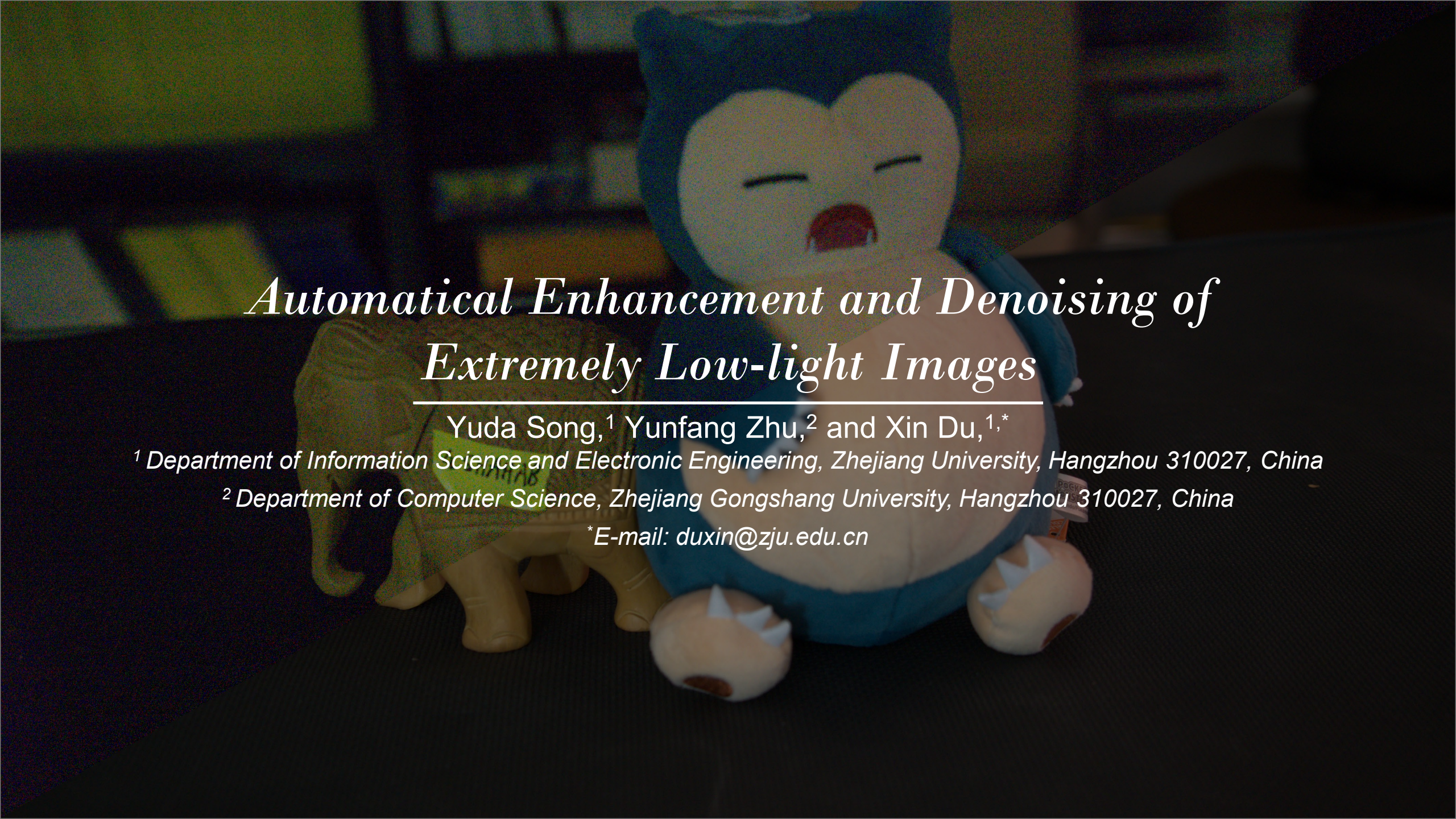

Automatical Enhancement and Denoising of Extremely Low-light Images

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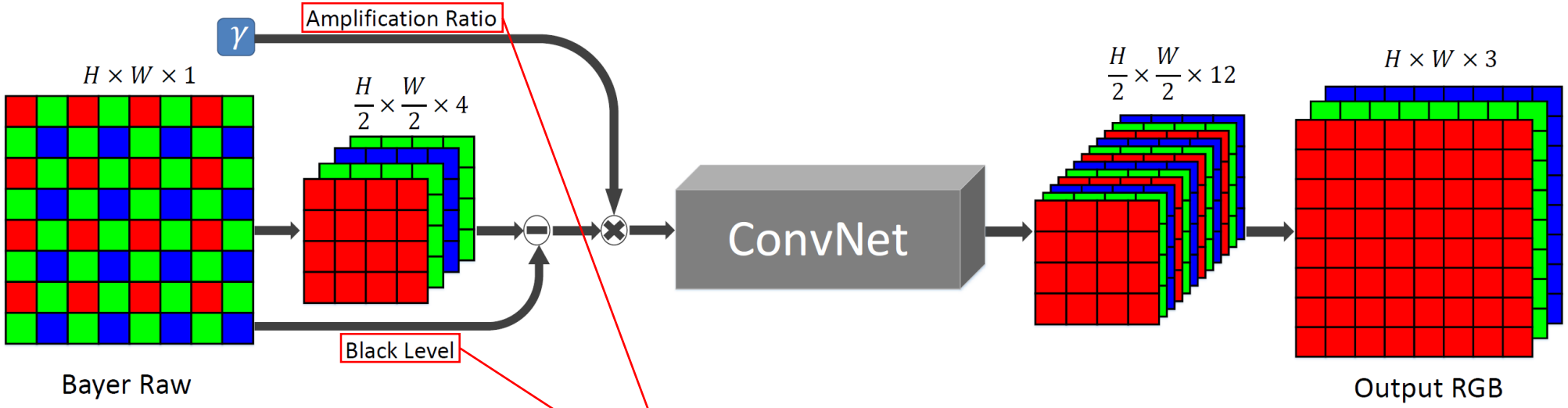
Problem



Condition	Sony	Fuji
1. **Our default pipeline**	28.88/0.787	26.61/0.680
2. U-net $\rightarrow$ CAN	27.40/0.792	25.71/0.710
3. Raw $\rightarrow$ sRGB	17.40/0.554	25.11/0.648
4. $L_1 \rightarrow$ SSIM loss	28.64/0.817	26.20/0.685
5. $L_1 \rightarrow L_2$ loss	28.47/0.784	26.51/0.680
6. Packed $\rightarrow$ Masked	26.95/0.744	–
