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Unpaired Face Restoration via Learnable Cross-Quality Shift

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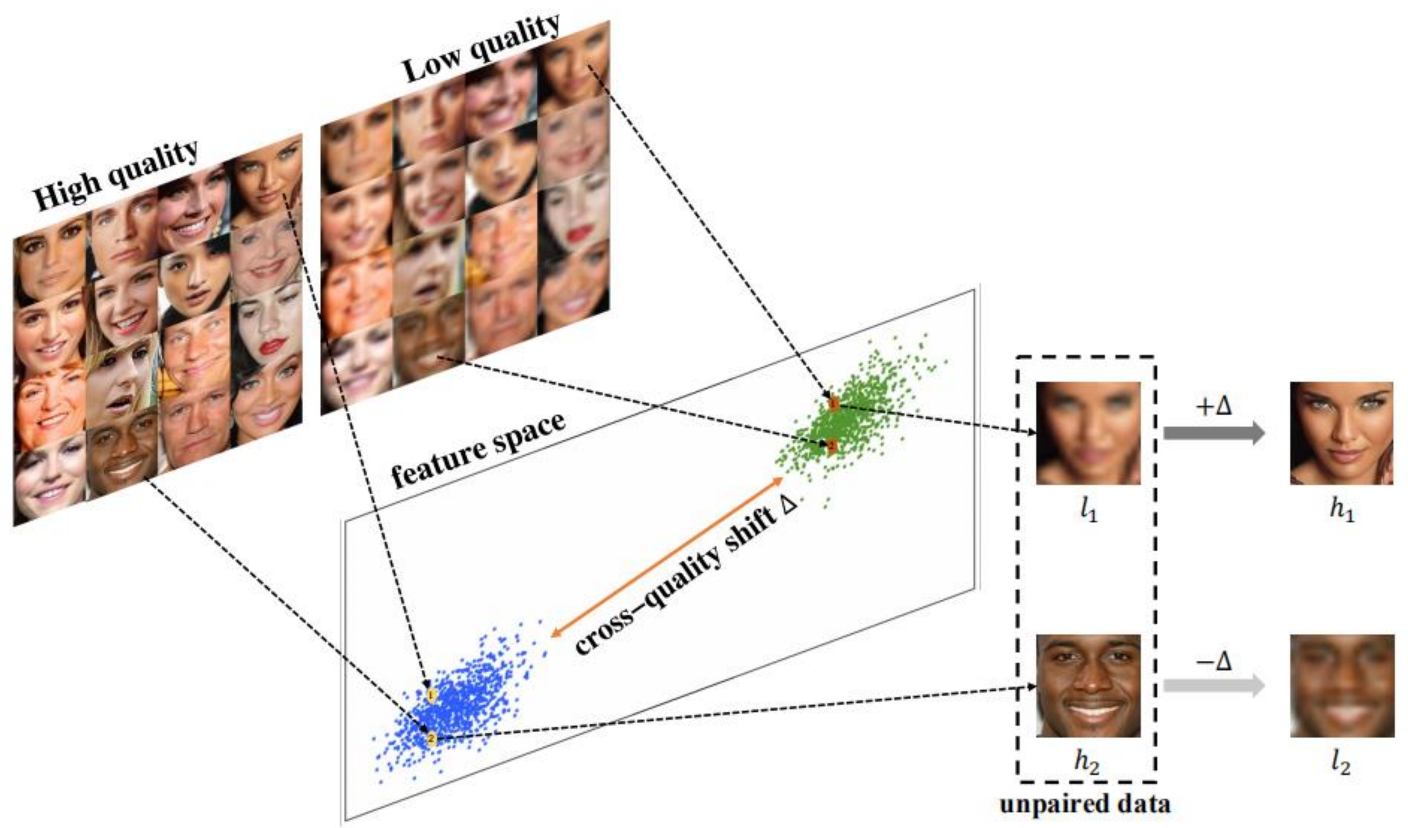
Motivation:

