PixPerfect: Seamless Latent Diffusion Local Editing with Discriminative Pixel-Space Refinement

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NEURAL INFORMATION PROCESSING SYSTEMS

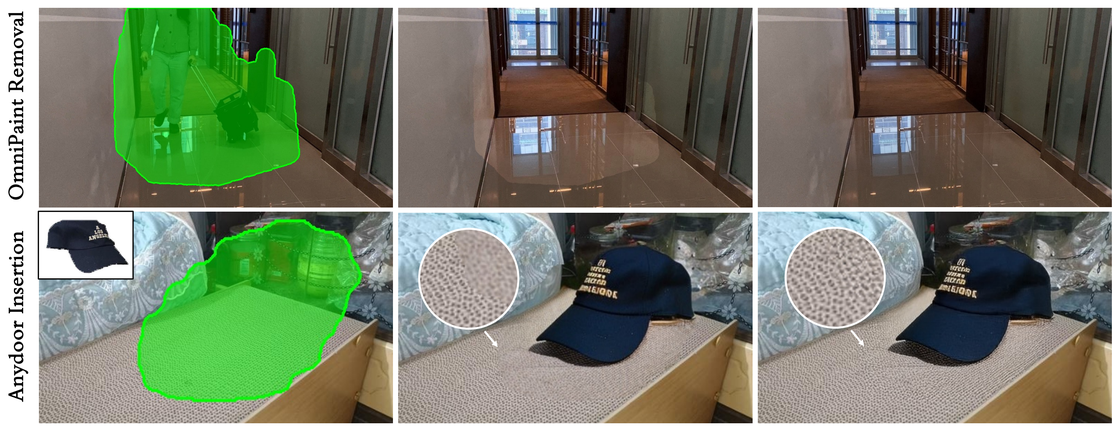
Motivation

- Latent Diffusion Model enables high-quality local image editing and inpainting, but latent compression leaves pixel artifacts (color shifts, texture mismatches, misalignment), causing **visible seams at edit boundaries**.
- Existing fixes (background-conditioned decoding, simple harmonization) reduce but rarely remove artifacts, and do not generalize well across tasks and latent spaces.
- We propose a **model- and task-agnostic pixel-space refiner** that can plug into diverse LDM pipelines and **clean up artifacts for seamless, production-level edits**.

Diffusion Inpainting

Inpainting Inputs | FLUX-Fill Inpainting | Asymmetric VQGAN | DiffHarmony++ | Ours Refinement

Object Removal and Insertion



Editing Inputs | After Local Editing | Our Refinement

Quantitative Results

Dataset / Method	MISATO FID↓	LPIPS↓	L1↓	PSNR↑	U-IDS↑	P-IDS↑
SDv1.5 [38]	18.15	0.229	0.068	19.01	9.55	4.03
SDv1.5-PixPerfect	13.25	0.171	0.044	20.40	17.24	**10.89**
SDv2 [38]	18.68	0.236	0.067	19.04	8.24	3.83
SDv2-PixPerfect	16.28	0.189	0.048	19.81	13.13	7.71
FLUX-Fill [3]	14.66	0.195	0.062	20.90	8.39	3.18
FLUX-Fill-AsyVQ [65]	15.99	0.202	0.057	20.91	7.46	3.33
FLUX-Fill-DH [63]	14.02	0.190	0.056	20.89	10.38	4.79
FLUX-Fill-PixPerfect	**10.87**	**0.141**	**0.036**	**22.18**	**18.09**	9.53