7. X-Trans $3 \times 3 \rightarrow 6 \times 6$	–	23.05/0.567
8. Stretched references	18.23/0.674	16.85/0.535

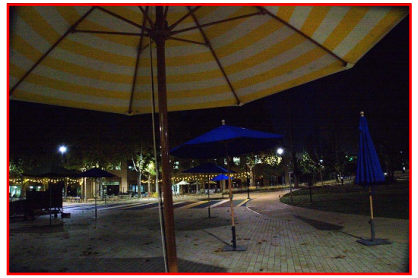
Table 3. Controlled experiments. This table reports mean PSNR/SSIM in each condition.

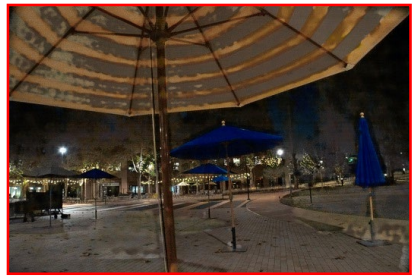
sRGB Domain: black level is useless, brightness mismatch

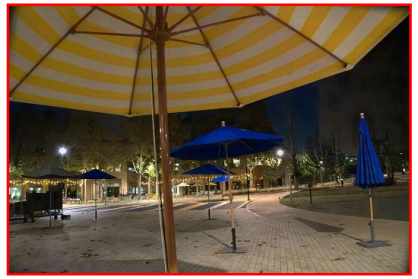
Histogram Stretching: brightness mismatch

Chen, Chen, et al. "Learning to see in the dark." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2018.