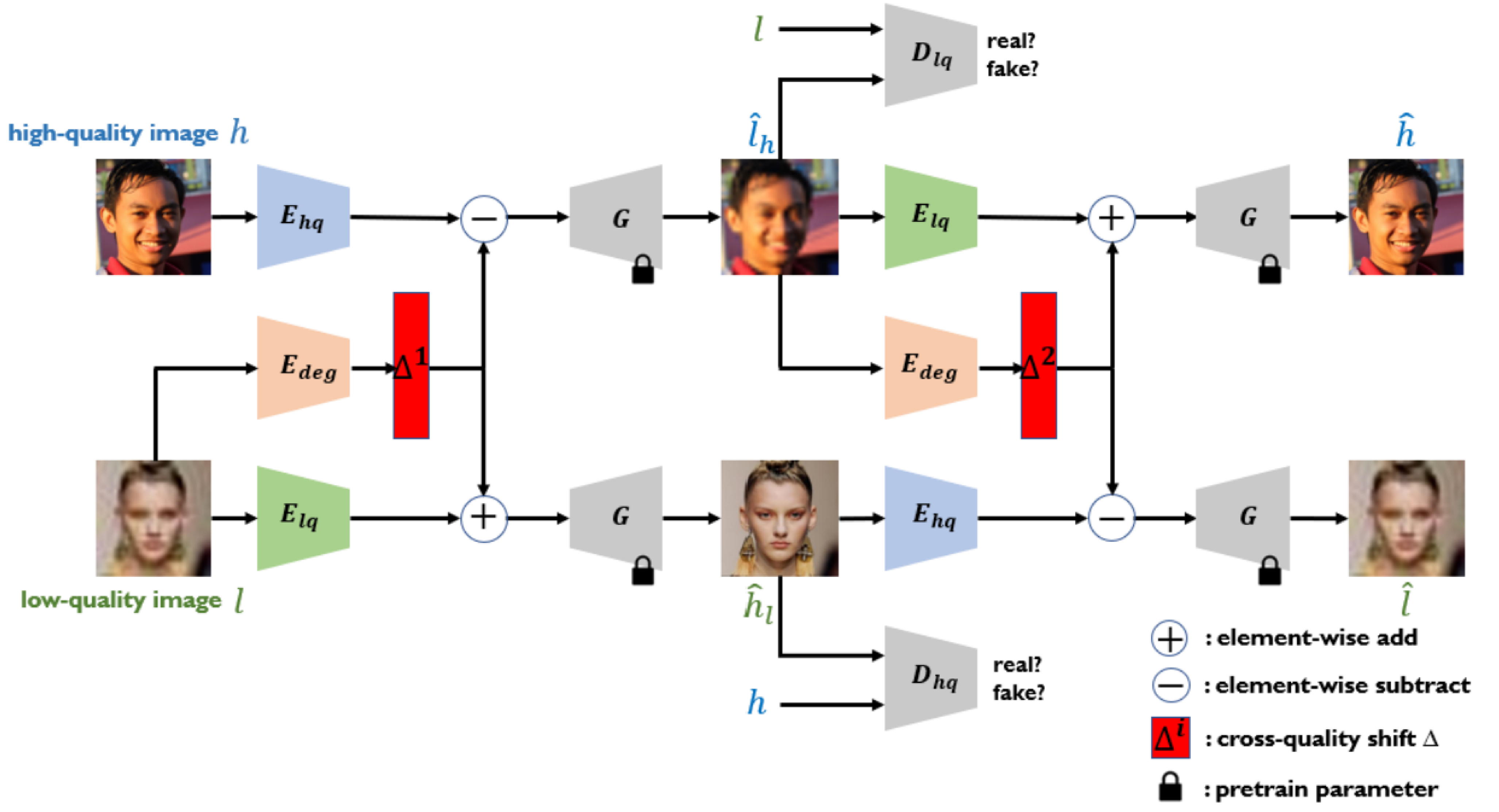
- **For restoration capability:** This method explicitly estimates degradation in the latent space W of StyleGAN, which enables a user to adjust the restoration level of the restored image and leverages facial priors in StyleGAN to improve restoration.
- **For image fidelity:** A two-branch network is designed based on the estimated degradation, which makes adding more constraints for fidelity possible.



Contributions:

- We propose a novel concept, learnable cross-quality shift, a unique translation operator that enables the conversion between two different quality levels in the latent space of StyleGAN. The proposed learnable cross-quality shift not only leverages the generative facial priors, but also allows a user to tweak the shifting scale to adjust the restoration level of the restored image.
- Based on the proposed learnable cross-quality shift, a two-branch framework is designed to deal with unpaired data and improve the fidelity of restoration.
- Extensive experiments are conducted to validate that the proposed unpaired face restoration method achieves higher perceptual quality on moderate and severe degradation images.

The Proposed Architecture:



Experimental Results:

Comparison

Methods		Bicubic+Compression (mild) SSIM↑	LPIPS↓	IP.↑	Bicubic+Noise (moderate) SSIM↑	LPIPS↓	IP.↑	Blur+Bilinear+Noise (severe) SSIM↑	LPIPS↓	IP.↑
Paired	PSFRGAN	0.680	**0.127**	0.703	0.598	0.153	0.655	0.581	0.152	0.646
	GFPGAN	0.671	0.137	**0.712**	0.474	0.251	0.616	0.523	0.184	0.644
Unsupervised	ZSSR	0.679	0.505	0.573	0.533	0.611	0.511	0.564	0.623	0.484
	PULSE	0.625	0.166	0.660	0.618	0.166	0.658	0.598	0.180	0.635
Unpaired	Bulat et al.	0.583	0.363	0.549	0.481	0.342	0.504	0.563	0.372	0.492
	Lu et al.	0.623	0.181	0.616	**0.676**	0.228	0.558	0.531	0.251	0.541
	Ours	**0.684**	0.139	0.711	0.643	**0.150**	**0.668**	**0.614**	**0.147**	**0.679**

