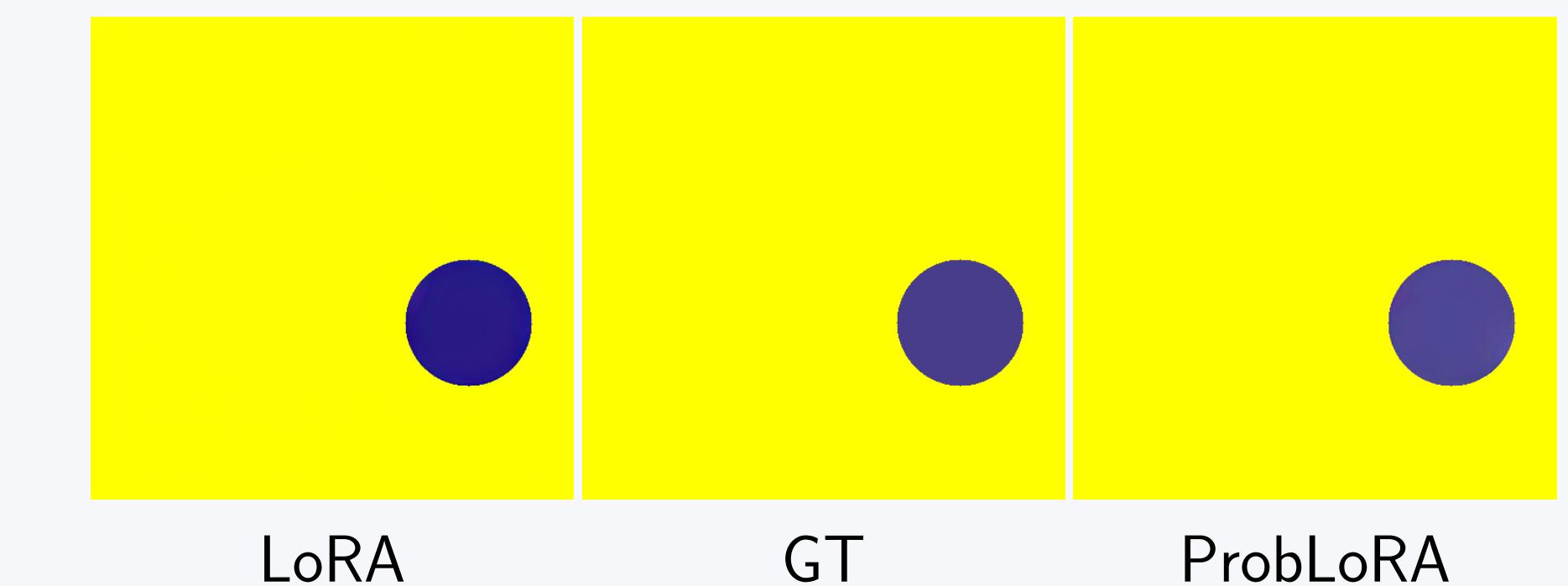
Experimental Results

Dataset	SHIQ		SSHR		PSD	
	PSNR ↑	SSIM ↑	PSNR ↑	SSIM ↑	PSNR ↑	SSIM ↑
Fu [1]	34.13	0.860	26.98	0.895	21.52	0.883
Wu [8]	23.42	0.920	25.73	0.894	21.80	0.880
TSHRNet [2]	25.58	0.933	28.90	0.940	22.76	0.903
Pan [5]	34.34	0.966	-	-	-	-
Baseline	33.94	0.966	34.12	0.957	29.23	0.949
Ours	36.19	0.971	35.76	0.965	29.99	0.957

Dataset	SHIQ			
	Metric	PSNR ↑	SSIM ↑	MSE ↓
Temperature(τ)				
0.5		33.664	0.964	0.085
0.6		34.268	0.966	0.085
0.7	36.190	0.971	0.059	
0.8		36.079	0.971	0.059
1.0		33.275	0.965	0.086

Generalization

We evaluate ProbLoRA on the Fill50K image generation task, where it achieves a significantly lower FID score (6.788) compared to LoRA (10.384) [6], indicating improved perceptual quality and better alignment with the target distribution as can also be seen below. These results highlight ProbLoRA's robustness across architectures and its adaptability to diverse generative tasks, including free-form image completion.



Links & Contact

Code: <https://github.com/mahiratmis/ProbLoRA>

Demo: [Demo Page](#)

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