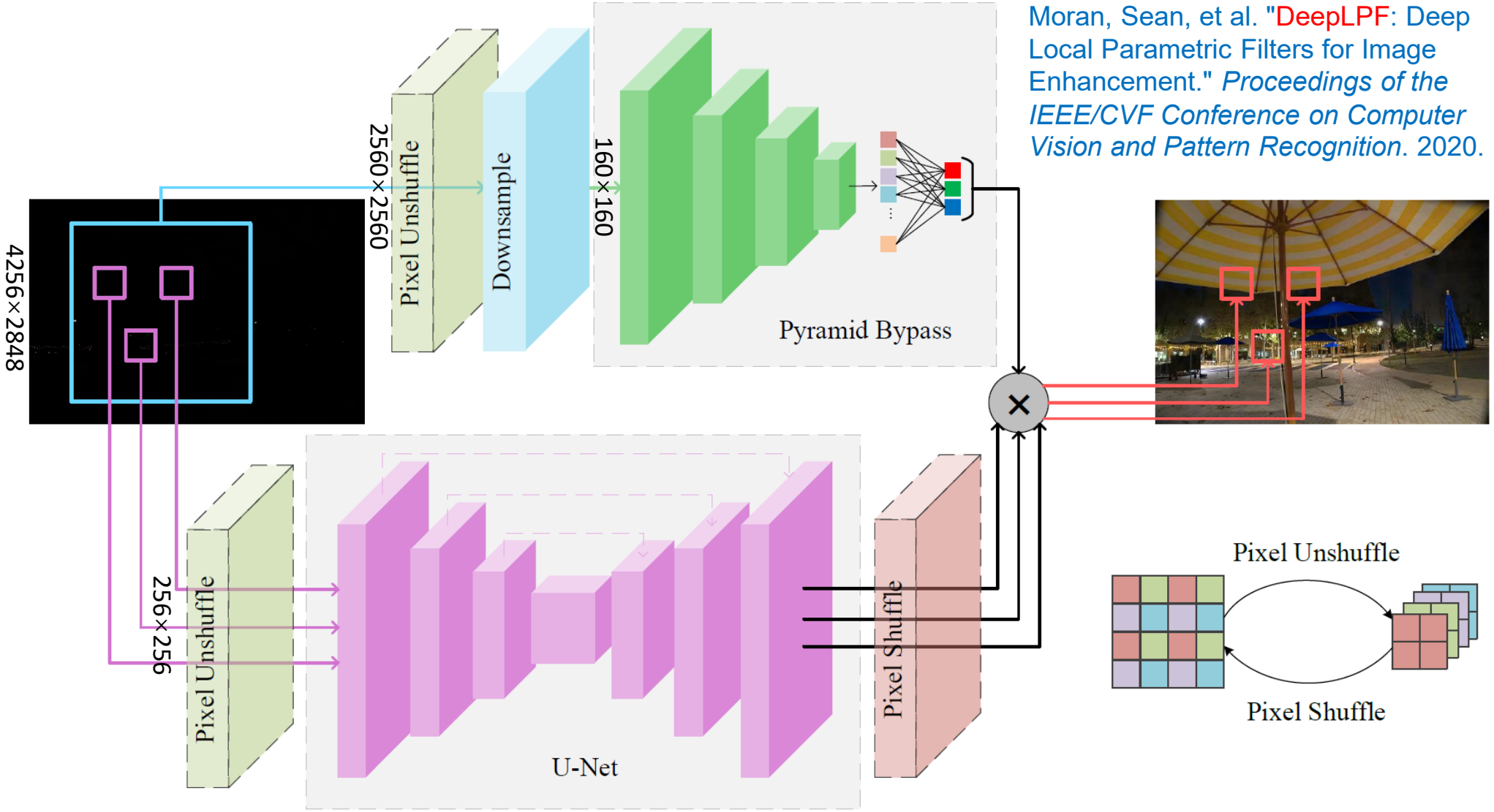
Comparison





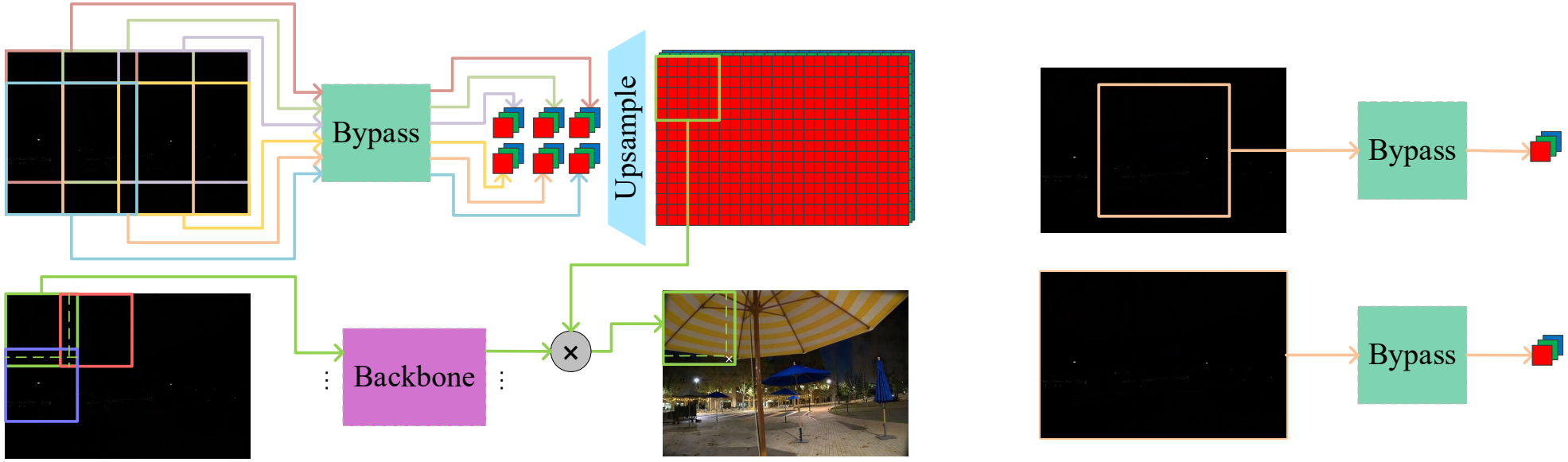


Training

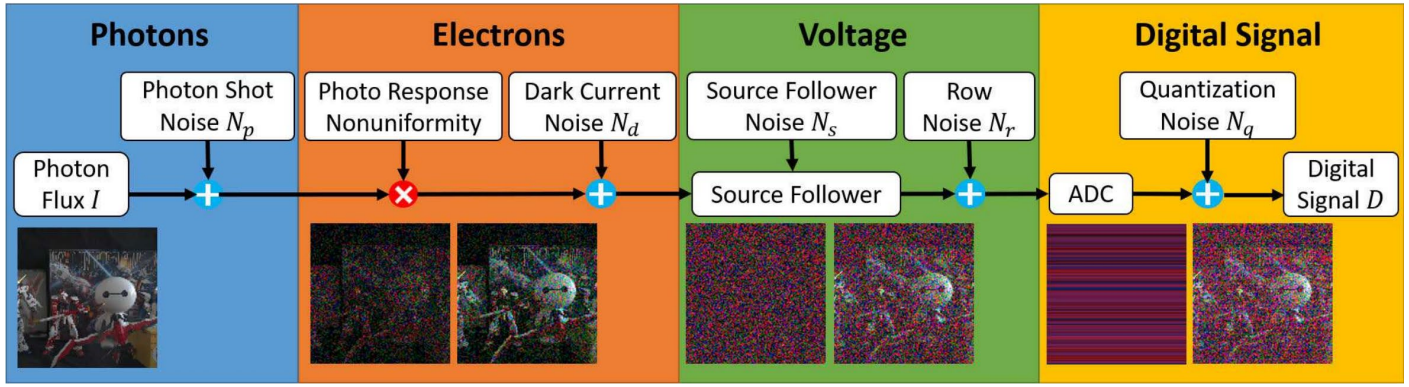


Moran, Sean, et al. "DeepLPF: Deep Local Parametric Filters for Image Enhancement." *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 2020.