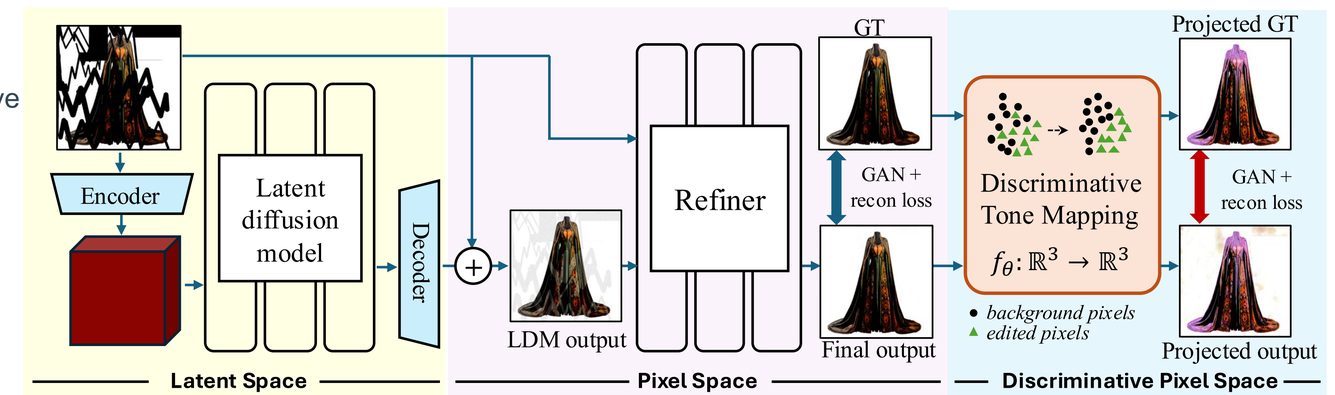
Results on inpainting + refinement

Method	FID↓	LPIPS↓	L1↓	MUSIQ↑	MANIQA↑
Pbe [50]	97.53	0.269	0.0856	69.33	0.4746
+ PixPerfect	**91.21**	**0.236**	**0.0793**	**71.04**	**0.5070**
ObjectStitch [41]	89.14	0.264	0.0838	69.27	0.4051
+ PixPerfect	**86.74**	**0.238**	**0.0790**	**71.38**	**0.5060**
AnyDoor [6]	73.17	0.251	0.0794	68.53	0.4306
+ PixPerfect	**71.74**	**0.223**	**0.0764**	**71.53**	**0.5058**
OmniPaint [55]	**56.80**	0.186	0.0713	70.32	0.5029
+ PixPerfect	57.42	**0.181**	**0.0678**	**71.54**	**0.5066**

Results on editing + refinement

Method

Training A Refiner with Discriminative Pixel Space Objective



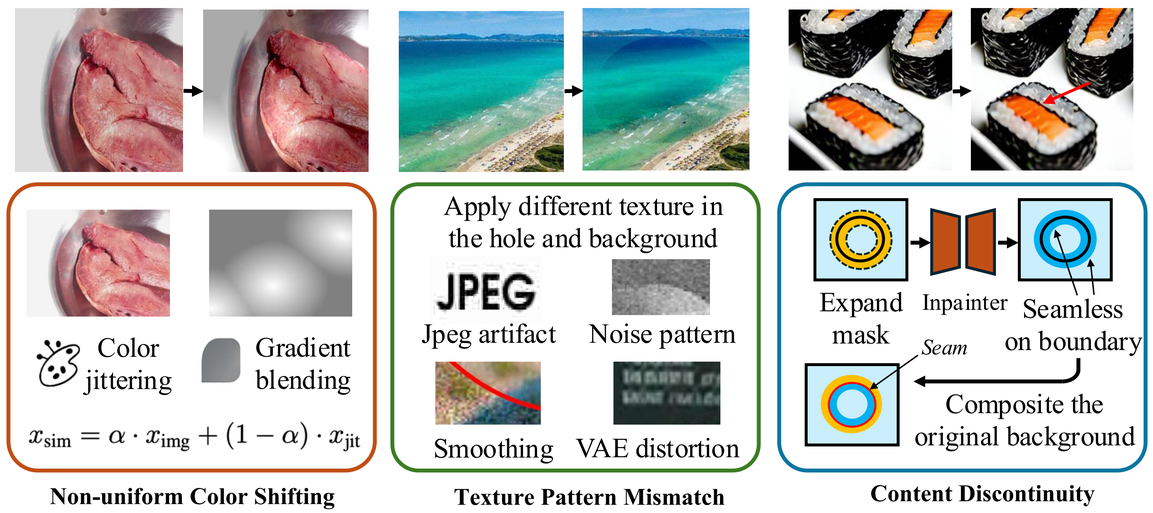
Local-editing LDMs can leave visible seams at edit boundaries, causing inconsistency to background pixels

PixPerfect is a GAN-based pixel-space refiner for removing editing seams

Transformation f is a polynomial regression $y = \sum_d p_d x^d$, that maps x to an amplified target $y_{amp} = x_{gt} + \beta(x_{pred} - x_{gt}), (\beta > 1)$

Simulating the Artifacts of Local Editing and Inpainting

We propose a comprehensive artifact simulation pipeline for local editing and inpainting.



Non-uniform Color Shifting | Texture Pattern Mismatch | Content Discontinuity

Conclusion

- PixPerfect is a **model- and task-agnostic, plug-and-play refinement module** that cleans up seam artifacts in image inpainting and local editing.
- It introduces (1) pixel-space refinement, (2) an editing artifact simulation pipeline, and (3) a discriminative pixel-space loss, enabling production-level seamless local edits.

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