Ablation Study

Methods	SSIM↑	LPIPS↓	IP.↑
baseline	0.633	0.181	0.626
+ upper	0.623	0.177	0.641
+ upper + Δ^i	0.614	0.163	0.660
+ upper + Δ^i + $\mathcal{L}_{\text{down}}$	**0.643**	**0.150**	**0.668**

Comparison

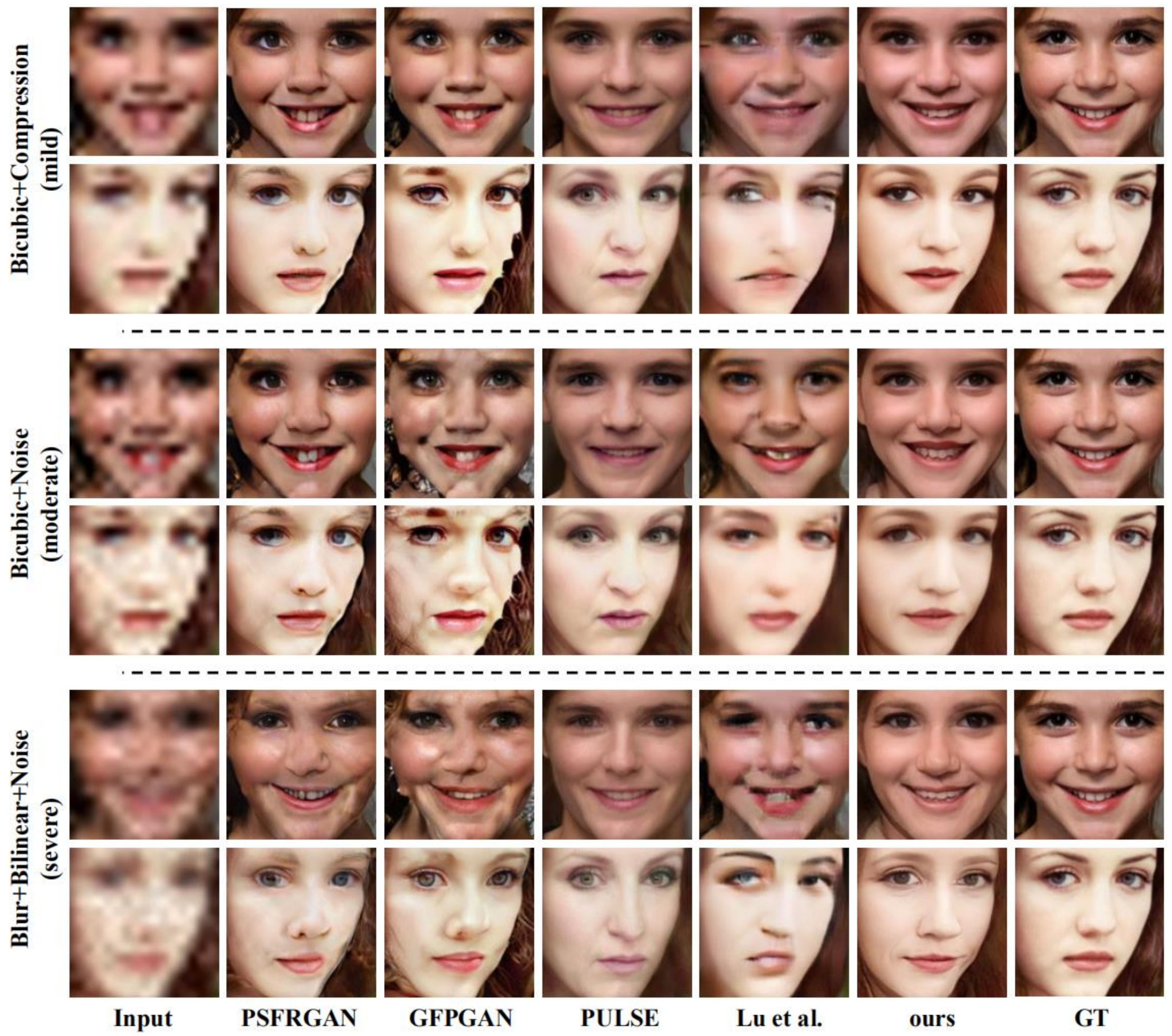


Image Restoration Level Adjustment