Improvement



Noise Model for Extreme Low-light Raw Denoising



Wei, Kaixuan, et al. "A Physics-based Noise Formation Model for Extreme Low-light Raw Denoising." *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 2020.

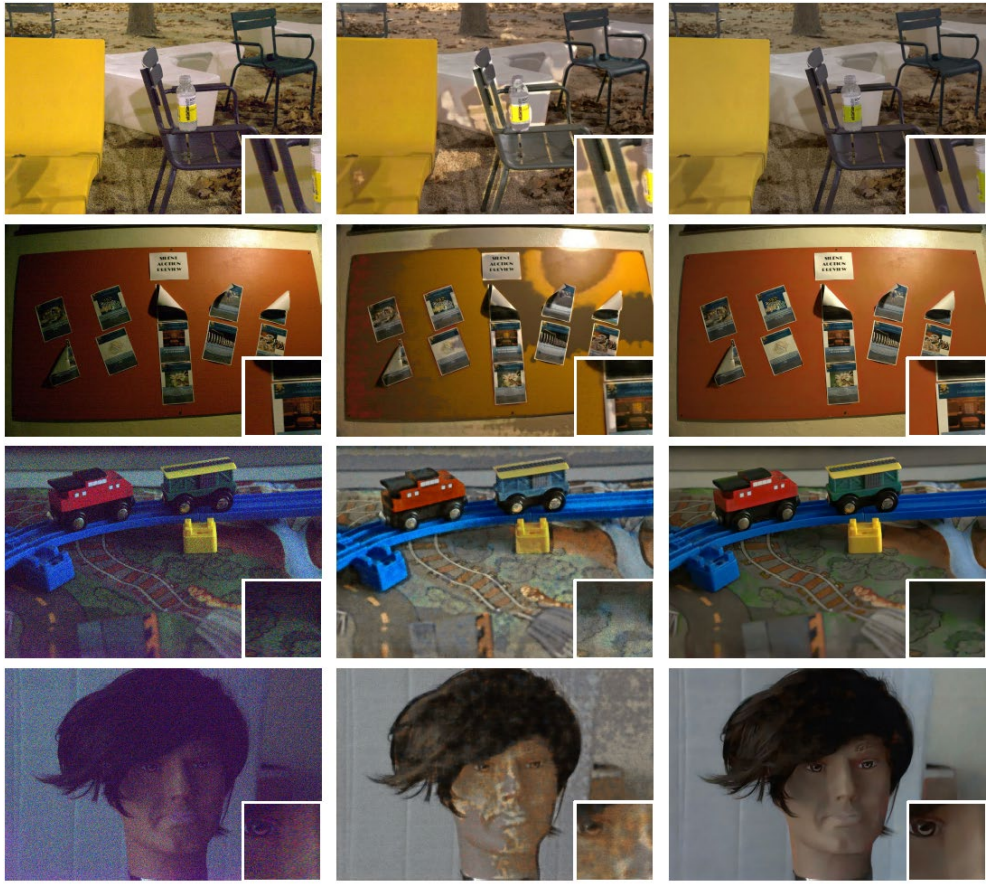
Experiments

TABLE I EFFICIENCY EVALUATION ON A FIXED-SIZE IMAGE.

Method	Image	Thumbnail	Params (M)	FLOPs (T)
U-Net	2560 × 2560	×	31.03	5.469
ours	2560 × 2560	160 × 160	42.21	5.471

TABLE II ENHANCEMENT RESULTS (PSNR / SSIM) ON THE SID DATASET.

Method	Blind / Non-blind	Process on	PSNR	SSIM
U-Net	Non-blind	RAW	28.60	0.768
ours	Non-blind	RAW	**29.10**	**0.775**
U-Net	Non-blind	sRGB	28.02	0.754
ours	Non-blind	sRGB	**28.51**	**0.767**
U-Net	Blind	RAW	22.60	0.712
ours	Blind	RAW	**25.41**	**0.744**
U-Net	Blind	sRGB	21.64	0.655
ours	Blind	sRGB	**24.73**	**0.734**
U-Net	Blind	sRGB*	18.08	0.589
ours	Blind	sRGB*	**21.56**	**0.660**



Traditional Pipeline U-Net INSNet

Thanks